

Request	Study of Request	Rehabilitation Plan
(3) Construction of new intake structure	(3) An intake structure is necessary for construction of new sub-lateral canal (HNS). For proper operation and maintenance, the intake structure should be the same type as the existing intake structure.	(3) The new intake structure will be constructed at 500.40 m left side from the existing intake structure.
(4) No request	(4) The surface of dam crest is partly damaged due to poor surface drainage.	(4) Damaged parts will be paved by laterite.
10 No request	Flood protection dike The flood protection dike is provided along the Nam Ngum river. The embankment of dike is still in good condition. However, there are partly damaged embankments, which are cut by farmers for constructing their path.	Repairing of flood protection dike in principle, the damaged embankments will be rehabilitated to the original.
11 Electric Facilities (Irrigation and Drainage Pump Stations)	(1) No maintenance has been carried out for the facilities in both the outdoor switchyards. The gas pressure is lower than specified one. The wires are used instead of power fuse. The fences of both switchyards are almost lost, thus replacement is required.	(1) The electrical facilities upto the transformer should be covered by EDL, but check and inspection will be carried out during this rehabilitation work.

Request	Study of Request	Rehabilitation Plan
(2) No request	(2) No maintenance has been made for the distribution and control panels. The parts such as indicating lamp, control auxiliary relay, push button, timer, etc., are out of order or deteriorated. Some part of wiring is damaged by mice.	(2) The followings are the outline of rehabilitation work a. Cleaning of parts in panels b. Replacement of indicating lamps c. Replacement of relays damaged d. Replacement of wire damaged e. Replacement of switches damaged f. Adjustment of instrument facilities g. Repair of panel damaged h. Cleaning and repair of duct for cables and pipes i. Replacement of terminal box rusted
(3) No request	(3) Almost spare parts are insufficient.	(3) The spare parts will be supplied.
(4) No request	(4) All lighting facilities are damaged.	(4) The lighting facilities will be repaired.
12 Operation House		
No request	The broken or damaged parts are observed as listed below. (a) Steel doors (b) Windows and glasses (c) Ceilings (d) Lightings (e) Outside paint The damaged doors and windows are also causes of troubles for electrical parts in panels by insect, mouse, dust, etc. As mouse is harmful for the wiring, the damaged part must be repaired to keep the panel in good condition.	The following repair will be carried out for the operation house. a. Repair of steel doors b. Repair of ceilings and walls c. Repaint of outside paint d. Repair of indoor and outdoor lightings

13

Supply of Operation and Maintenance Equipment and Spare Parts

- Shovel with cranshell 1 no.
- Backhoe 2 nos
- Swamp bulldozer 2 nos.
- Motor grader 1 no.
- Tractor with trailer 4 nos.

In accordance with the discussions with the Government of Leo PDR, the O&M equipment is divided by its purpose as follows:

- for land improvement: swamp bulldozer
- for maintenance of canals: small scale backhoe, cranshell, compacter
- for maintenance of roads: bulldozer, wheel loader, dump truck, motor grader, road roller, compacter
- for dewatering: small size pump
- for water supply to the paddy field and fish pond: pontoon type pump
- for others: truck with crane, pick-up truck, motor bicycle, gas and electric welder
- for farming: tractor and its accessory, harvester, sprayer

Table 4.3 shows the list of O&M equipment to be supplied under the Project

II Rural Development

1 Farm road

(1) Laterite pavement of existing farm road

(1) The main farm roads in the project area are partly damaged, because the surface drainage is obstructed by the grasses and trees covered on the both sides. Particularly, a part of No.1 main farm road is heavily covered with grasses and trees extending over 3.4 km out of total length of 9.6 km. Consequently, it has lost the road function due to improper surface drainage. A part of No.1 main farm road (1.2 km) from the beginning point of I-N13 sub-lateral canal to the drainage pump station is completely broken by the Lat Khouay cooperative to construct the irrigation canal on the surface of the road.

(1) Following sections of farm roads will be repaired:

- No.1 main farm road 9.6 km
- No.2 main farm road 6.4 km
- No.3 main farm road 2.5 km
- No.4 main farm road 2.3 km
- No.5 main farm road 2.2 km

Total 23.0 km

Total width of road will be 7 m. The width of laterite pavement will be 6 m, while thickness of pavement will be 15 cm. Seven cross drains will be provided under the farm roads.

(2) No request

(2)

Rural road
There exist two villages, Oudom Phol and Lat Khouay, at the southern part of project area. People of both villages are farming in the project area. At present, the road network from two villages to the project area is not sufficient. Subsequently, the existing foot paths should be expanded and improved for easy transportation and traffic.

(2) Improvement of rural road

- No.1 rural road: connecting with No.4 main farm road (0.7 km)
- No.2 rural road: connecting with No.5 main farm road (0.4 km)

2 Rice Processing and Storage Facilities

(1) Construction of road and electric power line (4.5 km)

(1) The prospective places for the facilities face the existing roads. Construction of road is not necessary. Electric power line will be constructed by Lao PDR.

(1) The land preparation for the facilities will be made with heightening the lands of about 30 to 50 cm for drainage purpose. Electric distribution to the facilities down to the transformer will be done under the grand aid from Japan.

- | | | |
|--|--|--|
| (2) Construction of three (3) rice processing facilities (300 m2 in total) | (2) Though three villages of Tha Som Mo, Oudom Phol and Lat Khouay occupy most of agricultural lands in the project area, they have no rice processing facilities or poor facilities. The capacities of existing facilities are not enough to meet with future rice production in their own lands. | (2) The areas of the facilities will be 100 m2 for each village. The each facility will be the wooden building (single story). |
| (3) Supply of three sets of rice mill plants (20 ton/day) | (3) The capacity of each rice mill plant is estimated at 400 to 500 kg/hr. taking future rice production into consideration. However, since the above rice mill plant of small capacity will produce much broken rice, the rather large mill plant shall be selected. | (3) The rice mill plant with a capacity of 750 kg/hr will be supplied. The plant consists of husker, rice mill equipment and bucket elevator. |
| (4) Transformer and distribution pannel | (4) The electric power line (22 kV) to the Tha Som Mo village is extended by Lao PDR. The electric works for installation of transformer and distribution pannel, etc. will be carried out by the grant aid from Japan. | (4) The capacity of transformer will be as follows:
a) Tha Som Mo: 100 KVA including electricity for the workshop for the farming machinery
b) Oudom Phol: 50 KVA
c) Lat Khouay: 50 KVA |
| (5) Construction of three (3) storage facilities (500 ton) | (5) The capacities of existing storage facilities at three villages, Tha Som Mo, Oudom Phol and Lat Khouay, are not enough to meet the future rice production. | (5) As stated in Chapter 5 in detail, the following storage facilities will be constructed at three (3) villages.
a) Tha Som Mo: 450 m2
b) Oudom Phol: 150 m2
c) Lat Khouay: 250 m2
The each facility will be the wooden building with elevated floor. Lightening facilities will be provided for night works. |
| (6) Supply of spare parts | (6) There are many unused machinery and vehicles in Laos due to lack of spare parts. Taking this situation into consideration, at least spare parts for one time and consumable parts for two years shall be supplied. | (6) Spare parts for operation and maintenance during two years will be supplied. |

3 Rural Water Supply System

(1) Construction of six (6) tube-wells with pump and distribution pipe lines

(1) Through the field survey, the followings are clarified:
 - Shortage of domestic water in the day season at the Lat Khouay, Oudom Phol, Ban Na and Tha Ngon is serious, particularly in the late dry season (3 to 4 months), because existing shallow wells mostly dry up in the dry season. Consequently, deep tube-well of about 50 m in depth shall be constructed for the above villages.
 - The houses in the Tha Som Mo and Keng Khai villages are widely scattered. From economic viewpoints, construction of water supply system for the villages is not recommendable, because the distribution pipe lines will be too long comparing with numbers of houses. Furthermore, the people of the villages can use the water from the Nam Ngum river, springs along the river and the north main canal even in the dry season. However, the tube-wells with manual pump should be constructed for emergency from the viewpoint of public sanitation

(1) The following tube-wells will be constructed:
 (a) Tha Ngon: 2 nos. for 3,000 persons
 (b) Ban Na: 1 no. for 1,300 persons
 (c) Oudom Phol: 1 no. for 1,000 persons
 (d) Lat Khouay (new): 1 no. for 1,000 persons
 (e) Lat Khouay (old): tube-well with manual pump of 1 no.
 (f) Keng Khai: tube-well with manual pump of 1 no.
 (g) Tha Som Mo: tube-well with manual pump of 1 no.

The elevated tanks will also be constructed as follows:
 (a) Tha Ngon: 2 nos (height: 15 m, capacity: 15 m³)
 (b) Ban Na: 1 no. (height: 15 m, capacity: 15 m³)
 (c) Oudom Phol: 1 no. (height: 15 m, capacity: 15 m³)
 (d) Lat Khouay (new): 1 no. (height: 15 m, capacity: 15 m³)

The pipe lines with dia 25 to 100 mm will be constructed for distribution of water.
 The water supply tap will be installed for 10 families each.

According to the available data of existing deep wells, the yield of well is about 1.0 l/sec (86 m³/day).

(2) Construction of electric power line (2.2 km) and other electric facilities

(2) Since existing power line is available near the above villages, extension of power line is not necessary. In case of the Oudom Phol and Lat Khouay, a transformer shall be provided between two villages. The electrical works down to installation of transformer shall be done under the grant aid from Japan

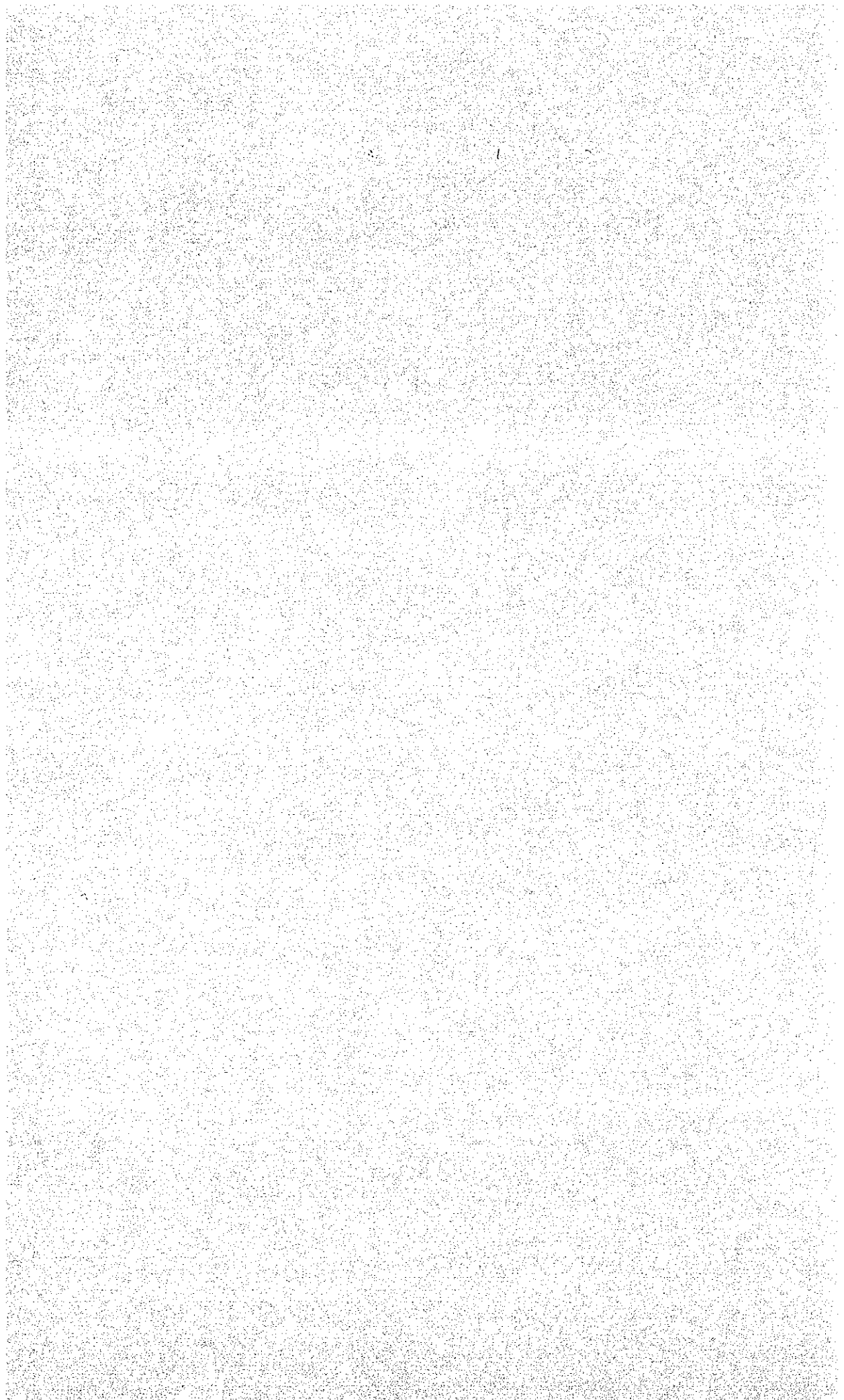
Capacity of transformer for the Oudom Phol and Lat Khouay will be 30 kVA each. Electricity for the Tha Ngon and Ban Na villages will be directly received the existing electric distribution lines in the villages.

Table 4.3 LIST OF O & M EQUIPMENT

Description	Quantity	Purpose for Use
1. Bulldozer, Swamp type, 10 t	1 unit	Land levelling of paddy field and farm road maintenance
2. Excavator, w/clamshell (0.6 m ³) and crane hook	1 unit	Maintenance and repairing of drainage canal and repairing of pumping equipment
3. Backhoe, 0.1 m ³	2 units	Maintenance of irrigation canal
4. Wheel loader, 1.7 m ³	1 unit	Material loading to dump truck
5. Dump truck, 6 t	2 units	Hauling of earth materials
6. Pickup truck, double cab, 4 x 4 drive	2 units	Administration and maintenance works
7. Motor grader, 9 t	1 unit	Farm road maintenance
8. Road roller, 10 t	1 unit	Farm road maintenance
9. Plate compactor, 100 kg	4 units	Compaction of earth materials
10. Pumping equipment		
1) Pumping set (100 ϕ x 2 nos.), electric motor driven, w/pontoon, pipes, houses and other necessary accessories	5 sets	Supply of irrigation water during rehabilitation works
2) Pumping set, 100 ϕ , electric motor driven, self-priming, w/houses and other necessary accessories	1 set	Dewatering during maintenance and repairing works

Description	Quantity	Purpose for Use
3) Pumping set, 50φ, electric motor driven, self-priming, w/houses and other necessary accessories	2 sets	Dewatering during maintenance and repairing works
4) Pumping set, 50φ, engine driven, self-priming, w/houses and other necessary accessories	2 sets	- do -
11. Miscellaneous equipment		
1) Gas cutting and welding set (cylinders, cart, torch, hoses, etc.)	1 set	Repairing of gates and other metal structures
2) Portable gasoline engine welder with cable, holder, earth, tools, helmet, etc.	1 set	- do -
12. Farm tractor, 65HP, w/3-point linkage	3 units	Farming and others
13. Attachment for the above tractors		
1) Disc plow, 7 discs	5 nos.	- do -
2) Disc harrow, 18 discs	5 nos.	- do -
3) Paddler, 3.6 m	5 nos.	- do -
4) Trailer, 4 t, 4 wheels	5 nos.	- do -
14. Diesel engine driven paddy thresher, 3.5HP	5 units	Threshing
15. Combine harvester, 26HP	3 units	Harvesting of paddy
16. Spare parts for the above equipment	1 lot	Maintenance and repair of the above equipment for at least 2 years

5. BASIC DESIGN



5. BASIC DESIGN

5.1 Basic Concept

Considering the present situation of operation and maintenance for the Tha Ngon Scheme and its impacts given to the agricultural development in the Vientiane plain as a pilot project, the basic design study is carried out in accordance with the following basic concepts.

- (1) Overhaul, repairing and replacement for pump equipment, electrical panels and instruments and gates will be made as the original design. As for the equipment and spare parts unavailable, they will be manufactured as similar to the original as possible taking easy check, maintenance and repairing into consideration. The pump equipment to be overhauled should be repaired to secure the same life as of the pump equipment to be replaced.
- (2) The supply of O&M equipment and rehabilitation of the facilities required for complex and high level technique to operation and maintenance should be avoided considering the present technical level of Laotian engineers for operation and maintenance of facilities and repairing works, and minimization of O&M cost.
- (3) Taking the easy repairing by Lao side into consideration, the materials available in Laos should be used for the civil work of rehabilitation as much as possible.

5.2 Determination of Basic Figures

The basic figures for the basic design of facilities to be rehabilitated or to be newly constructed are determined as follows.

(1) Irrigation water requirement

Since no data on the field measurement of consumptive use of water by crop are available in and around the project area, the consumptive use of water is estimated based on the potential evapotranspiration made by the Modified Penman method. The net irrigation water requirement is estimated based on the above potential evapotranspiration taking crop coefficient, percolation in the field, nursery and puddling water requirements, and effective rainfall into consideration. The gross irrigation water requirement is calculated considering the overall irrigation efficiency of 60%.

Table 5.1 IRRIGATION WATER REQUIREMENT

Season	Gross Water Requirement (mm)	Peack Water Requirement (l/sec/ha)
Wet season	1,013	1.0
Dry season	1,836	1.8

The peak water requirement of 1.8 l/sec/ha is used for baisc design of irrigation canal.

(2) Drainage water requirement

The design discharge of drainage canal is estimated in accordance with the following criteria:

- Return period of design rainfall is 10 years,
- Design rainfall is of daily rainfall,
- Design rainfall shall be drained off for one day, and
- On-field storage of an average surcharge is of 45 mm.

Design rainfall with return period of 10 years is determined at 122 mm based on the daily rainfall records at Tha Ngon from 1971 to 1985 by using the Gumbel method.

