IV-4-2. Irrigation Plan

1) Evapotranspiration

There are two methods for computing the evapotranspiration (ETp); one is in the use of measurement records by evaporation pan, and the other in the use of empirical equation derived from the meteorological records. This study has employed the Blaney-Criddle method for estimating the evapotranspiration of the proposed crops grown in the Project. As the basic data for estimation, the meteorological records observed at El Mansoura have been employed for 10 years of period.

2) Crop Factor (Kc)

Since no measured values of the crop factors for the Project Area, the Kc values in this study were taken from the FAO's Irrigation and Drainage Paper No.24. (Refer to Annex E)

3) Crop Water Consumption

The crop water consumptions were obtained by multiplying the above evapotranspiration by the crop factors for the respective crops on the decade basis.

The following table shows the peak water consumption of each crop. (More detail refer to Annex E)

Paddy	12.4 mm/day	(late June)
Cotton	9.7 mm/day	(late June)
Maize	9.0 mm/day	(mid May)
Wheat	4.2 mm/day	(early March)

4) Unit Water Requirements

The unit water requirements were calculated on the decade basis in conditions mentioned below together with the proposed cropping pattern.

- Field percolation is estimated at 2.0 mm/day throughout the crop growth stages

- Puddling water requirements are estimated at 125 mm in depth, taking 30 days for all the paddy fields

The maximum net water requirements was estimated at 8.2 mm/day (Net) and 13.7 mm/day (Gross) on the decade basis in taking into consideration the proposed cropping pattern and the proposed land use. (Refer to Appendix E-4)

5) Irrigation Loss and Conveyance Loss

In this study, the irrigation loss and water conveyance loss were taken by 25 percent and 15 percent, for main and lateral canals, and 40 percent for the total conveyance loss, respectively.

6) Design Discharge at Farm Ditches

In the tertiary canals and minors, rotational irrigation will be carried out at five days intervals. A tertiary canal will command an area of 42 ha (gross) for the standard farm plots. The design discharge of a farm ditch was estimated at 16.5 mm/day, including irrigation loss, and 9.6 ℓ/ha in taking into consideration the five days interval irrigation method.

Therefore, the design discharge in the farm ditch, when taking into account the irrigable area by one farm ditch and the deduction rate of 22 percent, was estimated at 15.7 ℓ/s.

The design discharge in the tertiary canal in five days interval irrigation will be equivalent to the discharge required for four farm plots; that is to say,

$$15.7\ \ell/sec \times 4 = 62.8\ \ell/sec$$

7) Canal Alignment

The General Planning Map illustrates the proposed canal alignment for the Project. According to this canal system, flow charts are prepared

separately on irrigable areas, irrigation water requirements, total extension of the canal. (Refer to Fig. IV-3, 4 and 5)

8) Water Quality

During the field survey the salt concentration of about 2,000 PPM of the drain water was observed. The amoung of 2.9 mm/day of the return flow is available for the Area.

On the other hand, irrigation water with 800 PPM of salt concentration is supplied to the Area. Therefore, the weight average of salt concentration is estimated as follows;

$$\frac{800 \times 10.5 + 2{,}000 \times 2.9}{13.4} = 1{,}059 \text{ PPM}$$

Salt tolerant crops such as cotton, paddy, etc. are proposed for the Area. The crops will permit the above salt concentration without any reduction of the yield.

IV-4-3. Drainage Plan

1) Purpose and Method of Drainage

The main purpose of drainage in the Project is to eliminate the leaching water to be supplied immediately after the land reclamation is finished, as well as surplus irrigation water and groundwater. It will be vitally important in the Project to decrease the groundwater in the fields in terms of prevetion of salt damage. The canal type most commonly used for this purpose is a deep open canal or culvert.

The soils of the Project Area are of silty-clay which belongs to soil type vulnerable to development of cracks. Tile or mole drains to be provided immediately after reclamation in the areas with such soil characters will permit the leaching water to be lost through cracks and are not expected to gain the successful leaching effect. Thereby, tile or mole drainage systems, if adopted in the Project Area, should be constructed