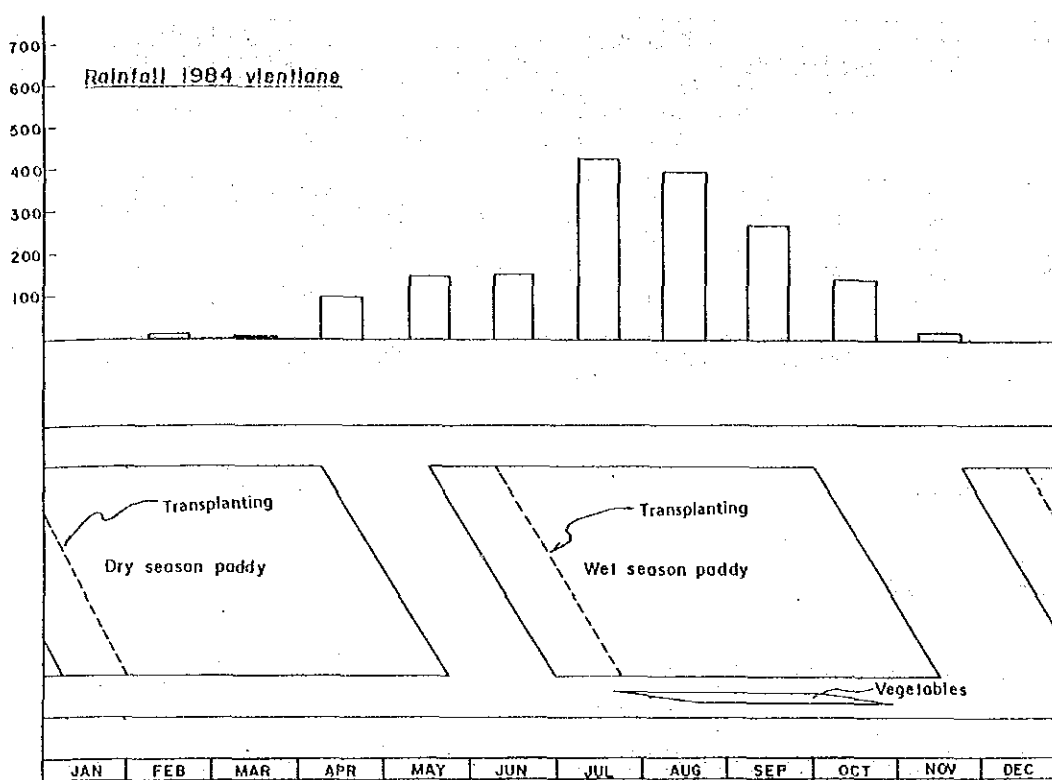
$$\text{The design discharge is: } \frac{(122-45) \times 10^{-3} \times 10^4 \times 10^3}{8,400 \times 1} = 8.8 \text{ l/sec/ha} = 9.0 \text{ l/sec/ha}$$

The design discharge of 9.0 l/sec/ha is used for basic design of drainage canal.

(3) Agricultural production

The irrigable area after rehabilitation is estimated at 610 ha considering the land capability, elevation of paddy plot, present drainage situation in the project area. The main crop in the project area is decided to be paddy, considering i) the governmental policy of agricultural development, ii) shortage of rice in the Vientiane Prefecture and iii) intension of MAFIC. The proposed cropping pattern is shown in Fig.5.1. The fallow period of about one month is considered in the proposed cropping pattern for maintenance and repair of the facilities.

Fig. 5.1 Future Cropping Pattern



According to the yield survey by the Study Team, the estimated yield of 18 samples vary from 1.10 ton/ha to 4.32 ton/ha. The average is 2.47 ton/ha. From the results of yield survey, it can be judged that the anticipated yield after rehabilitation will be 4.5 ton/ha, if the fertilizer application will be properly done. However, the anticipated yield with the Project is conservatively determined at 3.5 ton/ha taking knowledge and technology of farmers, shortage of fertilizer etc. into consideration.

In the original plan, the capacity of drainage pump was determined considering the justifiable investment amount. Consequently, the paddy field of 77 ha lower than elevation 162.64m might receive flood damage by several years. Taking the above situations into consideration, the anticipated yield in the area of 77 ha is estimated 2.6 ton/ha based on the relation table between the reduced yield and the inundated period made by the Ministry of Agriculture, Forestry and Fisheries in Japan. Total anticipated production is shown in the following table.

Table 5.2 ANTICIPATED PADDY PRODUCTION

Cooperative	Farm Land (ha)	Wet Season						Dry Season			Gross Production (ton)
		Non-Inundated Area			Inundated Area			Non-Inundated Area			
		Farm Land (ha)	Yield (ton/ha)	Production (ton)	Farm Land (ha)	Yield (ton/ha)	Production (ton)	Farm Land (ha)	Yield (ton/ha)	Production (ton)	
State Farm	101	94	3.5	329	7	2.6	18	101	3.5	354	701
Tha Som Mo	255	232	3.5	812	34	2.6	88	266	3.5	831	1,831
Lat Khouay	87	97	3.5	340	-	-	-	97	3.5	340	680
Oudom Phol	116	80	3.5	280	36	2.6	94	116	3.5	406	780
Ban Na	30	30	3.5	105	-	-	-	30	3.5	105	210
Total	610	533		1,868	77		200	610		2,136	4,202

5.3 Basic Design

5.3.1 Irrigation pump station

(1) Inlet and inlet channel to the pump station

Dredging of silts and sands deposited in front of inlet and at the conduit of inlet channel will be carried out at the beginning of March. The temporary bank will be constructed by bulldozer. The crest elevation of temporary bank is determined at EL.155.0m based on the water level records at Tha Ngon station. After completion of dredging works, the temporary bank should be removed.

(2) Rivetment of inlet channel

The rivetment to be rehabilitated is as follows:

Length of slope: 26m Average width: 20m Area: 520 m²

(3) Maintenance road to the pump station

The original design and present situation of the maintenance road is shown below.

(i) Original design

Width: 3.50m Connecting slope: 10% Pavement: none

(ii) Present situation

Shape of road: damaged

Condition of surface: covered with grasses

Proposed design of maintenance road is shown as follows:

Total length : 80m

Total width : 4.0m

Pavement : laterite pavement with width of 3.0m

(4) Irrigation pump equipment and operation house

(i) Pump unit:

Each pump unit should be repaired to have long life after overhaul. The repairing work is scheduled to replace the parts such as impeller, casing ring, bearing, etc., and to improve insulation of startor coils. Since the pump casing is to be replaced for No.1 pump, one complete set of pump will be newly manufactured.

The repairing and manufacturing work will be carried out at the manufacturer's factory in Japan.

(ii) Discharge pipe and accessory

The discharge pipes, air valves and loose flanges will be checked and the damaged part of coating will be repaired. The renewed parts are as follows.

a) Packings, bolts and nuts for flange joints

b) Compound gauge

(iii) Piping and tank of insulation oil

The insulation oil tanks, pipes and supports will be cleaned and checked. The damaged supports and coating of pipe will be repaired. The renewed parts are as follows.

a) Packings, bolts and nuts for flange joints

- b) Oil filter
- c) Oil gauge

(iv) Intake gate and trashrack

The hoist with spindle cover and one screwed spindle will be replaced by new one. As for the gate leaf, guide frames, shafts and trashrack, inspection and repair paint will be carried out. The renewed parts are as follows.

- a) Bolts and nuts for spindle supports

(v) Outdoor switchyard and transforming equipment

The transforming equipment such as disconnecter, power fuse, transformer, etc., will be checked and repaired. The fence for switchyard will be renewed.

(vi) Distribution panel, control and instrumentation

The panels for distribution and control will be cleaned and checked. The meters furnished in the panels will be calibrated. The pump pressure meters equipped with the panels will not be used after this rehabilitation work, because the pressure transmitters requires complicated maintenances. The pump discharge pressure can be measured by the compound gauge instead of the pressure meter. A water level indicator will be installed in the suction pit and the pumps will be controlled to stop automatically when water level at the suction pit comes below L.W.L. 151.90.

The renewed parts are as follows.

- a) Indicating lamps
- b) Control auxiliary relays and timers
- c) Push buttons
- d) Power and control cables

(vii) Spare parts, maintenance tools and equipment

The spare parts and tools will be supplied for maintenance of pumps and panels as follows.

- a) Spare parts for pumps 3 sets of each parts
- b) Spare parts for distribution panel 1 set
- c) Spare parts for control panels 1 set
- d) Tools and equipment 1 lot

(viii) Operation house

The damaged position of operation house will be repaired to keep the panels in good condition. The space of rack in the storeroom is insufficient to store the spare parts in good and to control its quantity, thus a new rack will be furnished in the operation house.

The detailed plan of rehabilitation work is shown in Table 5.3.

TABLE 5.3 IRRIGATION PUMP EQUIPMENT AND OPERATION HOUSE

Rehabilitation Item	Description	Specification	Quantity	Remarks
(1) Irrigation Pumps				
a) No. 1 Pump	Replacement	Total head: 19 m Discharge: 32.4 m ³ /min Dia.: 500 mm Submergible motor pump Power: AC 380 V 50 Hz Dia.: 500 mm Submergible motor pump	1 set	
b) Nos. 2 & 3 Pumps	Overhaul, repair paint, adjustment Parts renewal	1) Bearing 2) Mechanical seal 3) Impeller 4) Bolts and nuts 5) Packings 6) Seal cover 7) Balance ring 8) Suction ring 9) Ball nuts 10) Seal case 11) Seal ring 12) Slinger Dia.: 500 mm	2 set 2 sets 2 sets 1 lot 2 sets 2 sets 2 sets 2 sets 2 sets 2 sets 2 sets 2 sets 2 sets 3 sets 1 lot	
c) Discharge Pipes	Insulation improvement of stator coils Check, repair paint	6 P 135 kW Dia.: 500 mm	2 sets 3 sets	
d) Accessory	Renewal of packings, bolts and nuts Check, repair paint Air valves	Dia.: 25 mm (with cock) Dia.: 500 mm Dia.: 25 mm	3 sets 3 sets 3 sets	
e) Piping for Insulation Oil	Check, repair paint and supports Renewal of packings, bolts and nuts		3 sets	
f) Tank of Insulation Oil	Check, repair paint Parts renewal	1) Oil filter 2) Oil level gauge	3 sets 3 sets	
(2) Intake Gate and Trashrack	Check, repair paint Trashrack Gate leaf, guide frame, spindle	Clear spar: 1,500 mm Clear height: 1,500 mm	1 set 1 set	
	Renewal of bolts and nuts for spindle supports Replacement of hoist and spindle (screwed part)	Hoisting capacity: 16 tons	1 lot 1 set	
(3) Outdoor Switchyard	Check, cleaning	24 kV 3 P	1 set	
a) Disconnect	Check, cleaning	24 kV, 40 A - 1,500 MVA	1 set	
b) Power Fuse	Check, cleaning	3c 22,000/110V, 20/5A	1 set	
c) Metering Outfit.	Check, cleaning	3c 21 kV/380-220 V, 500 kVA	1 set	
d) Transformer	Check, cleaning, calibration	Demand meter, watt-hour meter, var-hour meter	1 set	
e) Panel				

Rehabilitation Item	Description	Specification	Quantity	Remarks
(4) Distribution Panel, Control Panel and Instrumentation	Check, cleaning, calibration	Main circuit: AC 380-220 V 3c 4w	1 set	
a) Distribution Panel	Check, cleaning, calibration	Control circuit: 110 V 1c	3 sets	
b) Control Panels	Replacement	Main circuit: AC 380-220 V 3c 4w	3 sets	
c) Oil Level Gauge	Replacement	Control circuit: 110 V 1c	1 set	
d) Water Level Gauge of Discharge Side	Replacement	Floatless type	1 set	
e) Water Level Gauge of Suction Side	Addition	Electrod type	1 lot	
f) Power Cable	Replacement	Electrtd type	1 lot	
g) Control Cable	Replacement	100 mm ² 3c	1 lot	
(5) Spare Parts, Maintenance Tools and Equipment				
a) Spare Parts for Pumps				
		1) Bearing	3 sets	
		2) Mechanical seal	3 sets	
		3) Impellor	2 sets	
		4) Bolts and nuts, packings	1 lot	
		5) Seal cover	3 sets	
		6) Balance ring	2 sets	
		7) Suction ring	2 sets	
		8) Ball nuts	3 sets	
		9) Seal case	3 sets	
		10) Seal ring	3 sets	
		11) Slinger	2 sets	
		12) Compound meter	3 sets	
b) Spare Parts for Electrical Equipment		1) Indicating lamp	15 sets	
		2) Bulb for indicating lamp	12 pcs	
		3) Push button	12 sets	
		4) Control auxiliary relay	35 sets	
		5) Timer	5 sets	
		6) Fuse 20 A	10 pcs	
		7) Fuse 3 A	15 pcs	
		1) Measure	1 lot	
		2) Tools	1 lot	
c) Maintenance Tools and Equipment				
(6) Operation House				
a) Steel Door	Replacement		3 sets	
b) Window	Replacement		3 sets	
c) Ceiling	Replacement		1 set	
d) Outside Paint	Replacement		1 set	
e) Bulkhead of Duct	Replacement		2 sets	
f) Lighting	Replacement	Fluorescent lamp 60 W x 2	10 sets	
g) Rack for Spare Parts	Addition	W: 3 m D: 80 cm Rack: 3 stages	1 set	Wooden

5.3.2 Inlet channel to the regulating pond

(1) Outlet tank

Two rectangular holes of 0.60 meter high and 0.85 meter wide are made on the existing partition wall in the outlet tank. The tank overflows three or four centimeters when the maximum discharge of 1.08 m³/sec is operated because the existing outlet tank of 4.2 meter long and 3.0 meter wide is small and the existing holes have insufficient flow capacity ($v = 1.059$ m/sec). So the outlet tank is enlarged 7.40 meter long and 4.00 meter wide. The existing partition wall is removed and two new walls are provided with two rectangular holes of 0.70 meter and 1.00 meter wide. The velocity in the new hole is estimated at 0.771 m/sec.

(2) Inlet channel to the regulating pond

The existing inlet channel made of precast concrete block is deteriorated. The existing Parshall flume is located very near the existing outlet tank and is not functioning properly.

A concrete flume canal is proposed to simplify the operation and maintenance works. Many types of water measuring device such as Parshall flume, Cipolletti weir and broad-crested weir are compared, and a broad-crested weir is eventually proposed since it has the most easiness of construction and operation and maintenance works.

The design high water level in the regulating pond is estimated at EL.168.20 m and flood water level is at EL.168.49. The inlet channel is designed to be safety against the flood water level. The main features of the inlet channel are as follows:

- Length of the channel: 32 m
- Cross section of the channel, base width x height = 1.70 x 1.10 m
- Width of the broad-creast weir = 4.9 m
- Cross section of the broad-crest weir, base width x height = 1.70 m x 0.79 m

5.3.3 Regulating pond

(1) Improvement of the intake structure of the north main canal

The existing intake gate is deteriorated and its water tightness is damaged because of missing and breakage of parts. This existing gate is to be replaced by the new one. The downstream end of the outlet canal of the intake structure is eroded.

According to the information obtained in the field survey period, the velocity of the outlet channel was very high and energy dissipator was constructed and the outlet channel was expanded more than two times of the original design. The new outlet channel is proposed to correspond to the cross section of the north main canal and to have a water cushion to diminish the velocity of water.

(2) Improvement of spillway

A suction pit of 1.0 m wide, 2.0 m long and 1.70 m deep is constructed at the downstream of overflow section. Because no safety facility is provided, this pit has a danger to children falling into it. This pit should be covered by a net made of steel bars to eliminate the danger.

(3) Removal of the intake structure of the south main canal

The existing intake structure of the south main canal is broken and not used. This intake should be removed from the view point of operation and maintenance works and scenery of the pond. The pipe of this intake is plugged by the concrete after removal of the intake gate.

(4) Removal of the sediment in the regulating pond and rehabilitation of the embankment

(i) Removal of the sediment

The sediment in the regulating pond was investigated after drainage of the water during the field survey period. The sediment of 20 m long, 10 m wide and 1 m depth is deposited at 10 m downstream of the outlet of the inlet channel.

This 200 m³ sediment is accumulated during the past 12 years from 1974 because no sediment removal work has been made. This sediment is to be removed in order to recover the design storage capacity of 13,000 m³.

(ii) Rehabilitation of the embankment

The embankment of the regulating pond is used for operation and maintenance road of the pump station and access road to the fields. The embankment near inlet channel and

embankment between the spillway and intake structure of the south main canal are seriously damaged due to the shortage of surface drainage facility. The surface of embankment in other sections are defaced. The damaged embankment is to be rehabilitated from the course base by means of laterite pavement. The defaced surface is also re-paved by laterite.

5.3.4 Irrigation canal

(1) Construction method

The canal lined by hard surface material is proposed to simplify the operation and maintenance works and water management activity, and to cope with leakage problem of the canal. The construction method of canal lining is determined based on the following considerations: i) Prevention of water loss by seepage, ii) Prevention of erosion of inside slope of the canal, iii) Diminish the hydraulic friction and reduce flow area, iv) Diminish grow of weed and breakage, and simplify operation and maintenance works, v) easy construction to complete for a limited construction period. The following methods of lining works are considered from the view point of location of the project area and from the design capacity of the canal ($1.048 \text{ m}^3/\text{sec} - 0.025 \text{ m}^3/\text{sec}$):

- Concrete lining
- Precast concrete block lining
- Rubber sheet lining
- Precast concrete U-flume

The basic study on the above construction methods is made as shown in Table 5.4. The recommendable construction method of the project is determined by the overall study as follows:

- (i) The rubber sheet lining canal has never been constructed in Laos. Because the rubber sheet lining requires very high accuracy of construction works, it appears to be difficult to employ this construction method in Laos for the time being. Buffalos and cattle may easily damage rubber sheet. It is feared that the rubber sheet is broken by the removal work of sediment and weeds. It probably meet with a difficulty in future to repair damaged part and to procure necessary material for repair. Therefore, rubber sheet lining is not employed in the Project.

- (ii) Merits and demerits of concrete lining and precast concrete block lining are compared as follows:

An about 30% of extra concrete is required for lining work even if appropriate construction work is made because the proposed canal is small ($1.048 \text{ m}^3/\text{sec}$ - $0.025 \text{ m}^3/\text{sec}$).

The finishing work of lining surface costs much labor and curing works have to be carried out with a minute plan.