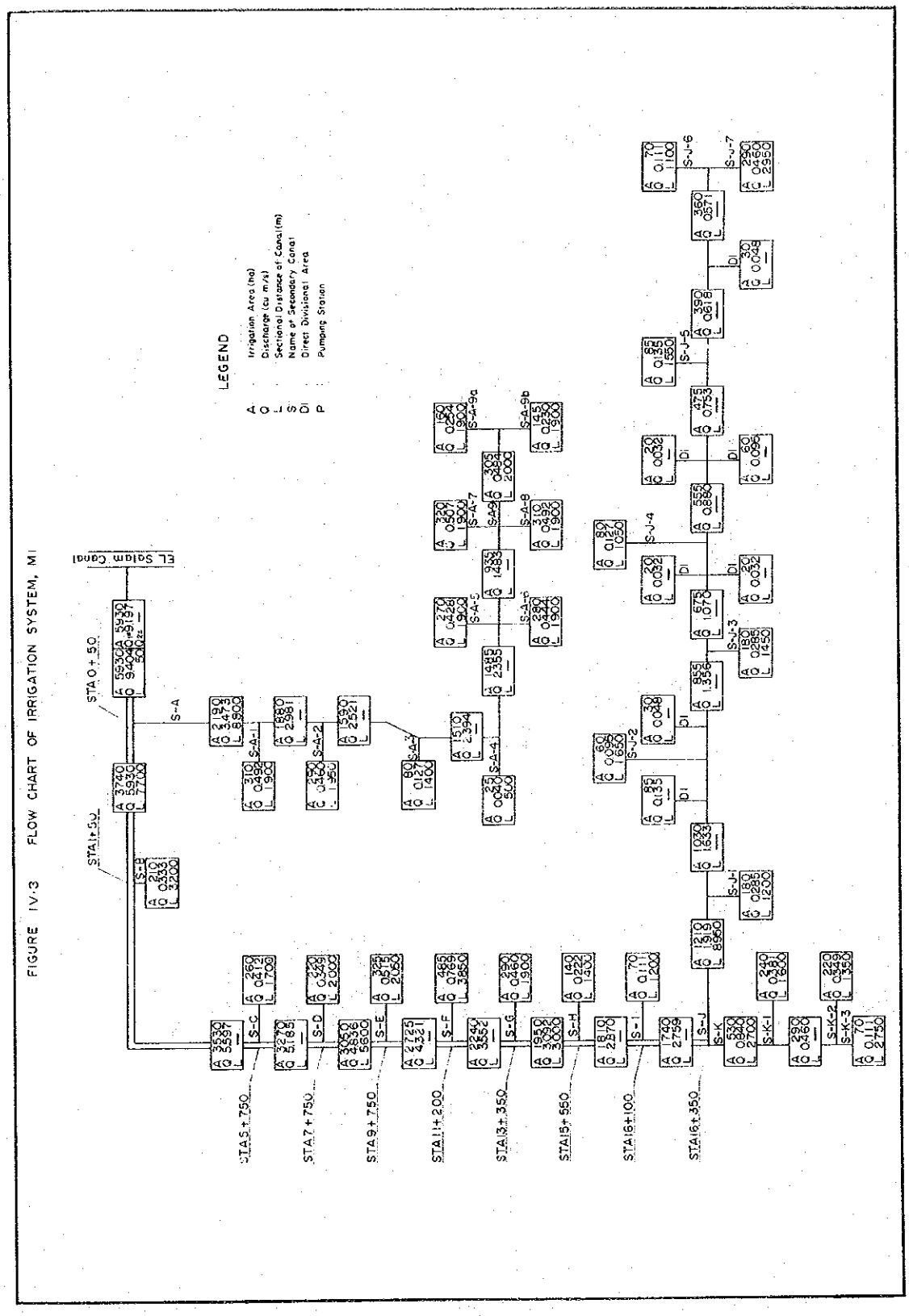


FIGURE IV-3 FLOW CHART OF IRRIGATION SYSTEM, M1

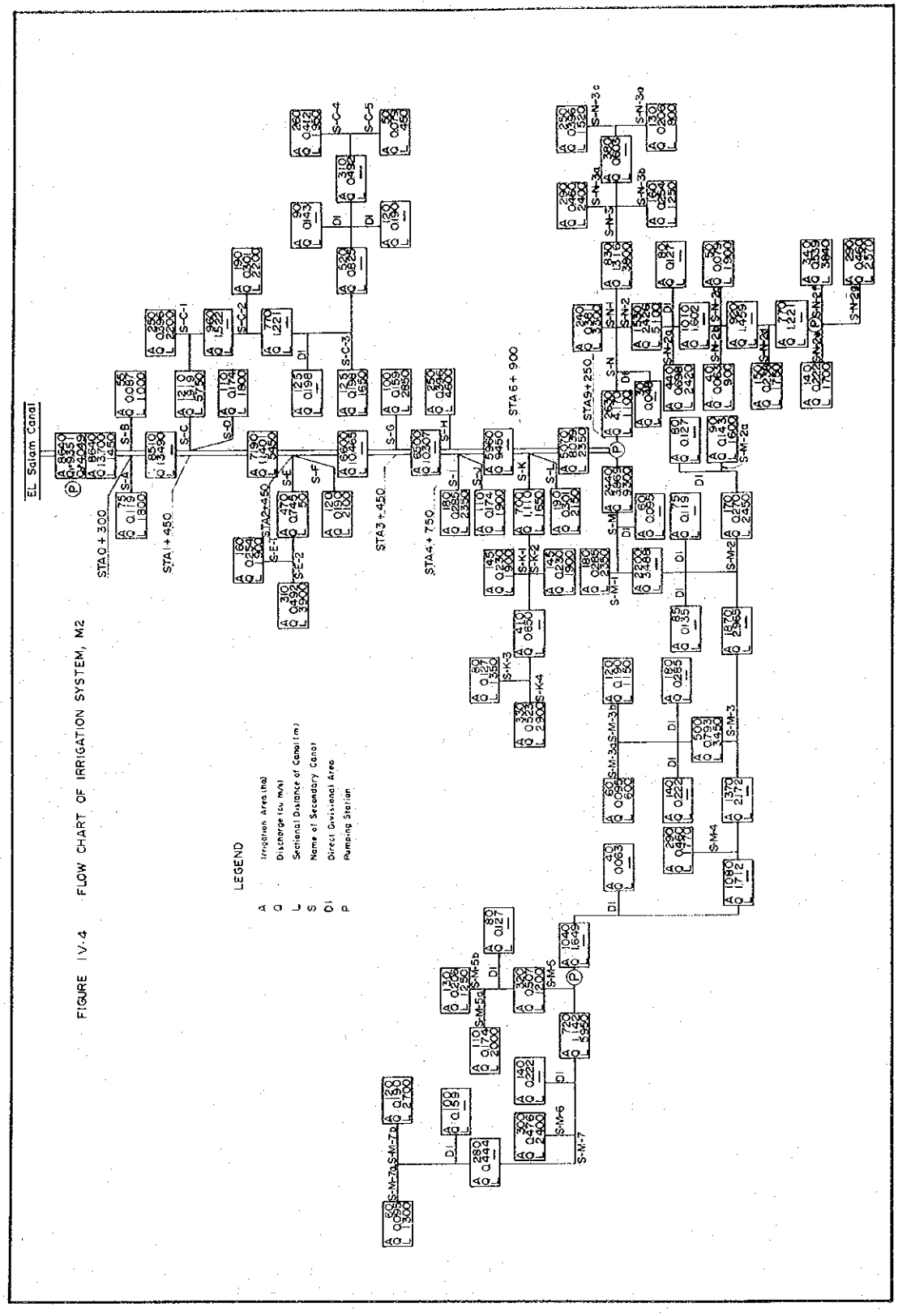


FIGURE IV-4 FLOW CHART OF IRRIGATION SYSTEM, M2

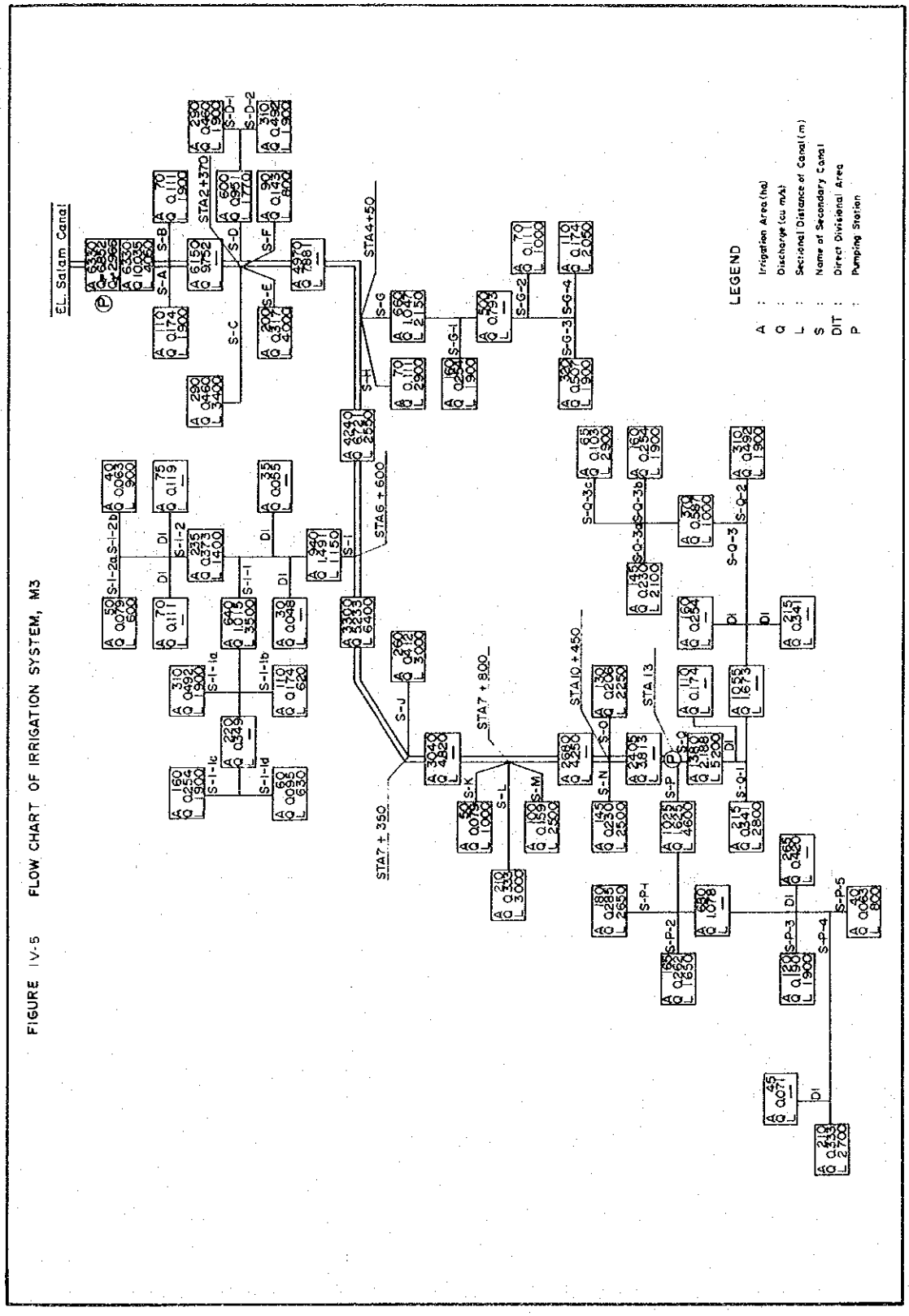


FIGURE IV-5 FLOW CHART OF IRRIGATION SYSTEM, M3

10-15 years after the reclamation in taking into account the crack conditions in the soils.