On the other hand, precast concrete blocks are produced in place and its quality control such as standardization and curing is very easy. Precast concrete blocks can be produced in the wet season when site works are difficult to be done so that a good progress is expected to complete the construction works within a very limited construction period. Maintenance work of the block lining is easier than that of concrete lining since concrete blocks of the broken parts can be simply replaced by the new blocks. Consequently, precast concrete block lining is employed in the Project because this method matches with the limited construction period of the Project and its maintenance work is easy.

- (iii) The design discharge of the canal ranges from $1.048 \text{ m}^3/\text{sec}$ to $0.025 \text{ m}^3/\text{sec}$ and the those of 53% of total canals are to be less than $0.10 \text{ m}^3/\text{sec}$. A better progress of construction is expected in the precast U-flume type canal than that of the precast concrete block canal in particular with compaction work of canal foundation because precast block lining needs trimming works of a trapezoidal cross section but U-flume canal needs only flat foundation which costs less labor than that of trapezoidal cross section. The maintenance work of the U-flume is easier and more excellent than that of block lining. Thus, U-flume canal is employed to the canals of which design discharge is less than $0.10 \text{ m}^3/\text{sec}$.

Table 5.4 STUDY ON CONSTRUCTION METHOD OF LINING CANAL

Item	Concrete Lining	Precast Concrete Block Lining	Rubber Sheet Lining	U Shape Concrete Flume
I				
Construction				
(1) Treatment of foundation	Unsuitable soils should be replaced with the sands and the compaction is followed. Even suitable soils, the concrete should be placed immediately after excavation to minimize the change of moisture ratio.	Same as concrete lining	Same as concrete lining Grasses and stones under the sheet are not allowed.	The foundation should be compacted against differential settlement. Comparing with the other lining, treatment of foundation is easy.
(2) Treatment of groundwater	A weep hole or drains should be provided for groundwater. A flap valve should be also provided for under drain	Same as concrete lining	Same as concrete lining The connection between flap valve and the sheet is difficult	Treatment of groundwater is not necessary, because the flume has enough strength against the groundwater pressure. Fast progress of construction works is expected.
(3) Stability of canal	The stability of canal is supported by the inside slope of canal. The inside slope of canal is required for 1 to 1.5 or 1.0.	Same as concrete lining	Same as concrete lining	The flume itself should be stabilized against the soil and water pressures.
(4) Availability of materials	Concrete materials are available in Laos.	Same as concrete lining	The rubber sheet is not available in Laos.	Concrete materials are available in Laos.
(5) Placing	Extra concrete of 30% is expected for placing of concrete. The treatment of surface is required for much time. Since the construction will be carried out in the dry season, the careful curing of concrete is necessary.	Since the concrete block is manufactured in the factory, the quality control and curing are easy. Extra concrete is not necessary. Comparing with the concrete lining, the fast progress of works is expected.	Careful placing of the sheet is necessary. Special adhesive and experienced person are required for placing. Consequently, the rubber sheet lining can not be done by the local contractor.	Since the concrete flume is manufactured in the factory, the quality control and curing are easy. Extra concrete is not necessary.
II				
Operation and maintenance	The concrete lining canal is strong against the scouring of canal slope by change of water level and damage by person and animals, while the canal is weak against undifferential settlement. The maintenance for weeding and deposited silts and sands is easy.	Same as concrete lining The damages by the undifferential settlement are easily repaired, because replace of concrete block.	The rubber sheet lining is very weak against damage by person and animals. The repairing of damaged parts is very difficult, because of availability of materials and experienced person.	The flume concrete lining is very strong against damage by person and animals. Even damaged, the repairing is easy comparing with the other lining canals.

(2) Irrigation canal

Design works of the irrigation canal are made according to the following basic standard.

(i) Canal Type: Precast concrete block lining for north main canal and lateral canals,
U-flume for sub-lateral canals

(ii) Allowable Velocity: Maximum 1.50 m/sec.
Minimum 0.25 m/sec

(iii) Roughness coefficient: Precast concrete block
lining : 0.017
U-flume : 0.016

Cross section of canals are classified into the following types to simplify the construction works:

Table 5.5 TYPE OF IRRIGATION CANAL

Type	Base Width (m)	Canal Height (m)	Side Slope
(1) Pre-Cast Concrete Block Lining Canal			
A	0.60	1.20	1:1.25
B	0.50	1.05	1:1.25
C	0.40	0.80	1:1.25
D	0.30	0.80	1:1.00
(2) U-Flume Canal			
(A)	0.30	0.50	-
(B)	0.40	0.75	-
(C)	0.50	0.90	-

The main features of irrigation canal are as follows:

Table 5.6 FEATURES OF IRRIGATION CANAL

Name of Canal	Design Discharge (m ³ /sec)	Type	slope	Length (m)
North Main Canal	1.048 - 0.182	A,B,C	1/6,000 - 1/4,500	6,139.40
Lateral Canal	0.369 - 0.251	D	1/1,100 - 1/4,000	916.10
I-N6 Sub-Lateral	0.107 - 0.025	(B),(C)	1/400 - 1/5,000	1,037.30
I-N10-1 Sub-Lateral	0.040 - 0.026	(C)	1/400 - 1/5,000	815.10
I-N10-2 Sub-Lateral	0.118 - 0.048	(A),(B)	1/4,000	1,757.90
I-N10-3 Sub-Lateral	0.093 - 0.025	(B),(C)	1/2,000	1,244.60
I-N13 Sub-Lateral	0.118 - 0.025	(A),(B),(C)	1/1,800	1,473.60
I-NS Sub-Lateral	0.025	(C)	1/1,800	530.00
Total				14,914.00

5.3.5 Related structures of the irrigation canal

(1) North main canal

(i) Turnout

The existing turnouts are to be used in the Project if they are not damaged. Main features of the turnouts of the north main canal are proposed as follows:

Turnouts: 13 nos.

- Gate: 16 nos. (2 gates of N-7 and 3 gates of N-10 are included)
New/Replacement: 5 nos.
Partly replacement 11 nos.

- Structure: 13 nos.
New/Replacement: 1 no.
Rehabilitation: 2 nos.
Use of existing trunouts: 10 nos.

Installation of staff gauge for water level measurement: 13 nos.

The rehabilitation plan of turnouts is shown in Table 5.7

Table 5.7 REHABILITATION PLAN OF TURNOUTS ON NORTH MAIN CANAL

Name of Turnout	Gate		Structure		Installation of staff gauge	
	Use of existing	Parts of replacement	Replacement	Use of existing		Parts of rehabilitation
N-1	-	-	Dia.200	-	Installation of wall and pipe	Provide
N-2	-	-	Dia.200	-	ditto	Provide
N-3	-	-	Dia.200	-	-	Provide
N-4	-	Capstan, Pedestal, Spindle, Skin plate	-	Use	-	Provide
N-5	-	ditto	-	-	Replacement of pipe (l=2.50 m)	Provide
N-6	The existing turnout is removed and new turnout is constructed in correspondence with construction of I-N6 sub-lateral canal.					
N-7	-	Capstan, Spindle, Skin plate	Dia.300	Use	-	Provide
N-8	-	ditto	-	-	Outlet approach canal (l=3.00 m)	-
N-9	-	ditto	-	Use	-	Provide
N-10	-	ditto (left, middle, right)	-	Use	-	Provide
N-11	-	ditto	-	Use	-	Provide
N-12	-	ditto	-	Use	-	Provide
N-13	-	Spindle cover	-	Use	-	-

(ii) Check structure

The existing check structures are employed as much as possible in the Project similarly with turnouts.

Check structures: 6 nos.

- Gate: 6 nos.

New/Replacement: 3 nos.

Partly replacement: 3 nos.

- Structure: 6 nos.

New/Replacement: 1 no.

Rehabilitation: 5 nos.

The rehabilitation plan of check structures are shown in Table 5.8.

Table 5.8 REHABILITATION PLAN OF CHECK STRUCTURE ON NORTH MAIN CANAL

Name of check Structures	Parts of Replacment	Gate Replacement	Structure Parts of Rehabilitation	Replacement
N-1	Hoist Spindle	-	Construction of approach road from canal crossing to flood protection dike slope 1:3	-
N-2	ditto	-	ditto	-
N-3	ditto	-	ditto	-
N-4	-	B x H = 0.80(m) x 1.00(m)	ditto	-
N-5	-	B x H = 0.70(m) x 0.70(m)	ditto	-
N-6	-	B x H = 0.70(m) x 0.70(m)	-	Replaced

(iii) Side spillway

There exist five side spillways. The crest elevation of those spillways is lower than the design water level and stop logs are installed on its overflow crest to keep the design water level and to prevent water overflowing. Maintenance of the design water level by stop logs results in inadequate water management activity due to the leakage of water from them and frequently missing of the stop logs. In order to improve such inadequate situation, the existing overflow crest is to be heightened upto the design water level and stop logs are removed. The main features of side spillway are shown in Table 5.9.

Table 5.9 MAIN FEATURES OF SIDE SPILLWAY

Name of spillway	Crest		Flow Capacity (m ³ /sec)	Rehabilitation Works
	Raising height (m)	Elevation (m)		
N-1	0.34	166.94	0.17	-
N-2	0.28	166.60	0.42	-
N-3	0.15	166.33	0.36	-
N-4	0.16	166.05	0.05	filling of depression
N-5	0.18	166.86	0.10	-

(iv) Washing basin

Inhabitants along the irrigation canal take their domestic water from the irrigation canal. In order to secure canal inside slope from the disturbance caused by them, seven washing basins of 1 m wide are proposed from the N-1 turnout to N-8 turnout.

(v) Foot bridge

Foot bridges which cross the irrigation canal are proposed for the traffic of inhabitants above mentioned from their house to their field. The dimension of the foot bridge is as follows:

- Material: Concrete slab
- Width: 0.60 m
- Approach to the embankment: Concrete step
- Numbers of bridge: 10 nos.

(vi) Outlet pipes disorderly installed

Inhabitants disorderly installed outlet pipes on the canal at six locations. These pipes are to be removed to secure canal embankment and adequate water management.

(2) Related structures on the lateral canals

(i) Turnout

Turnouts of the lateral canals have also gates in similar with turnout on the north main canal. Field investigation reveals that gates and structures are broken and deteriorated. These existing turnouts are replaced in order to correspond with the dimensions of new concrete block lined canal and to improve the water management activity and to simplify the operation and maintenance works. The improvement plan of the turnout of the lateral canals is as follows:

Name of Canal	Name of Turnout	Gate and Pipe Length (mm)		
		Right	Center	Left
Lateral	L-1	-	-	Dia 300
Lateral	L-2	Dia 300	Dia 400	Dia 400
Total	2 places			

(ii) Check structures

The water level is controlled by the stop logs at the existing check structures. However, most of them are buried in the sediment and are deteriorated. New check structures which have gates are proposed to improve water management activity and to correspond with dimensions of the new lateral canals.

The main features are shown as follows:

Name of Canal	Name of Regulating Gate	Gate and Pipe Length (mm)
Lateral	L-1	700 x 700
Lateral	L-1	Dia.400 <u>1</u>
Total	2 places	

1: Gate is counted in L-2 Turnout

(3) Related structures on the sub-lateral irrigation canals.

(i) Turnout

The existing division boxes on the sub-lateral canals are operated by stop logs. These division boxes are to be replaced by the new turnouts which have conventional gates in order to improve water management activity and to simplify the operation and maintenance works. The main features of the new turnouts are shown in Table 5.10.

Table 5.10 FEATURES OF TURNOUTS

Name of Canal	Name of Turnout	Type (Direction of Outlet)
I-N6 Sub-Lateral	1	II (L,R)
"	2	II (L,R)
"	3	I (L)
"	4	I (R)
"	5	I (L)
"	6	I (R)
"	7	I (L)
"	8	I (R)
I-N-10-1 Sub-Lateral	1	II (L,R)
"	2	II (L,R)
I-N10-2 Sub-Lateral	1	I (R)
"	2	I (L)
"	3	I (L)
"	4	I (L)
I-N10-3 Sub-Lateral	1	I (R)
"	2	I (R)
"	3	I (R)
I-N13 Sub-Lateral	1	I (R)
"	2	I (R)
I-NS Sub-Lateral	1	I (L)
Total	20 places	

Type I: Outlet to either left or right side
 Type II: Outlet to both left and right sides

(ii) Regulating gates

The water level at the division box is controlled by stop logs at present. These stop logs are to be replaced by the conventional gates which ensure better water management and easy operation and maintenance works. Regulating gates are installed at immediately downstream of the turnout for easy control of water level in the turnout. The main features of regulating gates are shown in Table 5.11.

Table 5.11 FEATURES OF REGULATING GATES

Name of Canal	Name of Regulating Gate	Section (Base x Height) (mm)
I-N6 Sub-Lateral	1	400 x 750
"	2	400 x 750
"	3	400 x 750
"	4	400 x 750
"	5	400 x 750
"	6	400 x 750
"	7	300 x 500
I-N10-1 Sub-Lateral	1	300 x 500
I-N10-2 Sub-Lateral	1	500 x 900
"	2	500 x 900
I-N10-3 Sub-Lateral	1	400 x 750
"	2	400 x 750
I-N13 Sub-Lateral	1	500 x 900
Total	13 places	

(iii) Culvert

Culverts are necessary on the new sub-lateral irrigation canals I-N6 and I-NS to cross a main farm road. A concrete box type culvert is proposed and extra embankment of the farm road is diminished as little as possible. Main features of the culverts proposed are shown in Table 5.12.

Table 5.12 FEATURE OF CULVERTS

Name of Canal	Name of Culvert	Section (Base x Heights) (mm)
I-N6 Sub-Lateral	1	400 x 750
"	2	400 x 750
I-NS Sub-Lateral	1	300 x 500
Total	3 places	

(iv) Aqueduct

An aqueduct is proposed at grade crossing point of I-N6 sub-lateral irrigation canal and drainage canal since the design discharge of the sub-lateral canal is very small ($0.066 \text{ m}^3/\text{sec}$) and maintenance work of a aqueduct is easier than that of other structures e.g. syphon.

The main feature of the aqueduct is

- Cross section: base width x height = $0.30 \times 0.50 \text{ m}$
- Net span: 10.65 m

(v) Cross drain

Two cross drains are constructed to drain the excess water from the left side to the depressed area on the right side of the new I-NS sub-lateral canal which starts from No.1 Nong Sam Kha dam and runs through a forest to supply the water for the existing reclaimed land.

In addition, a cross drain is provided at that I-N6 sub-lateral canal crosses with No.4 main farm road and drainage canal in the field; two cross drains at the two crossing points of the new sub-lateral canal I-N10-3 and existing drainage canals.

These cross drains are made of corrugated pipe in similar with field cross drains and its minimum diameter is determined at 600 mm for maintenance work. The main features of the cross drains are shown in Table 5.13.

Table 5.13 FEATURE OF CROSS DRAINS

Name of Canal	Name of Cross Drain	Pipe Diameter (mm)
I-N6 Sub-Lateral	No.1	Dia.600
I-NS Sub-Lateral	No.1	Dia.600
"	No.2	Dia.600
I-N10-3 Sub-Lateral	No.1	Dia.800
"	No.2	Dia.800
Total	5 places	

5.3.6 Drainage canal

Drainage canals in the project area are broadly divided into i) the Nong Sam Kha river and its tributaries and ii) drainage canals in the paddy fields. The rehabilitation plan of drainage canal is summarized as follows:

Table 5.14 REHABILITATION PLAN OF DRAINAGE CANAL

Name of Drainage Canal	Design Discharge (m ³ /sec)	Channel Slope	Length (m)	Related Structure Cross Drain	Bride
Nong Sam Kha river	9.59-3.00	1/6,400	8,090	-	7 nos.
No.1 Branch	2.51-1.78	1/2,200	1,833	1 no.	1 no.
No.1-1 Branch	0.22	1/200	178	1 no.	-
No.2 Branch	1.02-0.31	1/8,500	1,624	1 no.	-
D-N13	1.08-0.42	1/1,500	679	2 nos.	-
D-N12	0.47	1/950	870	2 nos.	-
D-N9	0.48	1/1,000	162	1 no.	-
D-N8	0.96-0.33	1/2,150	1,166	2 nos.	-
D-C1	2.41	1/1,600	498	2 nos.	-
Total			15,100	12 nos.	8 nos.

(1) Nong Sam Kha river

(i) Rehabilitation plan of channel

The proposed cross section of channel is determined based on the non-uniform hydraulic calculation method by trial and error. If the present flow capacity of cross section is not enough for design discharge, the cross section is enlarge. The allowable maximum and minimum velocities are 0.90 m/sec and 0.30 m/sec, respectively.

(ii) Rehabilitation plan of related structure

There exist seven (7) bridges on the Nong Sam Kha river. The effective width of existing bridges is 3.0 m and height of parapet is 0.30 m. The existing bridges are still in good condition. Consequently, the existing bridges are excluded from the rehabilitation plan.

(2) Tributaries of Nong Sam Kha river

(i) Rehabilitation plan of channel

The same manners as of the Nong Sam Kha river are applied for determination of proposed cross section.

(ii) Rehabilitation plan of related structures

The existing bridge is still in good condition. The cross drains are mostly deteriorated and plugged by silts and sands. These cross drains will be replaced by new ones to secure the flow capacity.

(3) Drainage canals in the paddy fields

(i) Rehabilitation plan of canal

The existing drainage canals are completely damaged and broken. The proposed cross section is determined based on the uniform hydraulic calculation method. The allowable maximum and minimum velocities are 0.90 m/sec and 0.30 m/sec, respectively.

(ii) Rehabilitation plan of related structures

Existing cross drains of 9 nos. on the drainage canals are mostly damaged and plugged by silts and sands. These cross drains will be replaced by new ones to secure the flow capacity. The corrugated steel pipe will be used for the conduit of cross drain.

5.3.7. Drainage pump station

(1) Drainage pump equipment and operation house

(i) Pump unit

The general conception of repairing work is almost same as the case of irrigation pump unit. The repairing work is scheduled to replace the parts such as impeller, casing ring, bearing, etc., and to improve the insulation of stator coils.

The repairing and manufacturing work will be carried out at the manufacturer's factory in Japan.

(ii) Discharge pipe and accessory

The discharge pipes, air valves, check valves and loose flanges will be checked and the damaged part of coating will be repaired. The renewed parts are as follows.