2) Drainage Modulus (q)

In general, the amount of drainage is expressed as difference between inflow (Qin) of rainfall, etc. to the drainage area and outflow (Qout) of evaporation, transpiration, etc. from the area; is other words, the residual amount of water (Q) to be drained out of the Project Area within a given time (T). The following equation expresses the above relations.

$$Q = Q/T = (Qin - Qout) / T$$

In the Project Area, a greater part of the amount corresponding to (Qin) is irrigation water, since the rainfall is negligibly small by about 50 mm per annum and the no direct inflow of drain water from the upperstream is observed. On the other hand, the amount corresponding to (Qout) is evapotranspiration and deep percolation.

The deep open canal shall be adopted in the Project, accordingly. As mentioned previously, the maximum irrigation water requirement appears by 13.7 mm/day in the end of June, while evapotranspiration a deep percolation are estimated at 8.2 mm/day and 2.0 mm/day as a result of field survey. Therefore, the drainage modulus (q) is expressed by

$$13.7 - (8.2 + 2.0) = 3.5 \text{ mm/day } (14.7 \text{ cu.m/feddan/day})$$

For the Bahr Hadous drain, the annual discharge is 2.84 billion cu.m for the catchment area of 2,300 km^2 (546,000 feddans), and the unit discharge is estimated as follows;

$$(28.4 \times 10^9 \text{ cu.m}/2{,}300 \times 10^6) \times 1{,}000$$
$$= 3.4 \text{ mm/day } (14.3 \text{ cu.m/feddan/day})$$

On the other hand, the FAO's Research on Crop Water Use, Salt affected Soils and Drainage in the ARE quotes the design discharge by 2.0 mm/day for upland cropping and 4.0 mm/day for paddy cropping. Basing on these values,

the drainage modulus is computed as follows;

2 mm/day x 2/3 + 4 mm/day x 1/3 = 2.7 mm/day
(11.3 cu.m/feddan)

In due consideration of these values, 3.0 mm/day (12.6 cu.m/feddan/day) is adopted as the moderate value of the drainage modulus. Thereby, the total amount of the drainage in the Project Area is estimated at Q = 7.257 cu.m/sec.

3) Drainage System

The gravity drainage system is most recommendable system for all projects because of cheapper operation and maintenance cost. In the Project Area the outer water level — the water level in the canals surrounding the Project Area — measures WL + 1.0 m, while the inner water level should keep WL - 1.0 to 3.0 m due to decrease in groundwater table after completion of the Project.

The pumping drainage system, therefore, is recommended to the Area because the gravity drainage system is impossible to introduce the Area.

4) Canal Alignment

The General Planning Map illustrates the proposed drainage canal alignment for the Project, and the drainage area, the discharge and the total extension for the respective main and secondary canals are shown in Fig. IV-6, and -7, respectively.

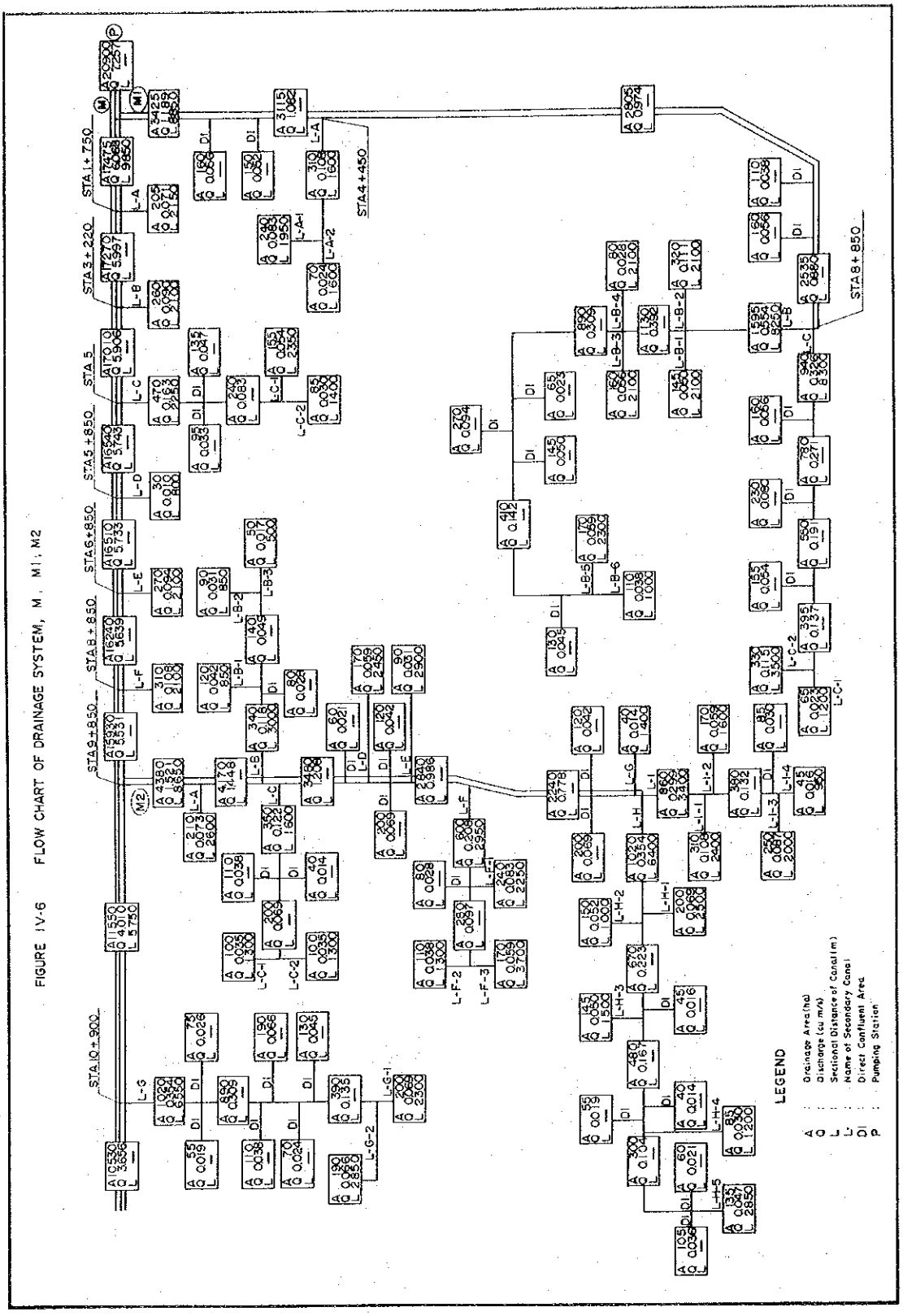


FIGURE IV-6 FLOW CHART OF DRAINAGE SYSTEM, M, M1, M2

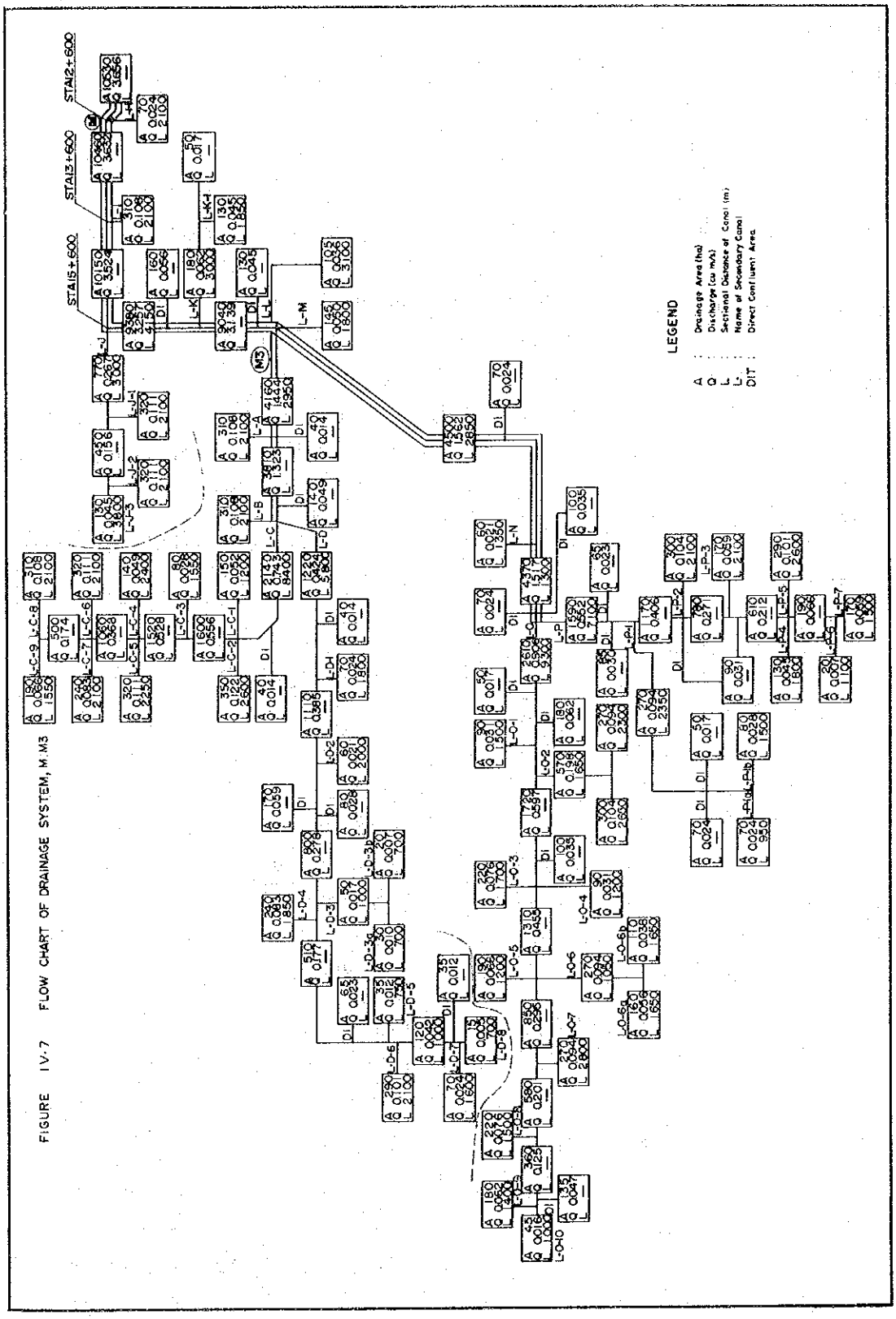


FIGURE IV-7 FLOW CHART OF DRAINAGE SYSTEM, M.M3

IV-4-4. On-farm Development Plan

1) Plot Layout Plan

The Government of ARE has decided the land holding of a farm household at 5 feddans (2.1 ha), therefore, this plot will be the standard unit in land consolidation.

A farm plot surface shall be kept as level as possible for economic operation of farm machinery and farm management in paddy cultivation. On the other hand, a farm plot with slope shortens the necessary time for irrigation water supply and drainage. Where a difference of the field surface elevation ranges in ± 5 cm within a farm plot, a difference of water depth in the related irrigation canal and that in the drainage canal would be less than 10 cm, and if the farm plot has a width less than 100 m, the slope of this farm plot would be logically more than 0.1 percent. It might be sufficient to obtain a proper irrigation efficiency for field crops such as cotton and maize.

Tertiary canals will be planned to go across contour lines whereas the length of run of farm plots will be in parallel with the contour lines. Therefore, the width of plots will be located in parallel with the teritary canals. If the standard length of tertiary canals is determined at one kilometer in consideration of the ration efficiency of farm machinery and effective land levelling works, the shape of a farm plot will be rectangular with the length of run of 210 m and the width of 100 m. A group of 10 farm plots (hereinafter called "field block") would be located at each of both sides of a tertiary canal. Therefore, a cultivated unit will be formed by two field blocks located at both sides of a tertiary canal.

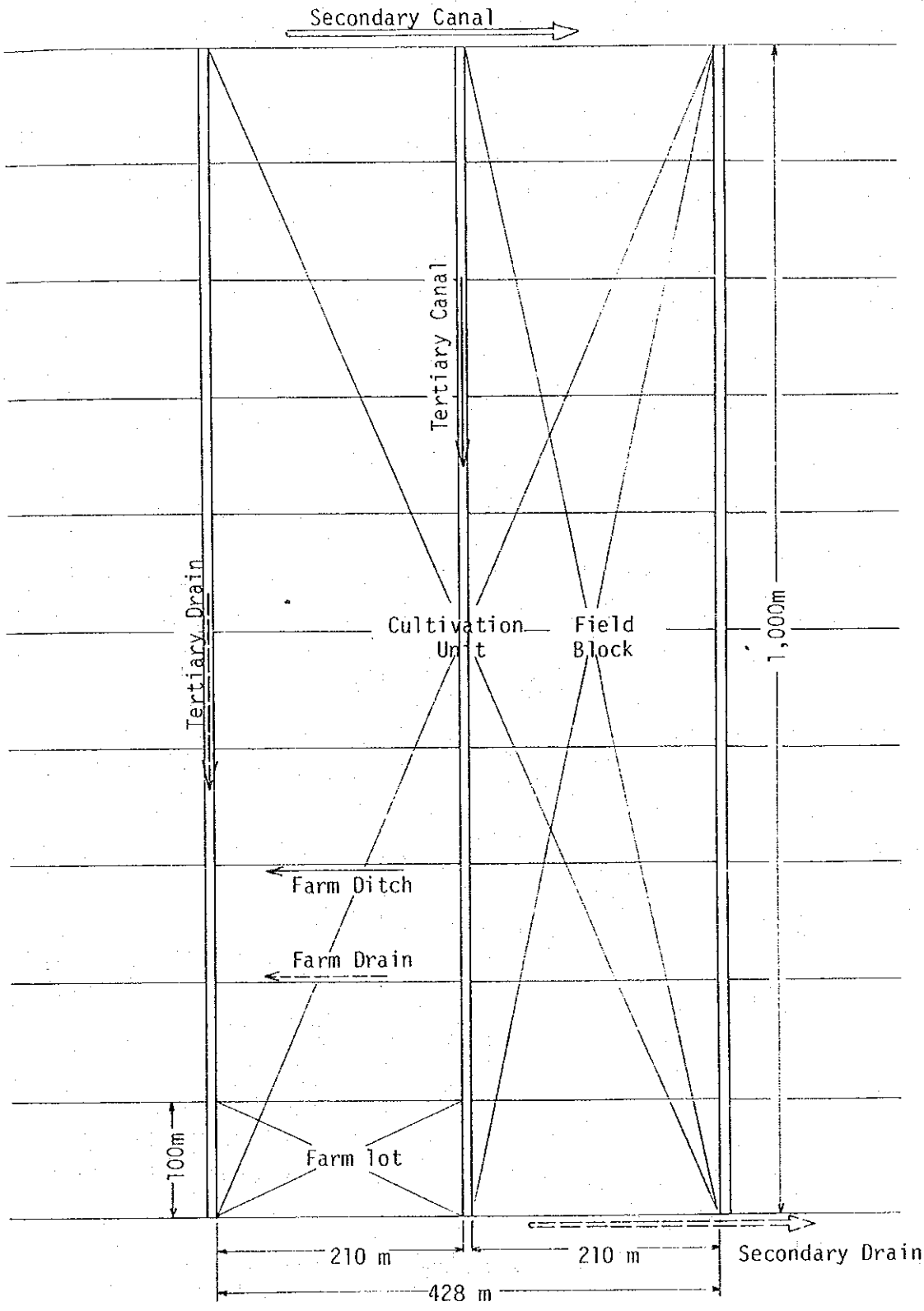
1 cultivation unit = 2 field blocks
1 field block = 10 farm plots