- a) Packings, bolts and nuts for flange joints
- b) Compound gauge

(iii) Piping and tank of insulation oil

The insulation oil tanks, pipes and supports will be cleaned and checked. The damaged supports and coating of pipes will be repaired. The renewed parts are as follows.

- a) Packings, bolts and nuts for flange joints
- b) Oil filter
- c) Oil gauge

(iv) Screen and flap valve

Inspection and repair paint will be carried out for the screens and flap valves.

(v) Outdoor switchyard and transforming equipment

The transforming equipment such as disconnecter, power fuse, transformer, etc., will be checked and repaired. The fence for switchyard will be renewed.

(vi) Distribution panel, control panel and instrumentation

The panels for distribution and control will be cleaned and checked. The meters furnished in the panels will be calibrated. The pump pressure meters equipped with the panels will not be used after this rehabilitation work, because of the same reasons of the irrigation pump station. The water level indicator will be replaced by new one at the gauging well. The pumps will be operated automatically between H.W.L. 163.0 and L.W.L 161.0.

The renewed parts are as follows.

- a) Indicating lamps
- b) Control auxiliary relays and timers
- c) Push buttons
- d) Power and control cables

(vii) Spare parts, maintenance tools and equipment

The spare parts and tools will be supplied for maintenance of pumps and panels as follows:

- a) Spare parts for pumps..... 2 sets of each parts
- b) Spare parts for distribution panel 1 set
- c) Spare parts for control panels 1 set

The maintenance tools and equipment of irrigation pump are also utilized for maintenance purpose of the drainage pumps.

(viii) Operation house

The damaged position of operation house will be repaired to keep the panels in good condition. The duct covers for cable and oil pipe will be newly supplied, because almost are lost.

The detailed plan of rehabilitation work is shown in Table 5.15.

Table 5.15 DRAINAGE PUMP EQUIPMENT AND OPERATION HOUSE

Rehabilitation Item	Description	Specification	Quantity	Remarks
(1) Drainage Pumps	Overhaul, repair paint, adjustment	Total head: 6 m Discharge: 52 m ³ /min Dia.: 600 mm Submergible motor pump Power: AC 380 V 50 Hz	2 sets	
a) Pumps	Parts renewal	1) Bearing 2) Mechanical seal 3) Impeller 4) Bolts and nuts 5) Packings 6) Seal cover 7) Balance ring 8) Suction ring 9) Ball nuts 10) Seal case 11) Seal ring 12) Slinger Dia.: 600 mm	2 sets 2 sets 2 sets 1 lot 2 sets 2 sets 2 sets 2 sets 2 sets 2 sets 2 sets 2 sets 1 lot	
b) Discharge Pipes	Insulation improvement of stator coils 12 P 70 kW Check, repair paint Renewal of packings, bolts and nuts	Dia.: 150 mm (with gate valve) Dia.: 500 mm Dia.: 25 mm	2 sets 2 sets 2 sets	
c) Accessory	Check, repair paint Air valves Loose flange	1) Oil filter 2) Oil level gauge	2 sets 2 sets 2 sets	
d) Piping for Insulation Oil	Check, repair paint and supports Renewal of packings, bolts and nuts			
e) Tank of Insulation Oil	Check, repair paint Parts renewal			
(2) Trashrack and Flap Valve	Check, repair paint Trashrack Flap valve	Height: 1,500 mm Width: 1,500 mm Dia.: 1,200 mm	5 sets 3 sets	
(3) Outdoor Switchyard	Check, cleaning	24 kV 3 P	1 set	
a) Disconnector	Check, cleaning	24 kV, 40 A.-1,500 MVA	1 set	
b) Power Fuse	Check, cleaning	3c 22,000/110V, 20/5A	1 set	
c) Metering Outfit	Check, cleaning	3c 21 kV/380-220 V, 500 kVA	1 set	
d) Transformer	Check, cleaning, calibration	Demand meter, Watt-hour meter, var-hour meter	1 set	
e) Panel				
(4) Distribution Panel, Control Panel and Instrumentation	Check, cleaning, calibration	Main circuit: AC 380-220 V 3c 4w Control circuit: 110 V 1c	1 set	
a) Distribution Panel	Check, cleaning, calibration	Main circuit: AC 380-220 V 3c 4w Control circuit: 110 V 1c	2 sets	
b) Control Panels	Replacement	Floatless type	2 sets	
c) Oil Level Gauge	Replacement	Float type	1 set	
d) Water Level Gauge of Discharge Side	Replacement	100 mm ² 3c	1 lot	
e) Power Cable	Replacement		1 lot	
f) Control Cable	Replacement		1 lot	

Rehabilitation Item	Description	Specification	Quantity	Remarks
(5) Spare Parts, Maintenance Tools and Equipment a) Spare Parts for Pumps		1) Bearing	2 sets	
		2) Mechanical seal	2 sets	
		3) Impeller	1 set	
		4) Bolts and nuts, packings	1 lot	
		5) Seal cover	2 sets	
		6) Balance ring	1 set	
		7) Suction ring	1 set	
		8) Ball nuts	2 sets	
		9) Seal case	1 set	
		10) Seal ring	2 sets	
		11) Slinger	1 set	
		12) Compound meter	1 set	
b) Spare Parts for Electrical Equipment		1) Indicating lamp	8 sets	
		2) Bulb for indicating lamp	75 pcs	
		3) Push button	9 sets	
		4) Control auxiliary relay	15 sets	
		5) Timer	5 sets	
		6) Fuse 20 A	10 pcs	
		7) Fuse 3 A	15 pcs	
(6) Operation House		Replacement	2 sets	
	a) Steel Door	Replacement	4 sets	
	b) Window	Replacement	1 set	
	c) Ceiling	Replacement	1 set	
	d) Outside Paint	Replacement	2 sets	
	e) Bulkhead of Duct	Replacement	5 sets	
	f) Lighting	Fluorescent lamp 60 W x 2		

(2) Related concrete structure

(i) Rivetment for outlet of pump station

The existing rivetment for outlet of pump station is mostly broken. Consequently, the rivetment will be replaced by new one. Total area of rivetment is about 320 m².

(ii) Construction of concrete step

For proper maintenance of outlet rivetment, the concrete step will be provided on the slope of flood protection dike. The width of step is 1 m and its total length is about 33 m.

(iii) Maintenance road to the pump station

The original design and present situation of maintenance road to the pump station are as follows:

Original design

- Width of road : 4.00 m
- Connecting slope : 12.5%
- Pavement : none

Present situation

- Shape of road : still good
- Surface condition : covered with grasses

The maintenance road of 45 m will be rehabilitated with laterite pavement.

5.3.8 No. 1 Nong Sam Kha dam

(1) Existing intake structure

The gate is out of order due to damage of hoist. The gate leaf is also damaged and water sealing is deteriorated. On the contrary, the structures are still in good condition, except for the wooden deck. Consequently, the hoist, spindle and gate leaf will be replaced. The operation deck will also be replaced by the concrete slab with H beam. The main features of operation

deck are as follows:

- Span : 6.60 m
- Width : 1.00 m

(2) Construction of new intake structure

An intake structure should be newly constructed for irrigation water supply from No. 1 Sam Kha dam to the new sub-lateral canal (I-NS). The intake structure is designed the same structure and type as the existing intake structure. The main features of new intake structure are below.

- Intake gate : Dia 400 mm
- Elevation of intake sill : EL. 165.00
- Diameter of conduit : Dia 400 mm
- Length of conduit : 21.00 m
- Connecting canal : water cushion type
- Operation deck
 - Span : 6.60 m
 - Width : 1.00 m

(3) Crest of dam

The crest of dam with width of 4.0 m is partly damaged due to insufficient surface drainage. The damaged parts will be paved by laterite.

5.3.9 Flood protection dike

The flood protection dike is partly broken by farmers for their passage. The broken parts of 5.2 km will be rehabilitated by laterite.

5.3.10 Intake, check and turnout gates

The detailed plan of gate rehabilitation is shown in table 5.16.

Table 5.16 CHECK AND TURNOUT GATES

Rehabilitation Item	Description	Specification	Quantity	Remarks
(1) North Main Canal Regulating Gate	Replacement of gate leaf and hoist	Clear span: 800 mm Clear height: 800 mm	1 set	incl. check, cleaning repair paint for guide frame
(2) Turnout Gate	Replacement of gate leaf and hoist	Dia. 200 mm	1 set	incl. check, cleaning repair paint for guide frame
a) N-4	- Ditto -	Dia. 200 mm	1 set	- Ditto -
N-5	- Ditto -	Dia. 300 mm	1 set	- Ditto -
N-7 (1)	- Ditto -	Dia. 300 mm	1 set	- Ditto -
N-8	- Ditto -	Dia. 300 mm	1 set	- Ditto -
N-9	- Ditto -	Dia. 300 mm	1 set	- Ditto -
N-10 (C)	- Ditto -	Dia. 600 mm	1 set	- Ditto -
N-10 (L)	- Ditto -	Dia. 300 mm	1 set	- Ditto -
N-10 (R)	- Ditto -	Dia. 300 mm	1 set	- Ditto -
N-11	- Ditto -	Dia. 300 mm	1 set	- Ditto -
N-12	- Ditto -	Dia. 300 mm	1 set	- Ditto -
b) N-1	Replacement of Gate leaf, hoist and guide frame	Dia. 200 mm	1 set	- Ditto -
N-2	- Ditto -	Dia. 200 mm	1 set	- Ditto -
N-3	- Ditto -	Dia. 200 mm	1 set	- Ditto -
N-6 (C)	- Ditto -	Dia. 400 mm	1 set	- Ditto -
N-6 (L)	- Ditto -	Dia. 200 mm	1 set	- Ditto -
N-7 (2)	- Ditto -	Dia. 300 mm	1 set	- Ditto -
c) N-13	Replacement of spindle cover	Dia. 400 mm	1 set	incl. check, cleaning repair paint for gate leaf, hoist and guide frame
(3) Check Gate	Replacement of hoist	Clear span: 1,300 mm Clear height: 1,350 mm	1 set	incl. check, cleaning repair paint for gate leaf and guide frame
a) N-1	- Ditto -	Clear span: 1,200 mm Clear height: 1,245 mm	1 set	- Ditto -
N-2	- Ditto -	Clear span: 1,100 mm Clear height: 1,145 mm	1 set	- Ditto -
N-3	- Ditto -	Clear span: 800 mm Clear height: 1,000 mm	1 set	- Ditto -
b) N-4	Replacement of gate leaf, hoist and guide frame	Clear span: 700 mm Clear height: 700 mm	1 set	- Ditto -
N-5	- Ditto -	Clear span: 700 mm Clear height: 700 mm	1 set	- Ditto -
N-6	- Ditto -	Clear span: 700 mm Clear height: 700 mm	1 set	- Ditto -
(4) Lateral Turnout Gate	Replacement of gate leaf, hoist and guide frame	Dia. 300 mm	1 set	- Ditto -
a) L-1	- Ditto -	Dia. 400 mm	1 set	- Ditto -
L-2 (C)	- Ditto -	Dia. 400 mm	1 set	- Ditto -
L-2 (L)	- Ditto -	Dia. 400 mm	1 set	- Ditto -
L-2 (R)	- Ditto -	Dia. 300 mm	1 set	- Ditto -
(5) Lateral Check Gate	Replacement of gate leaf, hoist and guide frame	Clear span: 700 mm Clear height: 700 mm	1 set	Playing a part of function for the check gate L-2
a) L-1	- Ditto -	Clear span: 300 mm Clear height: 650 mm	31 sets	- Ditto -
(6) Sub-Lateral Turnout Gate	New construction	Clear span: 300 mm Clear height: 650 mm	31 sets	- Ditto -

Rehabilitation Item	Description	Specification	Quantity	Remarks
(7) Sub-Lateral Check Gate	New construction	Clear span: 300 mm Clear span: 400 mm Clear span: 500 mm Clear height: 350 mm Clear height: 600 mm Clear height: 750 mm	2 sets 8 sets 3 sets	
(8) Nong Sam Kha Intake Gate	Replacement of gate leaf and hoist	Dis. 400 mm	1 set	incl. check, cleaning repair paint for guide frame
	New construction	Dis. 400 mm	1 set	

5.3.11 Farm roads

The farm road network of the project area consists of main farm roads provided in the Tha Ngon Scheme and rural roads linking the existing villages to those main farm roads.

(1) Rehabilitation plan of main farm roads

The main farm roads will be rehabilitated in the following manner.

Roads which are not damaged seriously will be improved by subgrade grading and laterite pavement. A part of No.1 main farm road of 3.4 km long, which is not allowing traffic at present due to serious damages to the road surface, will be improved by substantial strengthening of roadbed including laterite pavement. A reach of about 1 km long of No.2 main farm road near the fish pond will be improved by filling soils on roadbed by 20 cm to 30 cm high and laterite pavement.

The designs of rehabilitation of main farm roads are as follows:

- Total road surface width : 7 m
- Laterite pavement : 6 m wide and 15 cm thick
- Road height : 50 cm
- Surface drainage : 3% slope transversely

The length of roads rehabilitated are as follows:

- No.1 main farm road : 9.6 km
 - No.2 main farm road : 6.4 km
 - No.3 main farm road : 2.5 km
 - No.4 main farm road : 2.3 km
 - No.5 main farm road : 2.2 km
- Total : 23.0 km

Seven (7) cross drainage structures will be constructed as follows:

- No.2 main farm road : 2 nos.

(2) Village roads

There are two (2) villages named Oudom Phol and Lat Khouay (new) in the southern part of the project area and those villagers have been farming in the project. Both villages have foot paths having 3 m to 4 m wide for accessing to the field of Tha Ngon Scheme. However, these roads are so deteriorated that the traffic of vehicles and agricultural machinery is in difficult even in the dry season.

To solve the above inconvenient conditions for farming, the Project will construct village link roads connecting between the Tha Ngon Scheme and the both villages by improvement of the above two foot paths, involving widening and paving these foot paths. The same design criteria as the improvement of main farm roads in the Tha Nagon Scheme will be adopted to those village roads. The crest of No.2 Nong Sam Kha dam will be used as the village roads, leaving the present crest width of 4 m as it is.

The improvement plan of village roads are as follows:

- No.1 village road linking to No.4 main farm road: 0.7 km long
- No.2 village road linking to No.5 main farm road: 0.4 km long

Five (5) cross drainage structures will be constructed on the village roads as follows:

- No.1 village road: 3 nos.
- No.2 village road: 2 nos.

5.3.12 Rice processing and storage facilities

(1) Building plan

- (i) Basic design concept: The facilities will be designed under the proper design standards prevailed in the world. The design of facilities will be carried out in consideration of capacity of equipment, durability, cost and easiness in operation and maintenance and method of construction.
- (ii) Optimum scale of facilities: An optimum scale of the facilities depends on the purposes of facilities and operation methods. The required area and scale of facilities, consisting of rice processing facilities and storage, will be determined in

due consideration of local conditions and customs as well as paddy production and capacity of processing equipment.

- (iii) Outline of building plan: Three (3) rice processing and storage facilities will be constructed in three (3) villages respectively. The buildings for rice processing facilities have the same sizes because of the same sizes of processing equipment to be introduced in consideration of the exchangeability of spare parts of equipment. The size of storage building depends on the paddy production and other conditions involved in the respective villages. As shown in Table 5.17, required storage capacities are determined depending on the amount of rice payable as the water charge and taxes, compulsory amount for selling to the Government, amount of self-consumption in village and balance to be stored. The storages will be constructed adjacent to the rice processing buildings for smooth transfer of processed products between both facilities. The outlines of the facilities are as follows:

Table 5.17 BUILDING PLAN OF STORAGE FACILITIES

No.	ITEM	(1) THANGON	(2) BAN NA	(3) THASOM MO	(4) OUDOM PHOL	(5) LAT KHOUAY	(6) KENG KHAI	(7) STATE FARM	(8) TOTAL
1	Total cultivation area	238	133	265	116	226	43	101	1,123
a)	paddy field in the project area (end of 1991) 1/2	-	30+0=30	232+34=266	80+36=116	97+0=97	-	94+7=101	610
b)	paddy field around the project area (end of 1991)	238	103	-	-	129	43	-	513
2	Max. anticipated production of paddy at the end of 1991	4762	3112	9314	4064	5982	862	3544	3,162
a)	paddy field in the project area	-	105+0=105	931	406	340+0=340	-	354	2,136
b)	paddy field around the project 2	476	206	-	-	258	86	-	1,026
3	Total anticipated population in 1991 (annual growth rate = 2.9%)	(2,597)	1,283	(604)	(886)	1,170	(432)	-	(6,645)
4	Total home consumption for a half year in 1991 (paddy: 150kg/capita/half year)	449	192	105	153	176	75	-	1,150
5	Paddy reserve for emergency (for half year)	449	192	105	153	176	75	-	1,150
6	Total paddy to be stored (for half year)	898	384	210	306	352	150	-	2,300
7	Total estimated capacity of the existing storages 2	890	433	225	398	530	183	-	2,709
	[average capacity: (2.5x4x1m) = 0.5x0.5/m ² = 2.5t/storage	(OK)	(OK)	(OK)	(OK)	(OK)	(OK)	-	(OK)
8	Total water charge (0.2t/ha/crop season)	-	6	53	23	19	-	20	121
9	Production tax and governmental procurement (8% of total)	38	25	75	33	49	7	28	255
10	Total quantity for sale to market (2.4-8.9)	-11	88	698	197	354	4	306	1,647
a)	Sale immediately after harvesting	-	-	50%	50%	177	-	-	(624)
b)	Sale just before next harvesting = Paddy to be stored in the proposed storage facilities 2	-	-	50%	50%	177	-	-	(625)
11	Total floor area required for the storage facilities (10.b) + 0.56 t/m ³ + 2m ³ + 2 m (effective floor area) (10.b) + 0.56 t/m ³ + 2m ³ + 2 m]	-	-	312	88	158	-	-	558
12	Features of proposed storage facilities			(TYPE - III)	(TYPE - I)	(TYPE - I)			
a)	Effective floor area	-	-	312	92	172	-	-	576
b)	Floor area for entrance, passage, etc.	-	-	138	58	78	-	-	274
c)	Total floor area of the facilities	-	-	450	150	250	-	-	850
13	Percentage of satisfaction on the effective floor area [12.a) + 1]	-	-	100%	105%	109%	-	-	

Remarks: 1/ Classification of paddy field (Non-inundated field + inundated field during heavy flood)

2/ This paddy field is applied with the present average production rate of 2.0 t/ha/crop season.