And, the shape and acreage of the field lot will be as follows;

Plot	:	210 m x 100 m =	5 feddans (2.1 ha)
Field block	:	1,000 m x 210 m =	50 feddans (21.0 ha)
Cultivation unit	:	1,000 m x 428 m =	102 feddans (42.8 ha)

(Refer to Fig. IV-8)

Fig. IV-8 Typical Layout Plan of On-farm Facilities



2) Water Management and On-Farm Facilities

i) Principle of paddy irrigation

a) Designed duty of water at peak use period

The maximum water requirement for paddy cultivation, which is computed from climatic data and the crop coefficient, is 12.4 mm/day (in June derivery the last decade) on the assumption that the application loss on fields in 25%. The gross water requirement is calculated on the assumption that the application loss on field in 25% as follows:

$$12.4 \text{ mm/day} \div 0.75 = 16.5 \text{ mm/day}$$

b) Rotational irrigation and irrigation hours

Tertiary canals will be located across contour lines. Therefore, the elevation difference between the plots close to the uppermost of a canal and the plots near its lower end makes it difficult to distribute irrigation water uniformly to all farm plots if 10 farm plots are simultaneously irrigated. To distribute an equal amount of water to each plot, grouping of farm plots to apply rotational irrigation is useful. In this Project, a cultivation unit will be divided into five irrigation blocks (each block is formed by four plots), and each irrigation block would be irrigated every five days. One irrigation will be completed within one day. To minimize the canal size, 24 hours irrigation will be carried out.

c) Designed unit discharge of farm ditch

The unit discharge of a farm ditch is computed as follows:

$$\frac{16.5 \text{ mm/day} \times 10 \times 5 \text{ days}}{36,400} = 9.6 \text{ liter/sec/ha}$$

In case that 22 percent of a farm plot area is used for canals and drains, the designed discharge of a farm ditch is computed as follows:

$$9.6 \text{ liters/sec/ha} \times 2.1 \text{ ha/} \times 0.78 = 15.7 \text{ liters/sec}$$

d) Water application from farm ditches

Each farm plot will be divided into 10 sections by field drains. Therefore, 1.57 liter/sec of discharge should be applied to each section.

Synthetic rubber siphons could be used to supply water from farm ditches to fields. The difference of water level between the farm ditch and the paddy field would be about 8 cm. In this case, flow through a 50 cm diameter siphon would be 1.6 liter/sec approximately. Siphons with a length of about 1.3 m would be required.

e) Designed discharge at a tertiary canal

In order to carry out the rotational irrigation with a five-day interval, four plots should be irrigated simultaneously. Therefore, the designed discharge (Q) at a tertiary canal is,

$$Q = 0.0157 \text{ cu.m/sec} \times 4 = 0.0628 \text{ cu.m/sec}$$

Study on an irrigation requirement and a necessary period of irrigation in the furrow irrigation and border irrigation methods has been conducted in respect to the major crops.

As a result, the irrigation system of paddy cultivation as well as the furrow and border irrigation methods for upland crops will be all applicable with the proposed farm plots and canal cross-section. (Detailed explanation is made in Annex F)

3) Drainage Plan

i) Permeability (Refer to Fig. IV-9)

The permeability of soil is calculated as follows;

$$K = QL / A.\, hl$$

Where, K : permeability
Q : flow of water
A : gross soil cross-sectional area
hl : loss of hydraulic head
L : flow length

Fig. IV-9 Sketch of Permeability Test

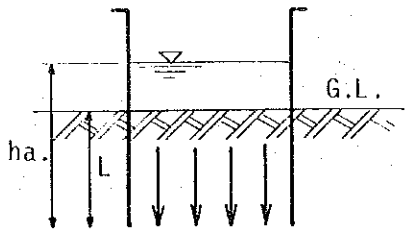


Fig. IV-10 Diagram of Drainage Model

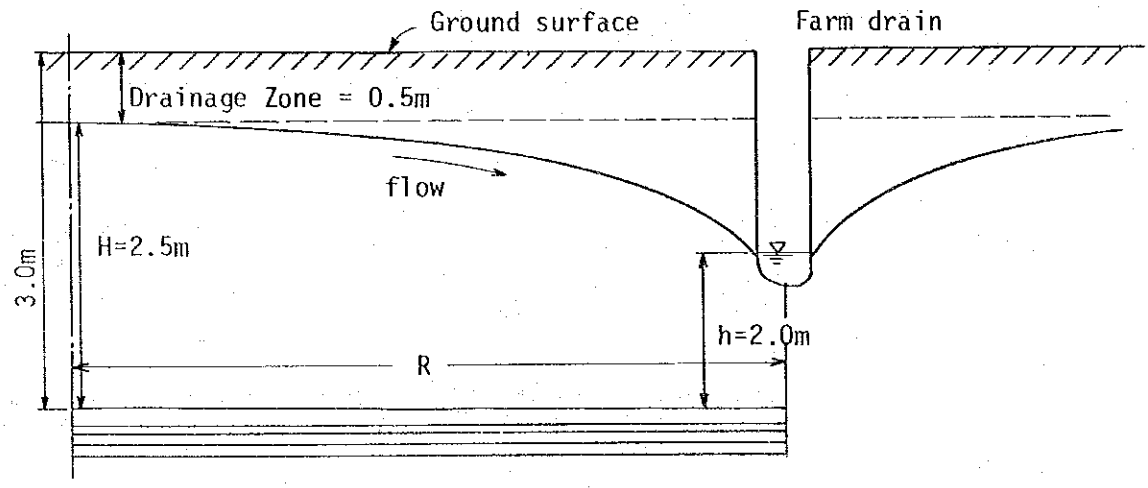
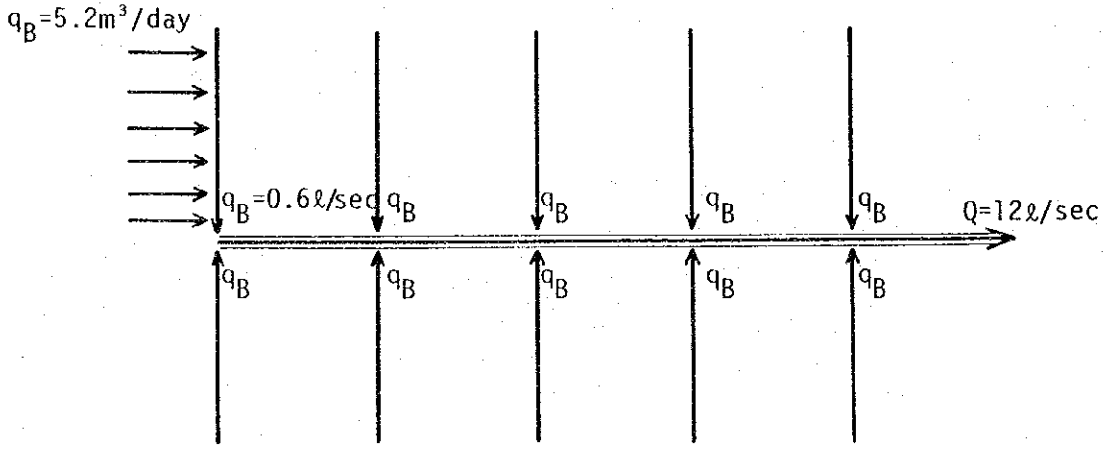