3/ Total production in the wet season.

4/ Total production in the dry season.

5/ Though there are many kind of existing storages, the total capacity for all storages is estimated by the average storage capacity.

6/ 50 percent of total sale to the market. This is including the reserves for emergency for each cooperative.

- Outline of facilities

(a) Tha Som Mo Cooperative

Storage building

Floor area	: 450 m ²
Type	: Elevated type single story
Structure	: Wooden building

Rice processing building

Floor area	: 100 m ²
Type	: Single story
Structure	: Wooden building

(b) Oudom Phol Cooperative

Storage building

Floor area	: 150 m ²
Type	: Single story
Structure	: Wooden building

Rice processing building

Floor area	: 100 m ²
Type	: Single story
Structure	: Wooden building

(c) Lat Khouay Cooperative

Storage building

Floor area	: 250 m ²
Type	: Elevated type single story
Structure	: Wooden building

Rice processing building

Floor area	: 100 m ²
Type	: Single story
Structure	: Wooden building

- Siting of facilities

- (a) Tha Som Mo Cooperative: The both buildings will be constructed at the existing repair yard of the cooperative adjacent to No.1 main farm road. An access road from the main farm road to buildings will be constructed.
- (b) Oudom Phol Cooperative: The facilities will be constructed at the western side of existing shop owned by the cooperative located at the center of the village. Some land clearing including cutting several trees and embankment for building area by 30 cm high will be necessary.
- (c) Lat Khouay Cooperative : The facilities will be constructed at the eastern side from the village center selected by the cooperative. It is mutually confirmed in writing that an existing farmers house being in the proposed site should be removed by the cooperative. An access road from laterite paved public road to the facilities will be constructed with provision of a culvert for side ditch of the public road. The building area will be elevated by about 30 cm high with filling.

- Floor planning

To protect stored products from moisture during the wet season, type of storage building will be of elevated wooden floor prevailed in Lao PDR. Height of floor from the ground will be designed upon the deck height of trucks transporting the paddy/rice from or to the storage. A concrete approach slope will be provided at the entrance of buildings for truck.

A track with 2 m wide will be provided in the center of elevated floor for enabling small carts to transport of paddy/rice.

To compensate the shortage of rice bags in Lao PDR, wooden paddy boxes equipped with stop logs, having a height of 2.8 m will be facilitated in the

storage. Capacities of paddy boxes will be 50 percent of the total capacity of the storage.

The floor of rice processing building will be constructed by concrete, of which elevation is higher by 30 cm than the ground surface. The both buildings will be ventilated through louvers to exhaust dusts from and to prevent stagnation of moisture and heated air in the building. In addition, skylights will be also provided to supplement the electric lights. An elevated corridor with 2 m wide allowing the movement of carts will be provided between two buildings of rice processing and storage.

(2) Structural design

(i) Basic design concept and design loads

The following basic design concept and design loads will be employed for the structural design of the facilities:

(a) All the buildings are designed to be single story type having foundations with reinforced concrete. Wooden materials, readily available in the local market are used for walls and roof trusses.

(b) Loads acting on the frames of building are dead load, live load and wind load as defined below:

- Dead load :

Weights of building materials presented as weight per unit area or unit volume

Reinforced concrete : 2,400 kg/m²

Mortar : 2,000 kg/m²

Timber : 800 kg/m²

- Live load :

Structures and men loads with multiplying by concentration and impact factors presented as weight per unit area

Roof : 10 kg/m²

Wooden floor and corridor of storage : 2,000 kg/m²

Concrete foundation of storage	2,000 kg/m ²
Concrete foundation of rice processing building	2,000 kg/m ²
Timber structure	800 kg/m ²

- Wind load : 50 kg/m²

(c) Use of building materials locally available will be maximized in due consideration of supplying capacity and construction methods.

(ii) Structures and materials

(a) Super structures

Taking into account the purpose of buildings, maximum use of local materials, accuracy expected, construction schedule and period, etc., super structures of buildings will be constructed by wooden materials. As minimum span of building frame will be 10 m long, its structures will be of wooden trusses.

(b) Foundation

Reinforce concrete will be used for the foundation of buildings without foundation piles.

(c) Strength of materials

- Concrete: 28 days compressive strength : 180 kg/cm²
- Reinforcement steel: Allowable tensile strength : more than 1,600 kg/cm²
- Timber: Allowable compressive strength : 60 kg/cm²
Allowable tensile strength : 70 kg/cm²

(3) Finishing

(i) Exterior finishing

- (a) Roof : Corrugated asbestos slate
- (b) Wall : Wooden plate with finishing by oil paint

(c) Doors, etc: Storage: Steel rolling shutter, wooden frame window, louver
Rice processing building: Steel rolling door, wooden frame window, louver

(ii) Interior finishing

(a) Storage : Wall : Ply-wood
Floor : Wooden flooring
(b) Rice processing buildings: Floor : Concrete metal trowel

(4) Facilities design

(i) Electric facilities

a) Power sources

Extension of power transmission line of 22 kV from the irrigation pump station to Tha Som Mo village will be carried out by the Government of Lao PDR. While, power for another two villages will be supplied from the adjacent 22 kV transmission lines.

b) Branch, transformation and distribution

Since no transformation is available in the three (3) villages, the following facilities to distribute power from the transmission line to rice processing and storage facilities will be constructed.

- Branch and transformation

Distribution lines will be branched off from the existing high tension transmission line within a distance of 300 m long, and transformer will be installed at the branching point. Transformer steps down the power from 22 kV to 380/220V. Distribution lines will be of 3 phases 4 wires with 50 Hz.

- Distribution line

Distribution lines will be installed from the transformer and those outlines are as follows:

Description	The Som Mo Villa.	Oudon Phol Villa.	La Khouay Villa.
1. Branch Line	150 m	200 m	300 m
2. Receiving, Distribution Panel	provide	provide	provide
3. Electric Motor	ditto	ditto	ditto
4. Lighting Facilities	ditto	ditto	ditto
5. Convenience Outlet	ditto	ditto	ditto
Sub Total for 3,4,5	30 kW	30 kW	30 kW
Others	30 kW	5 kW	5 kW
Total	60 kW	35 kW	35 kW
Capacity of Transformer	100 kVA	50 kVA	50 kVA

(ii) Plumbing and sanitary facilities

No water distribution and drainage facilities will be provided. Rain water will be drained off through natural infiltration into the ground and through unlined drainage ditches provided around the facilities yard.

(5) Plan of equipment

(i) Basic concept

Equipment introduced into the Project are huskers and rice mills. The following basic concepts in establishing the equipment plan were set out in consultation with the Lao Government authorities concerned:

(a) Grade of equipment

- Stressing the after-care services of equipment, such equipment as expecting the easy operation and maintenance including regular check and prompt supply of spareparts should be selected.
- Equipment should be operated with low cost and maintained without difficulty.
- Equipment should be equivalent or similar to those prevailed in Laos (mostly made in Thailand)

(b) Optimum scale of equipment

The following principles should be adopted in selecting of the type of equipment, its capacity and number of equipment:

- Rice mill should be combined type with huskers, with minimizing broken rice and having a function to select the grain size and quality, but not requiring the high techniques in operation of equipment.
- Capacity of equipment should be decided by the processing requirement. Equipment shall be of ready-made and standard types as much as possible.
- Bucket elevators will be employed for connecting respective equipment. However, throwing raw grains into equipment and handling of products will be done by man-power.
- A required processing capacity of rice mill is calculated theoretically at 400 kg/hr for Lat Khouay village, of which milling quantities are expected to be largest among three (3) villages. However, rice mill with larger size than calculated will be desired, about 750 kg/hr, in due consideration of minimizing broken rice.

(ii) Outline of equipment

The rice processing facilities with same sizes will be installed at the respective three villages and its rice processing capacity is proposed to be 750 kg/hr in paddy. The results of study on required equipment composing a processing facilities in those functions and capacities are shown as follows:

(a) Paddy siever	:	1 unit
(c) Whitner	:	1 unit
(d) Bucket elevator	:	2 units
(e) Separator	:	1 unit
(f) Motor	:	1 unit
(g) Hopper, shute, etc.	:	L.S.
(h) Bolt, nut, etc. for installation of facilities	:	L.S.

5.3.13 Rural water supply system

(1) Basic design concept

Basic design for rural water supply is prepared for two different types of villages. i.e. (i) village with relatively dense population and (ii) villages with scanty population. The following factors and conditions are taken into account for designing.

(i) Facilities for villages with relatively dense population

Tha Ngon, Ban Na, Oudom Phol and Lat Khouay are belonging to those villages.

- (a) Design standard and laws for controlling the water quality: Japanese standards for small water supply system are applied except for controlling the water quality due to the lack of relative laws in Lao PDR.

The water quality will be checked by application of the norms specified in the documents obtained in the field investigation.

- (b) Supply discharge: 60 l/man.day in the dry season. The discharge will be checked through the drilling tests of deep well which are scheduled to be carried out in the detail design stage.

- (c) Filtering and sterilizing: The treatment of filtering and sterilizing is omitted in due consideration of the water provided by the well.

- (d) Others: The plan enables to fit for an eventual extension of the facilities. For acquiring flexibility, simple and solid equipment is adopted.

(ii) Facilities for villages with scanty population.

The villages are new and old Tha Som Mo, Keng Khai and Lat Khouay.

- (a) Design standard for water quality: The norms above mentioned in (a) are adopted. The criteria for drilling the well are referred to those in empirical use by MAFIC of Lao PDR.

- (b) Others: Pumps are of manual type due to unavailability of electricity.

(2) Optimum scale of the facilities.

Optimum scale of facilities constructed in the different types of village is determined taking into consideration the following factors.

- (i) Villages with relatively dense population: Daily discharge of 60 l/man and estimated population in 1991.
- (ii) Villages with scanty population: Discharge replying on the demand in emergency case, for example, infectious outbreak or occurrence of muddy water in the wet season.

(3) Outline and siting of the facilities.

The facilities are designed so that they could be a model for improving sanitary and working conditions in the frame of rural development going on in the Vientiane prefecture. The main features are given in Table 5.18, and the summary is shown as follows,

Table 5.18 PLAN OF RURAL WATER SUPPLY SYSTEM

NO.	DESCRIPTIONS	NAME OF VILLAGES										KENG KHAI	TOTAL	
		THA NGON		THA SOM MO		OUDOM PHOL		LAT KHOUAY		OLD	NEW			S-TOTAL
		I	II	S-TOTAL	BAV MA	OLD	NEW	S-TOTAL	OLD					
1.	Nos. of Household in 1986	249	249	498	166	30	61	92	159	28	171	199	76	1,189
2.	Population in 1986 (G.R = 2.9 %/Y)	1,299	1,299	2,597	1,112	201	403	604	886	145	869	1,014	432	6,645
3.	Population in Planned Year in 1991	1,498	1,498	2,996	1,283	232	465	697	1,022	167	1,003	1,170	498	7,666
4.	Water Demand in 1991, Case A: 60%/cap/day Case B: 90%/cap/day	90 m ³	90	180	77	14	28	42	61	10	60	70	30	-
5.	Yield of Tubewell, Case I (1%/sec. x 16 hrs) % of Satisfaction for Case A % of Satisfaction for Case B	135	135	270	115	21	42	63	92	15	90	105	45	-
	Case II (1.5%/sec. x 16 hrs) % of Satisfaction for Case A % of Satisfaction for Case B	58 m ³ /d	58	116	58	(58)	(58)	(116)	58	(58)	58	(116)	(58)	-
	% of Satisfaction for Case A % of Satisfaction for Case B	64 %	64	64	75	414	207	276	95	580	97	165	193	-
	% of Satisfaction for Case A % of Satisfaction for Case B	43 %	43	43	50	276	138	184	63	387	64	110	129	-
	% of Satisfaction for Case A % of Satisfaction for Case B	83 m ³	86	127	86	-	-	-	86	-	86	-	-	-
	% of Satisfaction for Case A % of Satisfaction for Case B	96 %	96	96	112	-	-	-	141	-	143	-	-	-
	% of Satisfaction for Case A % of Satisfaction for Case B	64 %	64	64	75	-	-	-	93	-	96	-	-	-
6.	Kind of Well: Deep Tubewell = DT Shallow Tubewell = ST	6" x 50m	6" x 50m	2 wells	6" x 50m	6" x 20m	6" x 20m	2 wells	6" x 50m	6" x 20m	6" x 50m	6" x 20m	6" x 20m	5 wells
7.	Kind of Pump: Motored pump = MP Hand pump = HP	MP	MP	2 pumps	MP	HP	HP	MP	MP	HP	MP	MP	HP	5 pumps
8.	Regulating Reservoir, Concrete made	50 m ³	50 m ³	100 m ³	50 m ³	-	-	-	50 m ³	-	50 m ³	-	-	4 pumps
9.	Water Supply Pumping Set	MP	MP	2 pumps	MP	-	-	-	MP	-	MP	-	-	5 pumps
10.	Source of Electricity, from Commercial line From step-down transformer to be set	C.Line	C.Line	-	C.Line	-	-	-	(TR)*	-	(TR)*	-	-	5 pumps
11.	Elevated Steel Water Tanker w/acc.	5 m ³	5 m ³	2 tanks	5 m ³	-	-	-	5 m ³	-	5 m ³	-	-	1 set
12.	Distribution Pipeline, 100mm (SP&PVC) 80-50mm (SP&PVC) 32-25mm (SP&PVC) Sub-total	500 m	800 m	1,380	610	-	-	-	1,160	-	1,210	-	-	5 tanks
		1,540	1,600	3,140	2,650	-	-	-	2,430	-	1,490	-	-	4,360
		990	1,380	2,370	1,660	-	-	-	1,430	-	1,160	-	-	9,710
13.	Nos. of Washing Place/Nos. of Public Taps	3,030	3,860	6,890	4,920	-	-	-	5,020	-	3,860	-	-	6,620
		-	-	-	-	-	-	-	-	-	-	-	-	20,690

Remarks: * The electric power for the Oudom Phol and Lat Khonay pumps shall be supplied from a transformer installed near the Pig Multiplication Center.

(i) Facilities to be installed in the villages with relatively dense population:

(a) Water source: Deep well (Tube well), diameter 150 mm, depth: about 50 m, anticipated pumping discharge: more than 1.5 l/sec (Discharge of 1.5 l/sec is corresponds to 50 l/man.day in Tha Ngon and 60 l/man.day in Ban Na, Oudom Phol and Lat Khouay)

(b) Pumping method: Electric submersible pump, 40 Dia.mm, total pumping head: 40 m, pumping capacity: 150 l/min, 2.2 kW, equipped with automatic cut-off system at low water level.

(c) Regulating pond: Concrete tank with an effective storage capacity of 45 m³.
The capacity was calculated based on the peak demand occurring in the morning and the evening.

(d) Booster pump: This pump is installed for lifting up the water from the regulation pond to the elevated metal tank. 50 Dia.mm, total pumping head: 20 m, pumping capacity: 350 l/min, 2.2 kW, equipped with automatic on-off system.

(e) Elevated tank: Steel tank, height: 15 m, effective storage capacity: 5 m³.

(f) Supply pipe: Steel or PVC pipes with a diameter from 100 mm to 25 mm, combined total length: about 21 km.

All the pipes are buried in the ground and protected with a steel or concrete pipe for the portion where the pipe crosses the road.

(g) Washing place and tap: One tap for 10 families is installed, accompanied with construction of a washing place.

(h) Power supply: Electricity is supplied by direct branching-off from the existing line in Tha Ngon and Ban Na and by installing a transformer in Oudom Phol and Lat Khouay. The distance between the existing line and the pump house is less than 500 m.

(ii) Facilities to be installed in the villages with scanty population:

(a) Water source: Shallow well (Tube well), diameter 100 mm, depth: about 20 m.

The wells will be constructed along the Nam Ngum river. The pumping discharge is anticipated to be 0.5 l/sec which corresponds to water quantity required by the population of about 500 people.

(b) Pumping method: Line shaft pump (manual type).

(4) Installation plan

The plan for installing the pumping system was prepared taking into consideration the following factors:

(a) Facility and simplicity in operation,

(b) High safety and long durability,

(c) Economization on cost, and

(d) Easy operation and maintenance.

Electricity will be supplied by direct branching-off from the existing line for the pumps to be installed in Tha Ngon and Ban Na villages. As for the pumps in Oudom Phol and Lat Khouay, one transformer with a capacity of 30 kVA will be installed near the pig multiplying center located between two villages. The electric source is rated for three phases, four lines with a voltage 380/220; the frequency is 50 Hz.

(5) Training plan for operation and maintenance.

Adequate operation and maintenance will be realised in accordance with the following training program.

(a) Operators

Operators will be trained in parallel with installing the supply pipes during the construction period and through the actual operation of equipment after installation.

(b) Staff for maintenance and repairing

The staff for maintenance and repairing will be trained in collaboration with the Japanese experts during the construction period.

(c) Manuals for operation, maintenance and repairing

Manuals written in English will be prepared for adequate operation, maintenance and repairing of the facilities.

5.3.14 Supply of O&M equipment and farm machinery

(1) Basic concept

(i) Machinery and equipment are made in Japan, conforming to the Japanese Industrial Standards, or equivalents.

(ii) Sophisticated machinery and equipment are excluded.

(iii) Importance is put on the availability of spare parts. Selection will be made, taking into consideration the models which are prevailing in Lao PDR or Thailand.

(2) Selection of machinery and equipment

(i) Construction machinery to be provided for the proposed Tha Ngon O&M Office.

(a) Bulldozer, swamp type, 10 t 1 unit

This model is adopted, taking into consideration workability both in the paddy fields and borrow pits of laterite.

Land consolidation: Land levelling is generally made after harvesting to before transplanting. The farm plots with considerable undulation are graded and levelled during the dry season.

Rehabilitation of farm roads: The farm roads with total length of 29 km are rehabilitated immediately after the wet season and at the end of dry season.

The rehabilitation works are interrupted between June and September.

- (b) Excavation machinery, clam shell with a capacity of 0.6 m³ and crane with a hook
1 unit

This machinery will be used for maintenance of drains, and operated between January and April. It is selected for the reasons that the drainage canal is wide, and it will also be used for maintenance and repairing the irrigation and drainage pumps.