Fig. IV-11 Diagram of Drainage Water



From the field test, Q = 931 cc / 36 min, A = 665 sq.cm, h1 = 32.5 cm, L = 20 cm

$$K = \frac{931 \times 60 \times 20}{36 \times 665 \times 32.5} = 1.44 \text{ cm/hr} = 4 \times 10^{-4} \text{ cm/sec}$$

ii) Drainage discharge

The proposed drainage modulu is 0.35 liter/sec/ha (= 0.15 liter/sec/feddan)

iii) Spacing of field drains

The Project Area is entirely overlain by clayey soil and the thickness of this surface layer is considered as three meters. In order to determine the spacing of field drains, the following model (See Fig. IV-10) is assumed.

On this model, the spacing is determined as follows:

$$R = \frac{k1 \ (H^2 - h^2)}{Q}$$

Where, R : half distance between drains
K : permeability
1 : length of the drain
H : maintained depth of groundwater above low permeable layer
h : depth of groundwater at the drainage canal
Q : amount of water into the drain

In case of Q = 0.35 litre/sec/ha ≒ 5.2 cu.m/day, k = 4×10^{-4} cm/sec = 0.3456 m/day, L = 85 m, H = 2.5 m and h = 2.0 m.

$$R = \frac{0.3456 \times 85 \ [(2.5)^2 - (2.0)^2]}{5.2} = 12.7 \text{ m}$$

Therefore, the spacing of the field drain (type A) is,

$$2R = 25.4 \text{ m}$$

and with taking safety, the spacing is 20 m.

iv) Drainage canal alignment

The drainage canal networks is shown in the General Planning Map. The skelton map of drainage system is shown in Figure IV-6 and 7. Drainage canal system from field drains to tertiary drain is shown in Fig. IV-11.

IV-4-5. Roads Plain

1) Classification of Roads by Their Functions

The five kinds of roads such as trunk road, village road and three types of farm roads proposed to the Project Area are classified by their function into the following;

i) Trunk roads

Trunk roads will function to connect the Project Area to surrounding areas.

ii) Village roads

Village roads will play the role to connect small villages each other small villages to a service village and also to the central village.

iii) Farm roads

Farm roads are further divided into three such as main farm roads, secondary farm roads and on-farm roads. The main farm roads will be constructed along the main irrigation canals, the secondary roads along the secondary irrigation canals and drainage canals, and on-farm roads along tertiary irrigation canals.

The above-mentioned five classes of roads will fully function the role of operation and maintenance roads since all of these roads are constructed along canals.

2) Type and Structure of Roads

i) Trunk roads

The construction of two trunk roads has been planned for the Project Area. One of them will run through nearly the center of the Project Area

from south to north whereas the other will connect the above mentioned trunk road to the national road passing through the eastern most of the Project Area. These two trunk roads are about 42 km long in total.

The trunk roads will be given the effective width of seven meters, which is necessary for a heavy farm machine and a heavy truck to pass each other on the roads. The shoulder of one meter wide will be secured at the both sides of the trunk roads in consideration of tree planting thereon. The trunk roads will have the total width of nine meters, accordingly. The road surface will be paved with asphalt to cope with the future traffic volume.

ii) Village roads

The construction of village roads with a total length of about 82 km has been planned. The effective width will be six meters which is necessary for a operation and maintenance machine and a tractor or a operation and maintenance machine and a truck to pass each other there. The total widh of village roads will be eight meters inclusive of both shoulders of one meter wide for planting trees. The roads will be also paved with asphalt to cope with the future traffic volume.

iii) Farm roads

The construction of the trunk roads and village roads has been planned along irrigation and drainage canals. It is, therefore, considered that these roads will fully function the role of trunk roads. Taking it into consideration, the construction of a main farm road having the similar width to that of village roads has been planned along each of the three main irrigation canals to be constructed in the Project Area. It is computed that the main farm roads will be about 21 km long in total. These roads will be paved with gravel.

Secondary farm roads will be constructed along secondary drainage canals, and used for operation and maintenance of the canals in addition to the agricultural use. The effective width of this type of roads has been determined at six meters taking into consideration that two large scale tractors or a large scale tractor and on operation and maintenance machine are required to

pass each other thereon.

On-farm roads will be constructed along tertiary irrigation canals. This type of roads will have the total width of four meters, that is, the effective width of three meters plus shoulders of 0.5 meter wide. The effective width mentioned above is necessary for a heavy farm and construction machines to pass along the roads. No pavement has been considered for the roads.

IV-4-6. Rural Development Plan

1) Outline of the Plan

Based upon results of the field survey, a rural development plan inclusive of a settlement plan has been formulated for the Project Area covering the major study items listed below;

- ° Alignment of farm villages;
- ° Road networks;
- ° Drinking water supply;
- ° Disposal of sewage;
- ° Village facilities;
- ° Rural electrification; and,
- ° Communication.

The road networks plan aims to make the most use of farm roads which will be constructed along irrigation and drainage canals. In consideration of salty groundwater, the proposed drinking water supply plan depends upon El Salam Canal water. The proposed village plan has been formulated based on discussion made between the Governmental officials of ARE in charge of rural development and the Team members.

2) Alignment of Villages:

The Team exchanged views and opinions with the Governmental officials in charge of rural development to grasp firmly the concept of farm village improvement or rural development in this country. Based on this concept so obtained, the essential features of village improvement plan has been

determined. As seen on the schematic map shown in Drawing No.SH-20, the rural community of the Project Area will consist of small villages, service villages and one central village as follows;

i) Small villages

A small village will be an aggregate of 300 to 400 farm households, and a unit to constitute the rural community of the Project Area.

ii) Service villages

A service village will be responsible to control four to five small villages. A small village topographically situated in the center of four to five villages will be given the functions of a service village among them.

iii) Central village

It has been planned to establish one central village in the entire Project Area. The central village will function to control seven service villages. A service village topographically situated in the center of the Project Area will be selected to be the central village.

3) Road Plan

Detailed explanations on the proposed road plan in the villages are made in the section IV-4-5 in this chapter.

4) Drinking Water Supply Plan

i) Water source

As a result of discussions made between the Governmental officials of ARE and the Team, El Salam Canal water has been selected as the water source for drinking water supply to villages in the Project Area.

ii) Benefited population by the plan

The benefited population has been computed at 88,000 persons taking into consideration a future increase of population.

iii) Water supply to livestock centers

The water supply to four livestock centers has been planned in the Project. The water requirement for cattle breeding has been computed on the assumption that about 88,400 cattle will be raised in future.

iv) Designed water requirement

a) Unit water requirement

The unit water requirement of settlers has been determined at 150 liter/day/person whereas the water requirement for cattle breeding at 60 liter/day/head.

b) Averaged daily water requirement

The averaged daily water requirement for settlers and cattle is computed as follows;

150 liter x 88,000 person	=	13,200 cu.m/day
60 liter x 88,400 head	=	5,300 cu.m/day
Total		18,500 cu.m/day (0.21 cu.m/sec)

The designed capacity of the proposed facilities

18,500 cu.m/day x 1.1/86,400 ≒ 0.23 cu.m/sec

v) Water supply facilities

a) Intake and water conveyance facilities

The main irrigation canal, M-2 will be utilized for diversion and conveyance of El Salam Canal water in this drinking supply plan to villages and livestock centers.

b) Water clarification facilities

One unit of water clarification facilities will be installed near the central village to meet the daily maximum water requirement of 20,000 cu.m/day. The attached drawing No.SH-24 outlines the facilities.

c) Water conveyance facilities

The clarification facilities will be connected, by pipelines, to small villages, service villages and one central village as well as to four livestock centers. The trunk pipeline will be about 28 km long in total whereas the branch pipeline about 100 km long. Ductile pipes will be used for this. The diameter of pipes for trunk lines will be 450 mm whereas that of pipes for branch lines will range in 100 to 200 mm.

5) Sewage Treatment

i) Sewage treatment facilities

Filth and sanitary sewage from 50 to 100 farm houses will be first stored in a public soil tank for a while, and sent by vacuum tank to plain treatment facilities for the secondary treatment.

ii) Treatment of garbage

Trucks will be used to collect garbage. Garbage will be gathered at a specified pit, and buried and resolved in soils. Combustible materials will be destroyed by fire in an incinerator.

6) Village Facilities Plan

The small villages, service villages and central village will be equipped with necessary village facilities so that each village will be able to function as planned. The major village facilities are for the following services and activities;

- Agricultural extension services, guidance and experiment;
- Administrative guidance and public peace and order;
- Accommodation for settlers and marketing;
- Education, public health and medical treatment; and,
- Mosque and recreation.

(Refer to attached Drawing No. SH-21, 22 and 23)

7) Electric Power Supply Plan

The existing high voltage line of 66 KV running at the western most of the Project Area will be the power source for villages, pumping facilities for agricultural and clarification purposes. A high voltage transmission line will be constructed along the Saft drain from the existing line to the sub-station planned at the crossing point of the said drain and the trunk road. The voltage will be drawn down from 66 KV to 11 KV at the sub-station. From the sub-station a 11 KV line will be extended to each village, pumping station and clarification plant, etc., along major roads. Villages and various facilities which will require power will be provided with a transform equipment in order to obtain an appropriate voltage.

IV-4-7. Development Plan of Agricultural Facilities

1) Outline of the Plan

The agricultural development under the Project might necessitate agricultural facilities mainly for the following activities;

- Agricultural extension services;
- Marketing;
- Water management; and,
- Education of farmers

In planning these facilities, the scale and function of a village to which such facilities will be introduced should be taken into consideration. The type and location of agricultural facilities in each village are shown in attached Drawing No. SH-21, 22 and 23.

IV-5. Proposed Facilities

IV-5-1. Irrigation Canal

1) Canal Alignment

The gravity irrigation networks are mainly planned to completely cover the whole proposed beneficial areas according to the topo-map on a scale at 1:10,000 with 25 cm contour lines, which was developed from the results of field surveying. However, four booster pumping stations have come to be required for carrying out successful irrigation. This is deemed unavoidable from the view point of the location of El Salam Canal route and topographic conditions prevailing in the Area.

Design Length of the Canals

Irrigation Block No.	Kind of Canal	Length (m)	Beneficial Area
No.1	Main Canal	16,350	14,100 feddans (5,930 ha)
	Secondary C.	73,550	
	Sub-total:	89,900	
No.2	Main Canal	9,250	20,600 feddans (8,640 ha)
	Secondary C.	122,520	
	Sub-total:	131,770	
No.3	Main Canal	13,000	15,000 feddans (6,330 ha)
	Secondary C.	88,420	
	Sub-total:	101,420	
	Total:	323,090	49,700 feddans (20,900 ha)

2) Typical Closs Section

In general, the irrigation canals for the Project were designed in earth canal considering that the construction materials obtainable in the Area can meet the requirement in quality and quantity; however, concrete lining will be adopted for the portions which should provide higher embankments than ordinary ones. The cross-section was designed in trapezoidal shape and the Manning's formula was employed for hydraulic computation.

And the design criteria prepared by the Egyptian authorities concerned were adopted to determine the bottom width and depth of the canal. The side slope was fixed at 1:1.5 and the roughness coefficient at 0.025. The free-board was designed at 50 cm so as to have sufficient capacity to keep check water level. The flow velocity, which commonly depends upon canal scale and dynamic hydraulic slope, ranged from 0.3 m/s to 0.5 m/s in general. (Refer to attached Drawing No.SH-4, 5, 6, 7 and 8)

3) Appurtenant Structures

The appurtenant structures to the canals are those facilities for water intake, diversion, checking, and crossing. The diversion facilities were, in particular, designed in Parshal flume and double oriffice for enabling to check and control the discharge effectively. (Refer to attached Drawing No. SH-10, 11, 12, 13, 14, 15 and 16)

4) Pumping Facilities

The pumping facilities to be adopted in the Project are two kinds; one is to be used for re-using the return flow and the other is to boost the water at the terminals of the main canals. The dimensions of these pumping facilities are shown in Table IV-8. (Ref. to Drawing SH-1 and 2)

IV-5-2. Drainage Canal

1) Canal Alignment

The drainage canal alignment was made in parallel with that for the irrigation canals. Since the farm drain bottom was designed by one meter below the field surface for the on-farm development plan, it was essentially required to lower the inverts of the main and lateral drainage canals and to install the pumping facilities due to complete inability in gravity drainage.

Design Length of Drainage Canals

Main Drainage Canal	44,350 m
Lateral Drainage Canal	251,200
Total:	295,550 m

Table IV-8 List of Proposed Pump Equipment
(Irrigation)

Description	Unit	Pumping Station							
		M2 - No.1		M2 - No.2	M2 - No.3	M3		M4	M5
Total head	m	1.5		1.5	3.4	3.0	2.0	6.7	6.8
Delivery discharge	cu.m/min	77	83	33	24	32	44	80	60
Pump									
Type		Vertical Mixed Flow Pump							
Diameter	mm	800	800	600	ø500	ø600	ø600	800	700
No. of pump	sets	3	3	3	3	3	3	3	3
Motor									
Output	KW	30	30	15	22	30	22	120	95
Synchronous speed	rpm	170	155	250	490	420	270	490	585
No. of poles		4	4	4	12	14	4	12	10
Voltage	V	400	400	400	400	400	400	3,000	3,000
No. of motor	sets	3	3	3	3	3	3	3	3

2) Typical Cross Section

The cross section of drainage canals was determined in the same way that the irrigation canal section was determined. The cross-section was designed in trapezoid by earth canal. The side slope was fixed at 1:1.5 and the roughness coefficient at 0.025. The velocity was estimated at 0.5 m/sec or below. (Refer to the attached Drawing No.SH-9)

3) Appurtenant Structures

The major appurtenant structures to drainage canals are crossing structures for passing over the other canals and roads. (Refer to the attached drawing No.SH-17 and 18 for the design criteria of the structures)

4) Pumping Facilities

The pumping stations shall be located at the terminals of the main drainage canals. The dimensions of the facilities are outlined below. (Refer to Drawing No.SH-3)

Type	Bore Dia.	Q'ty	Discharge	Motor	KW
Vertical Shaft Mixed-flow	1,000 m/m	3 units	146 x 3 = 438 cu.m/min	Electric Motor	220 KW x 3

IV-5-3. Road

The kinds and length of the roads to be provided in the Project Area are tabulated below. The trunk roads and village roads shall be constructed in asphalt pavement, while the main farm roads in gravel pavement and the other roads without pavement.