- (c) Backhoe with a capacity of 0.1 m³ 2 units

Backhoe will be mainly used for rehabilitation works of the Tha Ngon Scheme to be carried out by the Government of Lao PDR. After completion of above works, the backhoe will be used for maintenance and repairing of farm lateral canals. Taking prospective canal length of about 30 km into consideration, two units of backhoe are necessary.

- (d) Wheel loader, 1.7 m³ 1 unit
Dump truck, 6 t 2 units

These machines will be used for maintenance and repairing works of the farm roads. The wheel loader charges the laterite into the dump truck, and two dump trucks transport it to the site over a distance of about 3.5 km.

- (e) Pick-up truck, double cab., 4 wheels 2 units

These pick-ups will be used for operation and management of the Project.

- (f) Motor grader, 9 t 1 unit
Road roller, 10 t 1 unit

Laterite transported by dump trucks is spread and levelled by the motor grader. Compacting works are made by the road roller. These machines will be fully operated during the dry season because of many roads to be maintained, such as farm roads in the Scheme, rural and public roads around the Scheme.

- (g) Plate compactor, 100 kg 4 units

Compacting works around the structures will be made by the plate compactor. These works are scheduled to be carried out in the dry season. Taking into consideration the scattered working places, 4 units of machine are arranged.

(h) Pumps

- 1) Electric pump with pontoon, delivery hose (Dia.100 mm) and pipes 5 sets

The electric pump will be used for water supply to the paddy fields and the fish pond during the construction period. The pumps of 5 sets consist of 1 set for the fish pond, 2 sets for the paddy field of Tha Som Mo, 1 set for the paddy field of state farm and 1 set for the paddy fields of Lat Khouay and Oudom Phol.

- 2) Electric pump, self suction type, hose 100 Dia.mm 1 set
- 3) Electric pump, self suction type, hose 50 Dia.mm 2 sets
- 4) Pump driven by engine, self suction type, hose 50 Dia.mm 2 sets

Remark: The pumps mentioned in (2) to (4) will be used for dewatering of maintenance and repairing of canals and structures.

(i) Other instruments

- 1) Gas cutter (cylinder, nozzle, and so on) 1 set
- 2) Portable welder driven by engine 1 set

They will be used for repairing gates in the project area and pumps for the rural water supply system.

(ii) Farm machinery to be provided for the cooperatives

- (a) Tractor, 65 HP, equipped with 3-point hitch 3 units

Tractor with a power of 65 HP is most suitable for the paddy fields. These tractors will be supplied to the main three cooperatives such as Tha Som Mo, Lat Khouay and Oudom Phol.

(b) Attachments 5 units

These attachments will be attached to the above tractors of 3 nos. Other than the said attachments, additional attachments of 2 units will be supplied to the villages which face shortage of attachment.

1) Plough 5 units

Remaining two units will be supplied to the cooperative of Tha Som Mo.

2) Disc harrow 5 units

Remaining two units will be given to the cooperative of Tha Som Mo.

3) Puddler, 3.6 m 5 units

One of the remaining two units will be furnished to the cooperative of Tha Som Mo, and the other to the cooperative of Ban Na.

4) Trailer, 4 t 5 units

One of the remaining two units will be provided to the cooperative of Tha Som Mo, and the other to the cooperative of Ban Na.

(c) Thresher driven by diesel engine 5 units

Each one unit is supplied to 5 cooperatives such as Tha Ngon, Ban Na, Tha Som Mo, Lat Khouay and Oudom Phol.

(d) Combine-harvester 3 units

This machine will be supplied to the cooperatives of Tha Som Mo, Oudom Phol and Lat Khouay for accelerating harvesting works after the completion of the Project.

(c) Spare parts

lump sum

Shortage of spare parts disturbs the effective operation of machinery and equipment. Considering smooth operation of the Scheme, stock of spare parts is essential. Appropriate spare parts will be supplied.

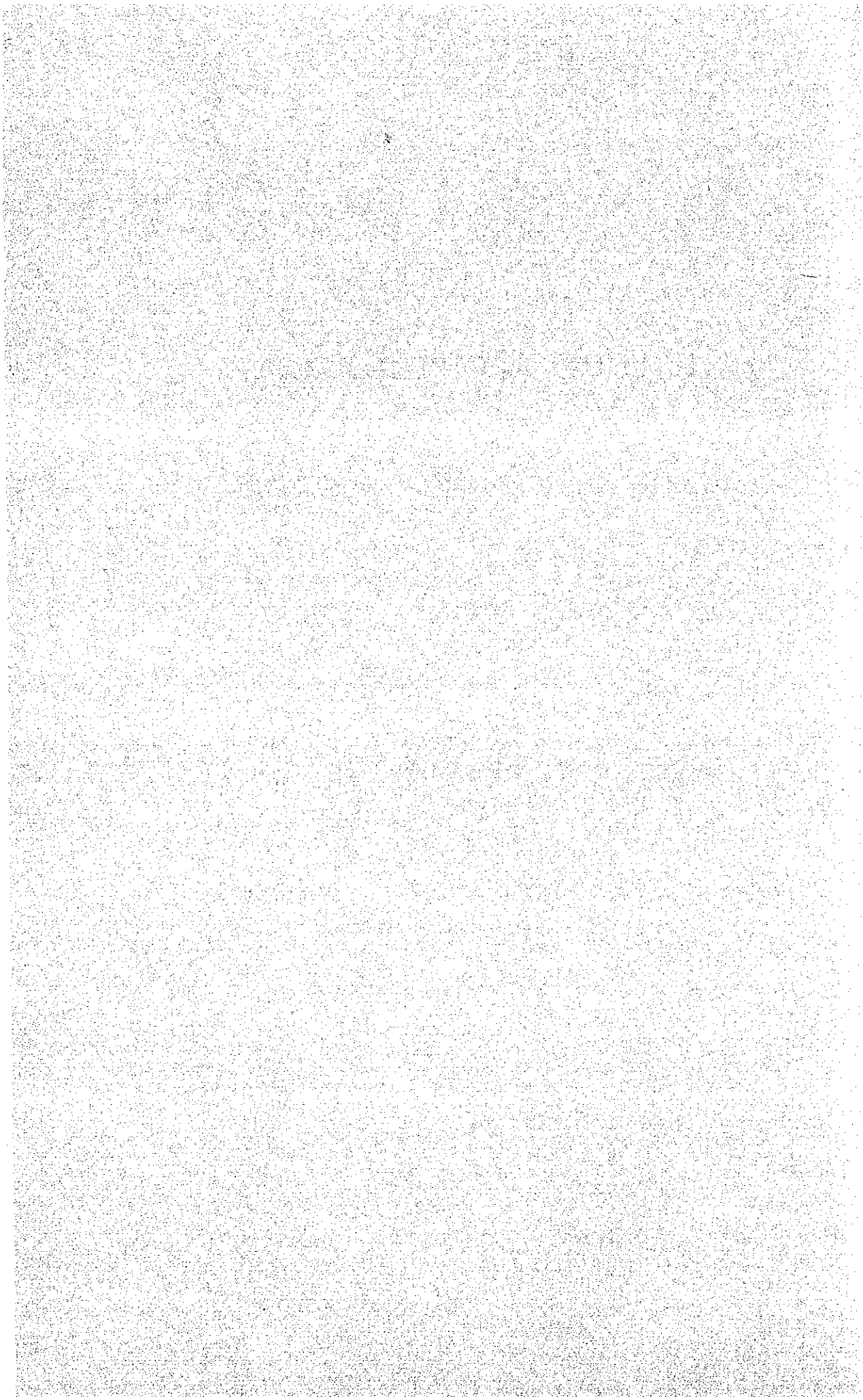
(3) Delivery and plan for training operation staff.

(i) All the machinery and equipment to be supplied will be transported to the project area, assembled in the designated place and handed over with spare parts to MAFIC.

(ii) Operation staff nominated by MAFIC will be trained for a few days.

(iii) List of spare parts and manual written in English will be submitted.

6. EXECUTION OF THE PROJECT



6. EXECUTION OF THE PROJECT

6.1 Organization of Project Execution

The Ministry of Agriculture, Forestry, Irrigation and Cooperatives (MAFIC), the Government of Lao PDR will become the execution agency for the Project. The Minister of MAFIC will be responsible for overall execution of the Project, who will be supported by directors of both Planning and Irrigation Departments. Present organization chart of MAFIC is illustrated in Fig. 6.1.

Tha Ngon Project Office will be established in the project area for smooth and effective construction of the project. The office will be controlled by MAFIC. After the implementation of the Project, the Tha Ngon Project Office will be reorganized to the office for operation and maintenance.

The overall organization for the Project execution is outlined as follows:

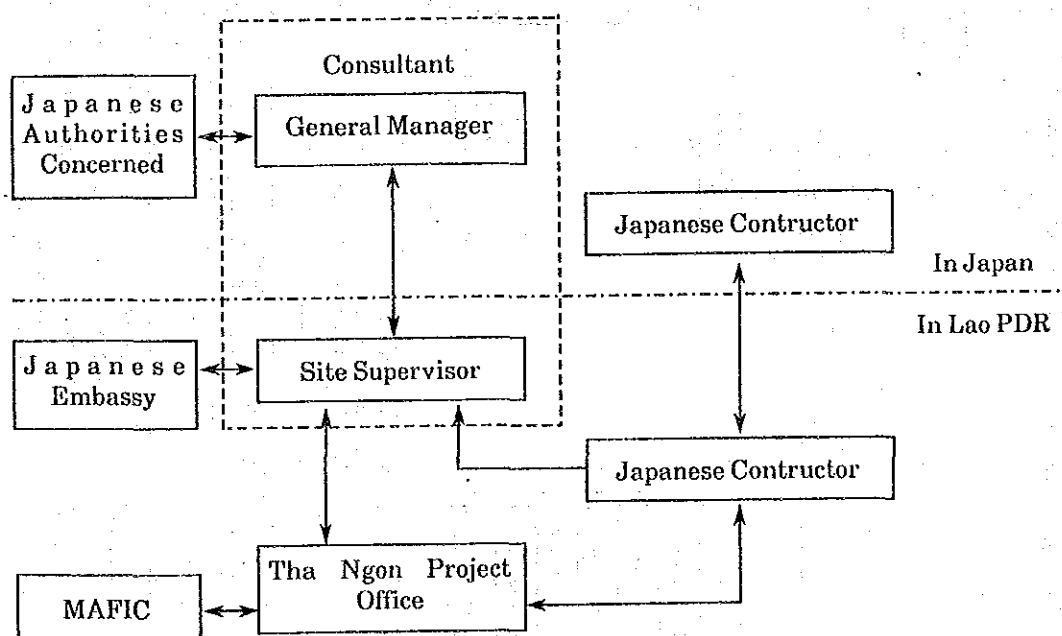
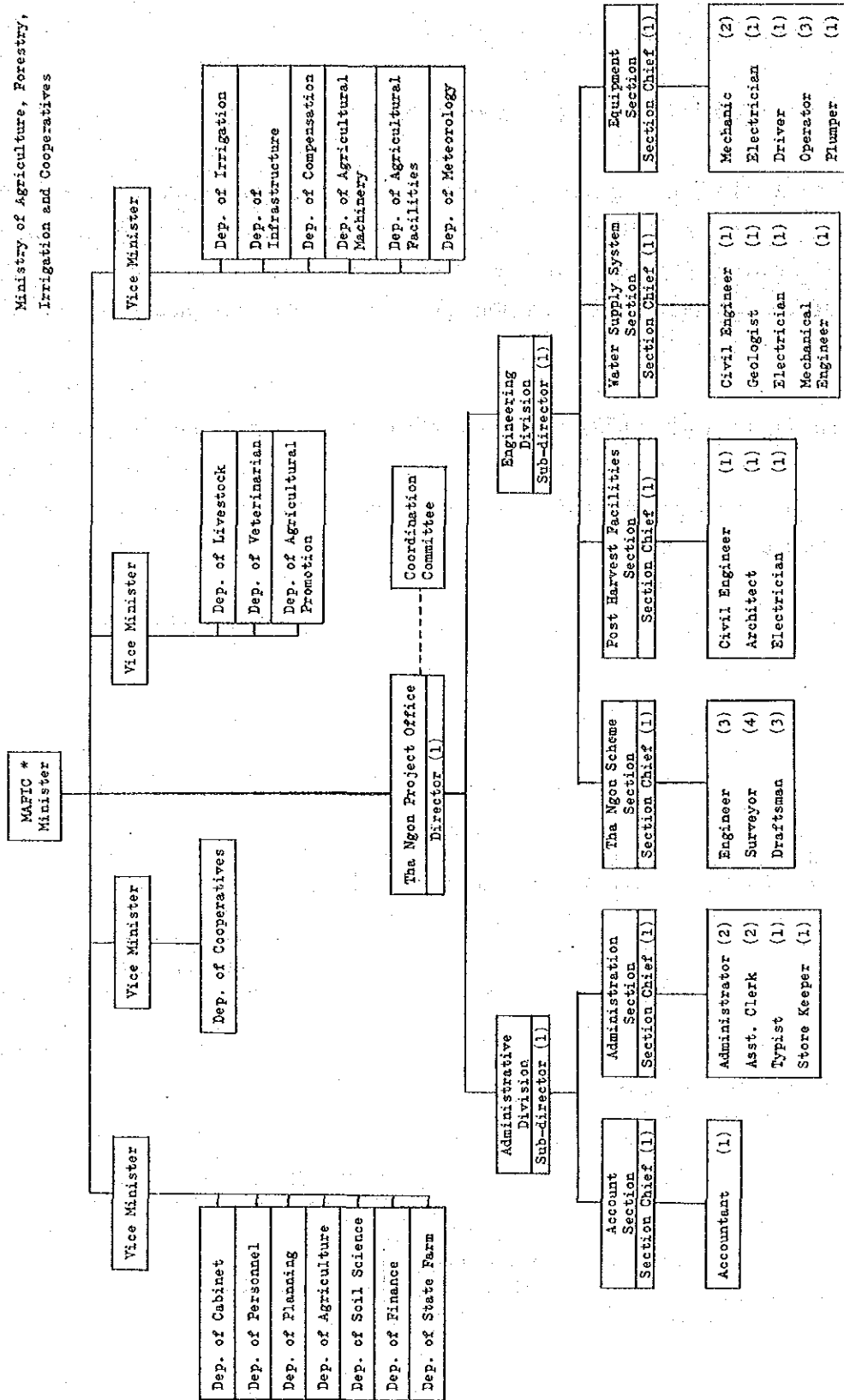


Fig. 6.1 ORGANIZATION OF MAFC AND PROPOSED THA NCON PROJECT OFFICE

Ministry of Agriculture, Forestry,
Irrigation and Cooperatives



6.2 Scope of the Work

Scope of Tha Ngon Rehabilitation and Rural Development Project covered under Japan's Grant Aid Program is outlined as follows (The details are shown in Chapter 5);

- (1) To rehabilitate main irrigation and drainage canals in the Tha Ngon Scheme,
- (2) To rehabilitate main farm roads, and to construct rice processing and storage facilities and rural water supply systems in the existing 6 villages around the project area, and
- (3) To supply equipment and spare parts necessary for operation & maintenance of the Project and farming.

While, the major understanding to be taken by Lao PDR for the executing the project below:

- (1) To furnish data, drawings and documentations necessary for the detailed design,
- (2) To ensure customs clearance of the existing pump equipment which will be repaired in Japan and their tax exemption,
- (3) To ensure transportation through Thailand, unloading and customs clearance and tax exemption at port of disembarkation in Lao PDR for equipment, apparatus, materials, vehicles and tools necessary for the Project,
- (4) To ensure tax exemption for the consultant and contractor engaged in the project execution,
- (5) To issue visa, traffic certificates and other certificates necessary for execution of the Project to the consultant and contractor,
- (6) To ensure payment of contract to consultant and contractor,
- (7) To secure and reclaim the lands for the construction of rice processing and storage facilities and to extend electric power line to the Tha Som-Mo village,
- (8) To properly maintain project facilities after the completion of the Project,

- (9) To arrange labor forces and construction machineries to Japanese consultant and contractor, and
- (10) To issue certificate for purchasing fuel for vehicles and machineries for Japanese consultant and contractor.

The consultant will assist MAFIC for technical management of the Project following the principle of Japan's Grant Aid Program and take charge for the undermentioned works:

- (1) To confirm the basic design on the Project and the project budget through the field survey for the detailed design,
- (2) To prepare the detailed design and the implementation program prior to the preparation of the tender documents,
- (3) To prepare the tender documents, to evaluate the results of tendering and to attend the negotiation and contract between MAFIC and the tenderer or the contractor,
- (4) To supervise the construction of project works concerned,
- (5) To study and approve the contractor's drawings, to inspect products before shipment and to supervise installation, adjustment and tests on equipment and apparatus,
- (6) To confirm with MAFIC and the contractor on the business concerned with the Project,
- (7) To prepare the reports, certificates for progress and to inspect the progress,
- (8) To prepare the completion certificate and maintenance certificates and to handover the Project to MAFIC,
- (9) To prepare the operation and maintenance manual for the project facilities, and
- (10) To provide the technical guidance with the MAFIC staff during the construction period.

The contractor will carry out the following undertaking:

- (1) For overhaul and repair of existing pump equipment, to take out them from Laos and to reinstall them in Laos after completion of overhaul and repair,

- (2) To manufacture pump equipment, gates and materials related to the Project,
- (3) To test the above-mentioned products in the factories in the presence of the consultant,
- (4) To bear packing for export and sea/inland transportation of the products from the factories to the project area,
- (5) To inspect the existing pump equipment and to repair the pump equipment,
- (6) To rehabilitate the existing irrigation and drainage facilities,
- (7) To rehabilitate the farm road and to construct rice processing and storage facilities and rural water supply system,
- (8) To manufacture equipment, apparatus materials, vehicles and tools for operation/maintenance of the Project and for farming, to test the products in the presence of the consultant, to bear packings for export and transportation of the products from the factories to the project site,
- (9) To insure all the products and field activities for the above mentioned works,
- (10) To provide technical guidance on maintenance of equipment supplied under the Project during the period of the field works, and
- (11) To ensure guarantee the project facilities and equipment for one year after delivery of the above mentioned facilities and equipment.

6.3 Implementation Plan

The Project will be executed in the formation and scope of works as stated in 6.1 and 6.2 mentioned above. The following are problems which may occur in the project execution, and countermeasures against the problems.

(1) Construction of electric power line

Electric power line (22 kV) of about 4.5 km will be necessarily installed from the existing power grid to the Tha Som Mo Village in which the rice processing storage facilities will be constructed. The construction cost of this electric power line installation is provided by Lao

PDR and construction of electric power line will be executed by EDL that have had various experience for the construction of such works. Since irrigation water (in dry season) during the construction period is planned to be supplied from the pump installed with boat of which electric power depends on the power line from Tha Som Mo village. Construction of extension of electric power line should be commenced immediately after agreement of E/N and should be completed at the end of September, 1987. The preliminary cost for extension of electric power line is estimated at about Kip 3,650 thousand.

(2) Land acquisition and land levelling

Land acquisition and land levelling works necessary for the construction of rice processing and storage facilities will be in charge of Lao PDR. These land acquisition and land levelling works should be completed before the construction. The site proposed for the land has been decided in the basic design period and prompt action of Lao PDR is expected for land acquisition and land levelling.

(3) Supplemental irrigation water supply during the construction period

The supply of irrigation water to the existing irrigated land can not be carried out during the construction period due to overhaul of the pump and rehabilitation of irrigation canals. It is agreed with both the Government of Lao PDR and the basic design team in the basic design period that the existing irrigated land will be cultivated under rainfed during the wet season. However irrigation water supply to the existing irrigated land of about 110 ha should be done during the dry season. And water supply to the existing fishery pond during the construction period is also essential. For the purpose five sets of pontoon type pumps will be installed. These sets, therefore should be sent to the site by the beginning of October, 1987, when the existing pumps are dismantled for overhaul in Japan. Prompt action by contractor and strong support by Lao PDR for installation of pump sets are expected. It is also hoped that unification of irrigated lands during the dry season and excavation of temporary irrigation canal will be executed under strong support of Lao PDR.

For effective and smooth execution of the Project, strong framework of organization is essential for the period from detail design to construction of the project works. Since the project comprises civil works, building works, drilling works and other various kind of works, not only one-site supervision but also short term assigned experts for executing various works will be assigned in site. And back-up support in Tokyo will be also prerequisite for smooth execution of the Project.

The basic design survey team set up the bench mark at the irrigation pump site during the basic design period.

6.4 Implementation Schedule

Overall implementation schedule of the Project is decided taking into consideration i) scale of the project works, ii) construction time, iii) maximum performance period under Japan's Grant Program and iv) climatic and social conditions, as shown in Fig. 6.2. Construction of the project works will be carried out dividing into two phases.

The first phase: Installation of pump equipment and gates, rehabilitation work of irrigation/drainage facilities except north main irrigation canal and supply of equipment, materials and tools for O&M work.

The second phase: Rehabilitation works of north main irrigation canal, and farm roads, and construction of rice processing and storage facilities and rural water supply system.

The construction of north main irrigation canal is planned to be done in the second phase because of the following reasons;

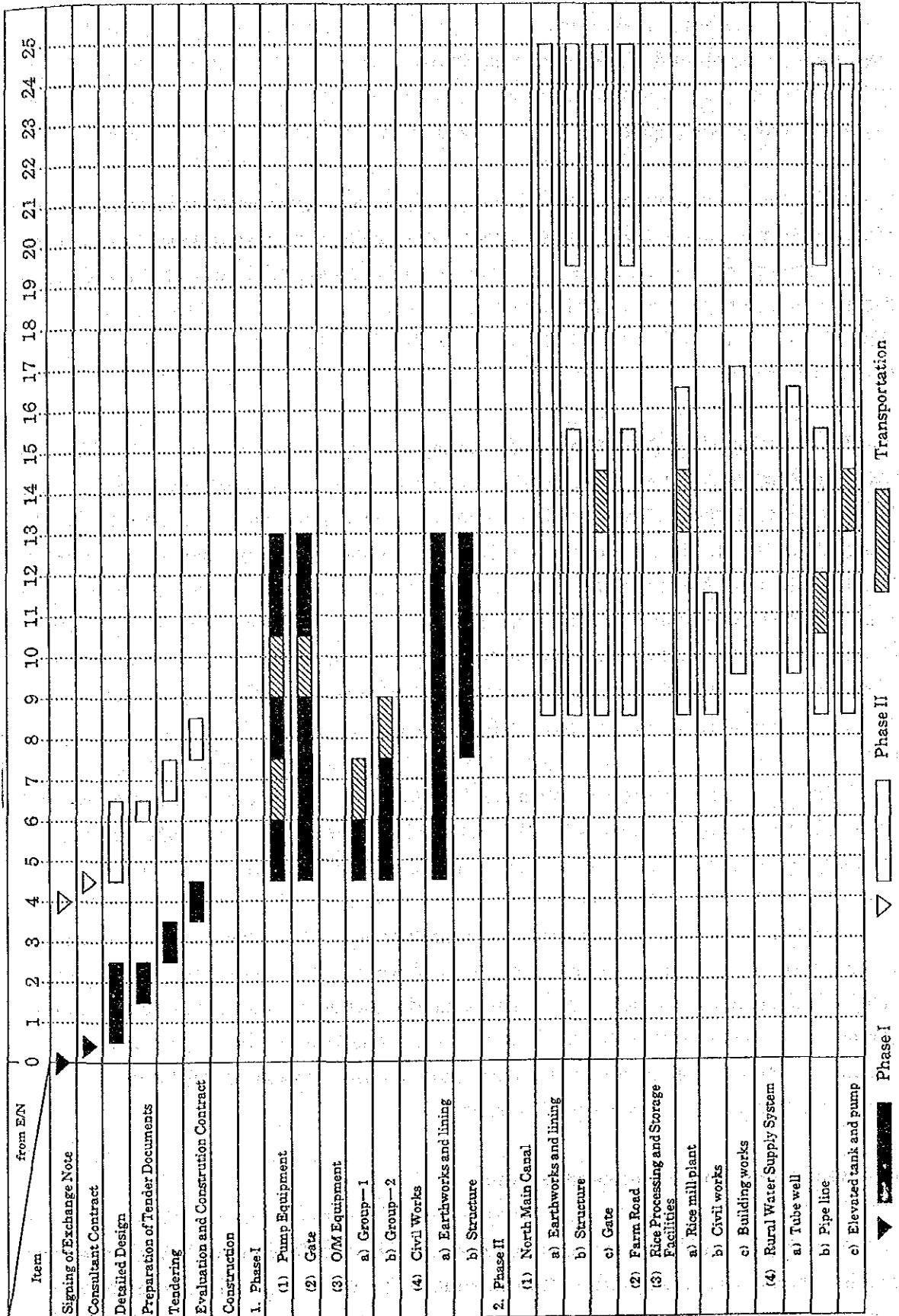
- (i) Rehabilitation works of the canal require long time, and
- (ii) Since north main canal runs in parallel with farm roads, combination construction of north main canal and turnout structures and farm roads at the same time will be effectively done.

Immediately after agreement on the Exchange of Notes with respect to the construction in the first phase (at the middle of February 1987), the contract of consultant will be carried out. The detail design of the Project will be completed for 2 months. Preparation of tender documents, tendering, tender evaluation and contract for execution will be executed for about 4.5 months. The construction of the Project is planned to commence at the beginning of July 1987. The construction requires 8.5 months and will be finished at the middle of March 1988.

The Exchange of Notes on the construction in the second phase will be scheduled to be agreed at the middle of July 1987. As same as the construction in the first phase, performance of works such as detail design, preparation of tender documents, tendering, tender evaluation and contract for execution requires 4.5 months. The construction in the second phase will be

started at the beginning November 1987. The construction period amounts to 16.5 month. The construction will be completed at the middle of March, 1989.

Fig. 6.2 CONSTRUCTION SCHEDULE



6.5 Procurement and Transportation Plan

(1) Procurement of equipment

Materials procurable in Laos are fuel and oil, timber, aggregate materials and concrete pipe. Other materials and equipments except cement will be procured in Japan. Cement will be procured in Thailand due to the lowest cost. Manual-pumps will be procure from Thailand because such pumps are not available in Japan.

(2) Transportation

Lao PDR imports all kind of goods through the neighboring countries, Thailand and Vietnam at present. Materials and equipments procurable in Thailand and Japan are planned to be transported through Thailand. Cargoes for this project from Japan will be landed at the Bangkok, from where the cargoes will be delivered on trucks to Nong Khai, a border town of Thailand along the Mekong river. Then the cargoes will transit over the river by ferry boats to the port of Thanaleng in Laos. Customs formalities are necessary at both Nong Khai and Thanaleng. In principle goods for Laos through Thailand are free from tax on custom clearance and export duty. The roads connecting Thanaleng with the Tha Ngon project site are well paved and transportation by trucks is functioned.

Under such circumstances of transportation system, packing for most of equipments and materials necessary for the Project is divided into two packing, i.e. case packing for instruments and crate packing for pump, gate, O&M equipment, etc.

Marine transportation of cargoes from Japan to Bangkok takes 2 weeks. Unloading and custom formalities at Bangkok require at least 2 weeks. Transportation of cargoes from Bangkok to Vientiane is handled with Thailand and/or Laotian businessmen. Transportation of cargoes from loading at Bangkok to Vientiane takes about 2 weeks after preparation of custom clearance. Under such situations of transportation, transportation period for cargoes from Japan to project site is estimated at 1.5 months.

6.6 Operation and Maintenance Plan

As mentioned in Chapter 4, deterioration and improper function of irrigation/drainage facilities in the Tha Ngon Scheme is mainly due to improper operation and maintenance of these facilities. In order to execute proper operation and maintenance of the project facilities

after rehabilitation, special attention should be paid on the following matters; i) to ensure appropriate budget, ii) to set up proper organization for O&M and staffing, iii) to provide appropriate technic for O&M, iv) farmer's better perception and cooperation for O&M and v) well understanding of Central Government to O&M.

At present operation and maintenance of the irrigation systems are executed by local government (prefecture or province). In Vientiane prefecture, State Enterprise operates and maintains 35-small scale irrigation systems in the basin of the Mekong river and its tributaries. Budget, staffing and O&M equipment of the Enterprise are insufficient for proper management of these irrigation systems. It has 23 bulldozers and 120 staffs including labors. Annual budget of the Enterprise in 1985 was Kip 30 million.

After the implementation of the Project, operation and maintenance of the project facilities in the Tha Ngon Scheme will be done by the local government, Vientiane prefecture. The recommended plan for operation and maintenance of the project facilities is shown as follows;

(1) Organization

It is recommended that Tha Ngon O&M Office will be newly established in the local government of the Vientiane prefecture. Structually the office comprises three divisions and 8 sections. This O&M office will operate and maintain not only irrigation systems but also rice processing and storage facilities and rural water supply system. Divisions consist of Administrative Division, Engineering Division and On-farm Water Management Division. Engineering Division will be responsible for O&M with respect to project facilities, rice processing and storage facilities, rural water supply system and O&M equipment. On-farm Water Management Division will take charge of planning of cropping pattern and irrigation schedule in cooperation with cooperatives in the Tha Ngon Scheme.

It is also recommended that the Coordination Committee will be established for smooth execution of O&M work. This Committee will comprise representatives from MAFIC, local government, villages and cooperatives concerned.

(2) Staffing

Total number of staff necessary for Tha Ngon O&M Office amounts to 68. In addition laborers will be temporarily employed for repairing project facility. For smooth O&M work, staff of the Office will be expected to be well trained and professional.

(3) Annual budget

Annual budget of the Tha Ngon O&M Office is estimated at about Kip 12 million as shown below. It is recommended that electric charge should be levied on beneficiaries for smooth O&M work.

Table 6.1 ANNUAL BUDGET

Item	Unit	Amount	Unit Price(Kip)	Total x103Kip)
1. Salaries				
Staff	man-month	68	4,000	3,264
labor	man-day	2,000	400	800
2. Electric charge				
irrigation	kWH	887,400	5.0	4,437
drainage	kWH	76,800	5.0	384
rice mill	kWH	252,000	5.0	1,260
water supply	kWH	45,000	5.0	225
3. O&M equipment	L.S			760
4. Materials & others	L.S			850
Total				11,980

(4) Periodical check and maintenance

In the Tha Ngon Scheme, various kinds of equipment such as pumps, instruments, rice mill facilities, O&M equipment, etc. will be installed. Daily and/or periodical check and maintenance of equipment will be essential. In addition periodical overhaul of the equipment will be required.

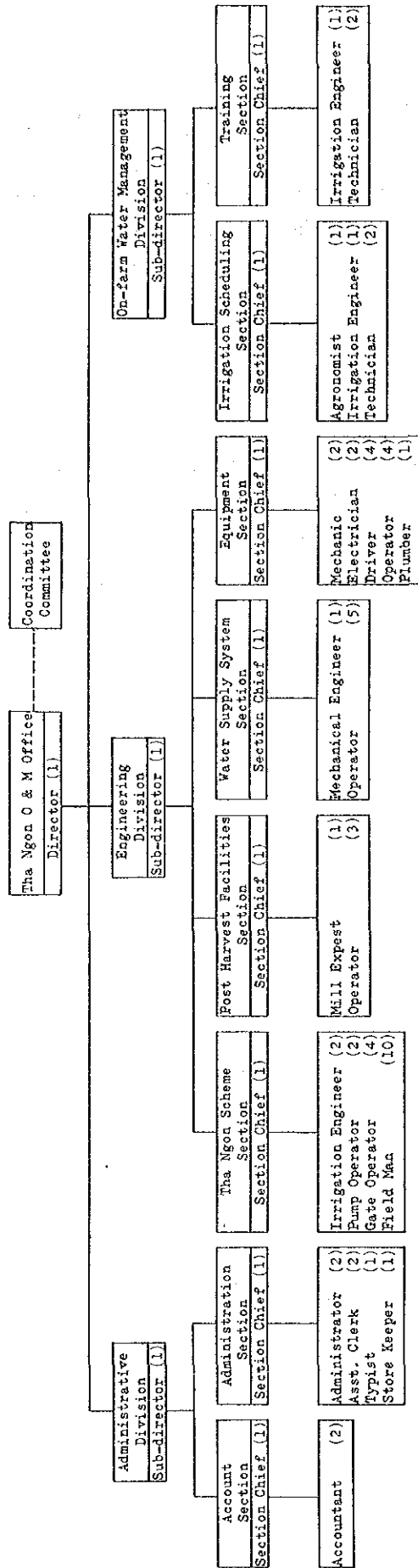
(5) Training and education of farmers

Water management on farm level will be carried out by farmers of cooperatives. So periodical training and education on irrigation farming practice are very important for farmers. Preparation of programs and manuals for training and educating is also prerequisite.

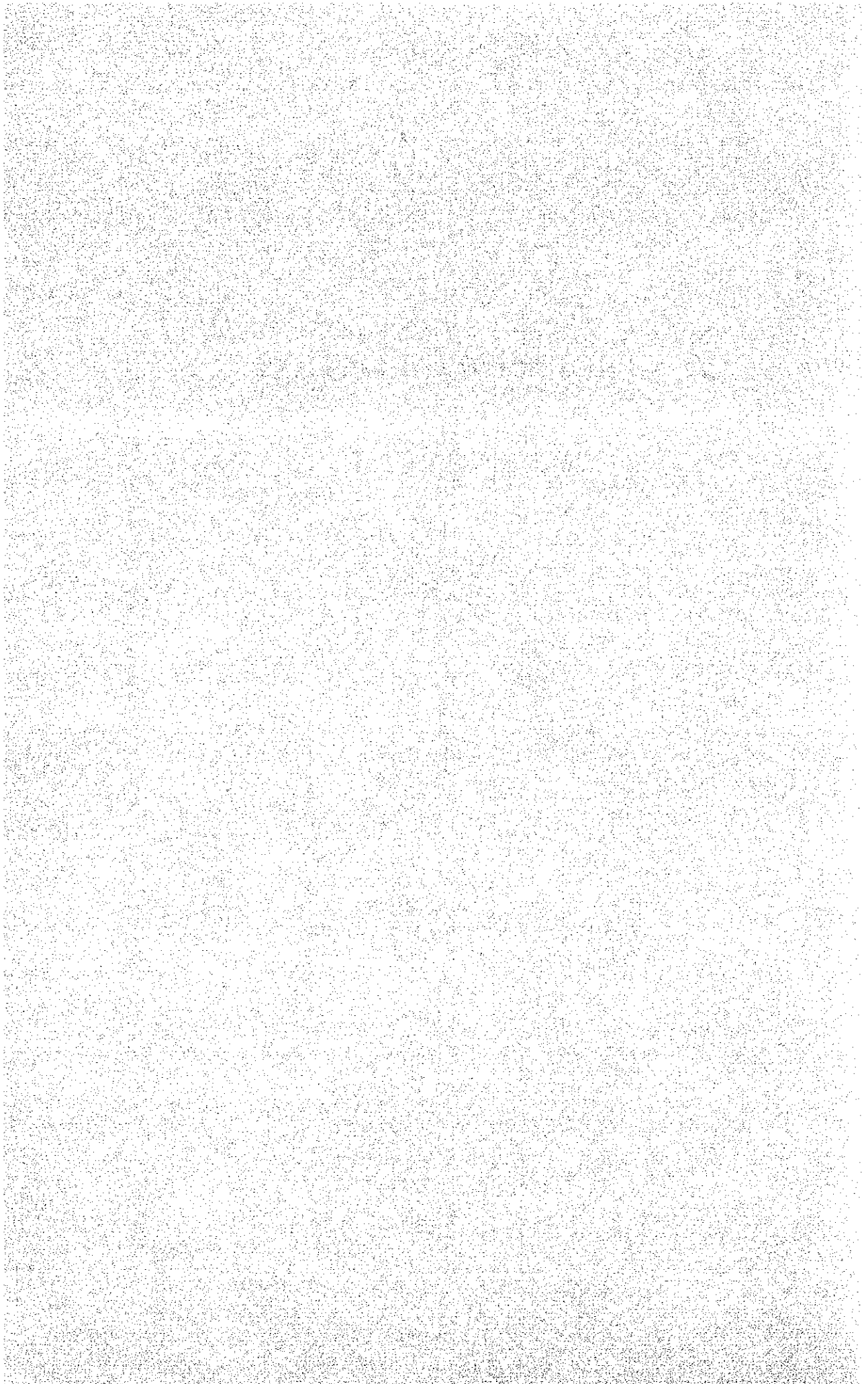
(6) On-farm facility

Under the grant aid, main facilities will be rehabilitated. Rehabilitation of on-farm facilities will be carried out by Lao PDR. Improvement of on-farm facilities is vitally important to execute smooth and effective water management. The rehabilitation work of on-farm facilities will be completed for two or three years by using O&M equipment which will be supplied under the grant aid.

Fig. 6.3 PROPOSED THA NGON OPERATION AND MAINTENANCE OFFICE



7. PROJECT EVALUATION



7. PROJECT EVALUATION

The project benefits to be expected from implementation of rehabilitation of the Tha Ngon Scheme and rural development around the Scheme are: directly i) increase of rice production, ii) improvement of regional traffic and transportation, iii) improvement of rice quality vi) stabilization of food self-sufficiency, v) improvement of living environment, and indirectly i) expansion and reinforcement of cooperatives, (2) demonstration and extension effects on the other projects and (3) improvement of social welfare.

Direct benefits

(1) Increase of rice production

Out of about 800 ha, which is the total farm area of the Tha Ngon Scheme, present cropped areas are only about 300 ha and 115 ha in the wet and dry season, respectively. The present rice production is no more than about 700 tons. With the implementation of the Project, the conditions on irrigation and drainage are expected to be greatly improved so that double cropping of paddy will be realized in 610 ha of the Scheme. The rice production is expected to reach 4,200 tons, an increase of 3,500 tons from the present production.

(2) Improvement of regional traffic and transportation

With the rehabilitation of farm roads and rural roads connecting the farm with the existing trunk roads, the Tha Ngon Scheme area will acquire the year-round access. The rehabilitation of road network will contribute not only to the economic activities in and around the Tha Ngon Scheme, but also to the wider traffic and transportation among regions.

(3) Improvement of rice processing situation

With the construction of the rice processing facilities proposed by the Project, the present rice processing situation in which the occurrence of broken rice is high, will be greatly improved so that it will be expected to contribute to the reduction of milling-loss and thus to the improvement in rice quality.

(4) Stabilization of self-sufficiency in food supply

With the construction of the storage facilities proposed by the Project, storing of increased rice production will be realized so that it is expected to contribute not only to the existing self-supporting type agriculture, but also to the stabilization of food self-sufficiency for the region and thus to play an effective role in the Government's food stock policy which is one of the main objective of the second Five-Year Plan.

(5) Improvement of living environment

With the construction of the rural water supply system, the living environment, especially the health and sanitary conditions in the rural area are expected to be greatly improved.

Indirect benefits

(1) Expansion and reinforcement of cooperatives

In the second Five-Year Plan, the Government of Lao PDR puts stress on the expansion of cooperative activity as one of the agricultural policies. With the implementation of the project which will greatly improve the living environment of the regional inhabitants in general and the cooperative members around the Scheme in particular, it is expected to promote the participation of the neighboring private farmers in cooperatives and thus the expansion and reinforcement of cooperatives.

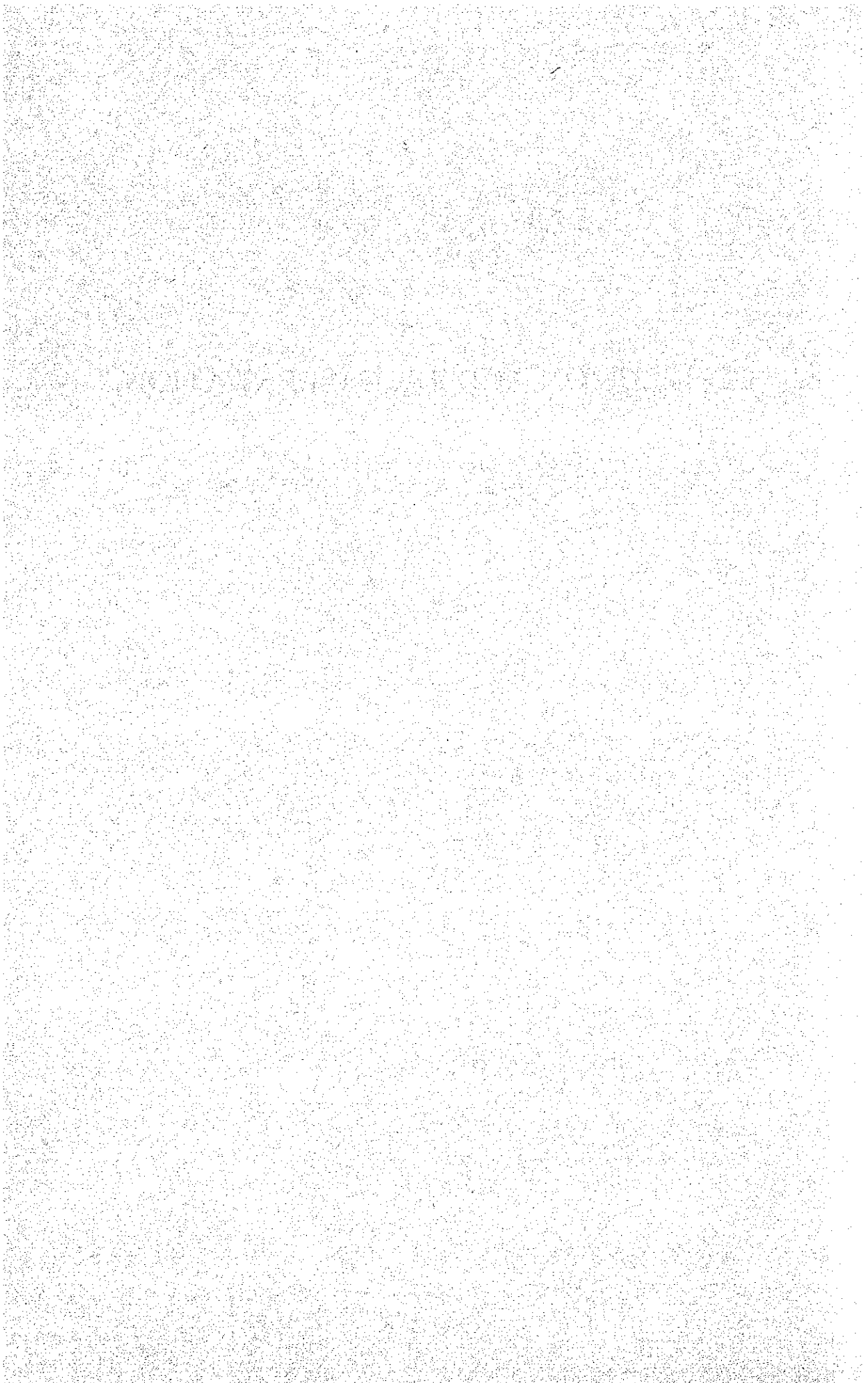
(2) Demonstration and extension effects

As the Tha Ngon Scheme is furnished with the basic conditions for a modernized farm and located near Vientiane (about 25 km north), it is expected to become a model farm which will provide the farmers in Vientiane plain with various demonstrations toward agricultural modernization. Moreover, through the operation and maintenance practices in the Tha Ngon Scheme, it is expected that the Scheme will provide the existing and future irrigation projects in the Vientiane plain with occasions for education and training on the O&M practices.

(3) Improvement of social welfare

The purposes of the Project are not only the rehabilitation of agricultural production facilities, but also include improvement of social infrastructures. Therefore the Project is expected to greatly contribute to the improvement of agricultural productivity and living standard, and thus social welfare.

8. CONCLUSION AND RECOMMENDATION



8. CONCLUSION AND RECOMMENDATIONS

As a result of the field survey and home analysis works, it was found that the direct benefits of the project would be an increase in rice production and farm income, improvement of regional traffic and transportation conditions, improvement of rice processing situation, stabilization of food self-sufficiency and improvement of living conditions. Indirect benefits resulting from the project would be the expansion and reinforcement of cooperatives, demonstration and extension effects and improvement of social welfare. Also it was found that the Project will not only contribute to the development of the rural area surrounding the Scheme, but also perform a role of a leading model farm that demonstrates the operation and maintenance practices for the similar projects in the Vientiane plain. And it was confirmed that there is no organizational problem in the Ministry of Agriculture, Forestry, Irrigation and Cooperatives which will take charge of the project implementation, and also the said Ministry strongly intends to strengthen its operation and maintenance organization toward an independent one.

However, taking account of the financial conditions of the Government of Lao PDR suffering from the chronic deficit on the trade balance, depending on foreign aids for the financial stringency, it seems to be very difficult, if not impossible, to make Lao PDR prepare the project cost.

Considering the above-mentioned situations, the request offered by the Government of Lao PDR is judged to be reasonable. It is concluded that the implementation of the Project which will be expected to fulfill the leading role in the agricultural development in the Vientiane plain and to have great impacts on other development projects, is extremely desirable, and the scale of the Project is favorable and suitable for the grant aid of Japan.

In order to realize the smooth implementation of the Project and the adequate operation and maintenance of the project facilities, the followings are recommended to the Government of Lao PDR:

- (1) immediate implementation and completion without delay of the construction works demarcated for Lao PDR,
- (2) establishing of the construction office under MAFIC (organization and staffing),

- (3) establishing of the O&M organization after the completion of construction works (organization and staffing),
- (4) preparation of adequate budget for the above O&M organization,
- (5) training of the project staff, and
- (6) periodical checkups and maintenance of equipments (pump, instruments, rice milling equipment, etc.).

APPENDICES

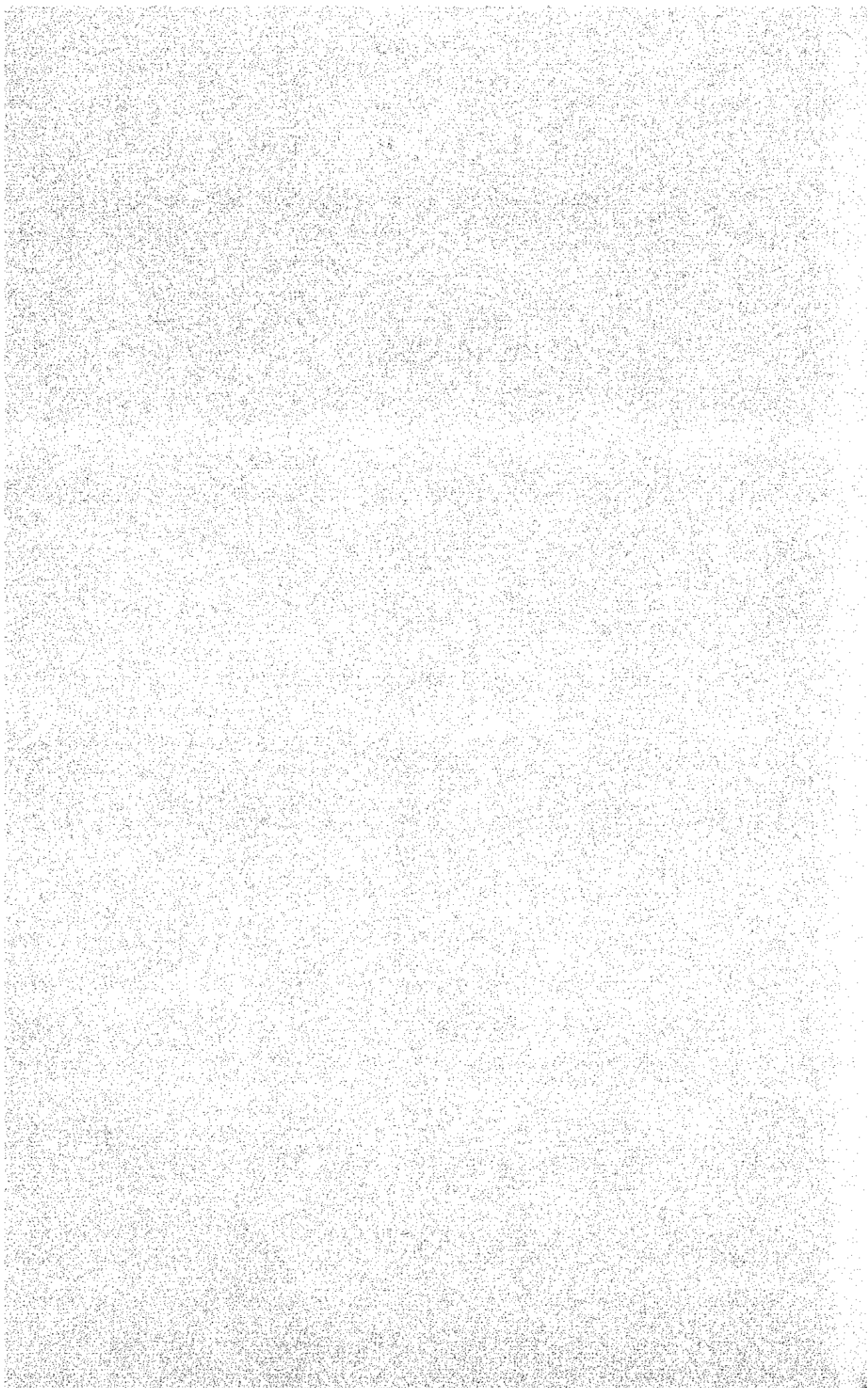


Table-1 MONTHLY RAINFALL

Station: Tha Ngon (Unit: mm)

Year	J	F	M	A	M	J	J	A	S	O	N	D	Total
1971	N	2.3	10.7	20.5	254.2	343.9	255.8	236.2	234.1	123.6	3.0	12.4	1,496.7
1972	N	11.2	93.2	74.1	125.6	216.0	180.4	317.6	120.5	233.9	12.9	2.6	1,388.3
1973	N	N	66.8	61.7	242.7	276.6	321.5	310.8	309.6	21.0	N	N	1,670.7
1974	T	0.1	57.0	60.3	121.9	304.9	280.5	453.9	157.3	N	39.5	0.8	1,478.2
1975	29.5	17.1	57.4	30.6	417.7	402.9	224.5	494.7	325.0	187.3	7.1	N	2,193.8
1976	N	31.8	83.0	106.6	268.4	251.8	337.8	265.9	344.6	28.6	8.7	N	1,727.2
1977	16.4	N	7.8	142.2	227.6	235.9	338.8	354.0	214.7	50.0	9.0	6.2	1,602.6
1978	8.5	5.6	71.4	171.3	360.4	256.4	434.0	261.1	247.1	53.6	28.2	N	1,897.6
1979	N	12.4	1.2	74.3	470.9	260.5	183.6	76.2	192.4	2.8	N	N	1,274.0
1980	N	3.0	97.4	74.5	289.4	543.5	443.0	341.5	430.8	71.2	N	N	2,294.3
1981	N	N	17.4	138.7	347.6	227.2	707.7	249.4	362.7	146.8	18.1	N	2,215.6
1982	N	6.4	36.2	105.1	177.8	204.0	369.5	548.3	495.5	92.2	6.4	N	2,041.4
1983	53.2	10.8	15.6	30.6	67.3	264.9	269.5	399.9	258.0	84.7	N	5.7	1,460.2
1984	N	39.8	5.4	33.3	358.0	199.4	396.6	461.6	192.4	140.6	10.9	N	1,838.0
1985	31.9	20.4	31.0	56.5	191.2	491.2	359.8	214.2	249.5	170.3	2.2	N	1,818.2
Average	9.3	10.7	43.3	78.7	261.5	298.7	340.3	332.4	275.6	93.8	9.7	1.8	1,755.8

Note: T = Trace

N = Nil

Table-2 TEMPERATURE

Station: Vientiane												(Unit: °C)
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1971	20.2	23.4	26.3	29.9	29.0	28.3	28.2	28.6	28.1	24.4	16.5	22.5
1972	22.6	24.9	25.0	29.1	30.3	29.3	29.2	28.3	28.4	27.9	25.9	23.5
1973	24.1	26.3	28.4	30.6	29.3	29.2	28.9	27.6	28.0	25.6	22.7	18.9
1974	18.4	24.1	25.0	28.5	28.8	28.9	28.7	28.9	28.2	27.4	25.6	23.9
1975	22.9	25.0	29.0	30.9	29.2	28.6	28.7	28.2	27.8	27.3	22.1	13.7
1976	20.2	21.0	26.1	27.7	27.1	27.7	27.7	26.8	27.1	26.7	23.3	22.3
1977	24.1	24.4	25.9	29.1	30.9	30.8	29.0	28.8	27.9	26.9	22.6	23.7
1978	24.1	24.4	27.8	29.2	28.5	29.1	28.6	28.2	28.4	24.5	24.1	24.7
1979	25.8	26.0	28.5	30.4	29.2	28.3	24.6	28.3	28.5	25.9	23.5	22.0
1980	22.3	23.8	27.7	29.1	28.5	27.6	27.8	27.7	27.0	27.2	25.2	23.0
1981	21.6	25.4	27.8	28.3	27.8	27.6	27.2	27.8	27.8	26.5	25.1	20.6
1982	21.9	24.7	28.1	27.4	29.1	28.5	27.8	27.0	26.7	26.8	25.8	20.2
1983	20.2	25.0	26.6	30.6	28.8	28.5	28.3	27.4	27.1	26.7	22.9	20.4
1984	20.9	24.7	27.2	29.5	27.5	28.0	26.9	27.1	26.9	25.3	24.6	22.2
1985	22.5	24.6	26.0	28.4	28.1	27.6	27.2	27.2	27.1	26.2	25.6	21.7
Average	22.1	24.5	27.0	29.2	28.8	28.5	27.9	27.9	27.7	26.4	23.7	21.6

Table-3 RELATIVE HUMIDITY

Station: Vientiane												(Unit: %)
Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1980	66	63	58	64	74	83	82	82	83	74	70	70
1981	66	65	63	70	78	82	83	81	79	78	71	67
1982	70	70	66	70	72	75	80	84	83	80	74	70
1983	75	68	62	63	77	80	84	87	85	82	70	74
1984	72	70	64	67	77	81	85	83	83	81	74	73
1985	74	73	65	66	77	82	84	86	85	83	76	72
Average	71	68	63	67	76	81	83	83	83	80	73	71