Type of Road	Length (m)
Trunk roads	41,500
Village roads	82,000
Farm roads	
Main farm roads	21,000
Secondary farm roads	483,000
On-farm roads	701,000
Total	1,328,500

IV-5-4. On-farm Facilities

The on-farm physical planning was carried out in the use of the total earth work volumes of the Area which were estimated by the respective earth work volumes of tertiary canal, farm ditch and drain, and tertiary drain according to the typical cross section of the canals and the plane drawings for the unit plot. For land levelling, sample areas were selected to estimated the earthwork volumes by slope classification of the areas and such volumes were averaged to be used for the planning.

1) Land levelling

Average volume of earthwork 231.4 m^3/ha x 26,800 ha
= 6,201,520 m^3

2) Farm ditch/farm road/field drain

Excavation	220 m^3/ha x 26,800 ha	= 5,896,000 m^3
Embankment	160 m^3/ha x 26,800 ha	= 4,288,000 m^3
A·C, Pipe	1.7 m^3/ha x 26,800 ha	= 45,560 m^3

3) Tertiary canal

Excavation	14.3 m^3/ha x 26,800 ha	= 383,240 m^3
Embankment	85.7 m^3/ha x 26,800 ha	= 2,296,760 m^3
Reinforced concrete	0.05 m^3/ha x 26,800 ha	= 1,340 m^3
Wood form	0.50 m^3/ha x 26,800 ha	= 13,400 m^3
Sand/gravel	0.20 m^3/ha x 26,800 ha	= 5,360 m^3
Gate	0.10 places x 26,800 ha	= 2,680 places

4) Tertiary drain

Excavation	119.0 m^3/ha x 26,800 ha	= 3,189,200 m^3
Embankment	16.7 m^3/ha x 26,800 ha	= 447,560 m^3

IV-6. Construction Cost Estimate

IV-6-1. Bases of Cost Estimate

1) Unit Costs

Basic data employed in construction cost estimate for the proposed facilities such as labor wages and unit prices of construction materials, etc., domestically available have been selected from various related data obtained in ARE through discussions made between the Governmental official in charge and the Team members. Unit prices as of 1980/1981 have been employed in this cost estimate.

Aparting from labor and construction materials domestically available, prices of construction equipment and materials to be imported have been estimated in consideration of their CIF prices and inland transportation cost from a neighboring port to the Project Area.

Unit costs of labor and construction materials are shown in Table IV-9.

2) Necessary Units of Construction Equipment

Necessary units of various construction equipment required for construction works in the Project have been determined based upon the proposed construction schedule in consideration of the following;

- ° Working days in a year: 265 days/year
- ° Actual working hours in a working day: 6 hours/day

IV-6-2. Outline of Construction Cost

1) Itemization of Construction Works

The construction works under the Project are itemized, for cost estimate, as follows;

i) Civil works

a) Preparation

b) Pumping station for irrigation

Table IV-9 Unit Cost of Labor and Materials

Description	Unit	Unit Cost (L.E.)
Unskilled labor	day	1.5
Skilled labor and operator	"	3-5.0
Reinforcement	ton	380.0
Cement (50 kg/bag)	bag	3.5
Gravel	cum	8.0
Sand	"	3.0
Woods	"	350.0
Brick	1,000 pcs	45.0
Gasoline	ℓ	0.13
Diesel oil	ℓ	0.03
Grease	kg	1.0
Electric power (more than 1,000 kwh)	kwh	0.01
Reinforced concrete work	cum	120.0
Plain concrete work	"	40.0
Concrete lining work	sqm	5.0
Asphalt lining work	"	3.0
Wooden form	"	10.0
Asphalt pavement (5 cm thick)	"	3.0

Source: Egyptian government agency concerned.

c) Pumping station for drainage
d) Irrigation canals
e) Drainage canals
f) On-farm facilities
g) Roads

ii) Livestock breeding facilities

iii) Land aquisition and compensation

iv) Construction equipment

v) Operation and maintenance

vi) Project facilities

vii) Operation and maintenance of the project facilities

viii) Consultant services

ix) Contingency
The amount equivalent to 15% of the total cost under the above items (i) to (viii) has been summed up.

x) Price escalation
The annual compound rate of 10% has been imposed.

xi) Foreign currency and local currency portions
Costs for construction equipment and materials, etc., to be imported have been estimated in the foreign currency portion whereas costs for the others in the local currency portion.

2) Construction Cost

A cost has been estimated for each of the construction works itemized hereinabove. The construction cost is divided into the foreign and local currency portions, however, is expressed in Egyptian Pound. (Refer to Table IV-10 and 11.)

Table IV-10. Project Cost (Financial)

(Unit: 1,000 $\frac{LE}{US\$}$)

Description	Total (LE)	Foreign Currency (LE)	Foreign Currency (US$)	Local Currency (LE)	Local Currency (US$)	Remarks
1. Civil Works						
1-1. Preparation	81	-	-	81	(116)	
1-2. Pumping Station (Irrigation)	8,932	7,653	(10,933)	1,279	(1,827)	
1-3. Pumping Station (Drainage)	1,382	1,257	(1,796)	125	(179)	
1-4. Irrigation Canal						
Main Canal	2,538	540	(771)	1,998	(2,854)	
Secondary Canal	2,655	919	(1,313)	1,736	(2,480)	
1-5. Drainage Canal						
Main D. Canal	758	-	(-)	758	(1,083)	
Secondary D. Canal	1,268	-	(-)	1,268	(1,811)	
1-6. On-farm Facilities	8,002	-	(-)	8,002	(11,431)	
1-7. Road	1,002	9	(13)	993	(1,419)	
Sub-total	26,618	10,387	(14,836)	16,240	(23,200)	
2. Land Acquisition and Compensation	90	-	(-)	90	(129)	
3. Construction Equipment	17,002	16,192	(23,131)	810	(1,157)	
4. Agricultural Development	3,924	484	(691)	3,440	(4,914)	
5. Operation and Maintenance Cost	447	-	(-)	447	(639)	
6. Project Facilities	689	89	(127)	600	(857)	
7. Project Administration (8% of 1 to 6)	1,730	-	(-)	1,730	(2,471)	
8. Consultant Services	1,407	1,112	(1,589)	295	(422)	
Total (1 to 8)	51,907	28,255	(40,364)	23,652	(33,789)	
9. Contingency (15%)	7,786	4,238	(6,054)	3,548	(5,069)	
Total (1 to 9)	59,693	32,493	(46,418)	27,200	(38,858)	
10. Price Escalation (1 to 10)	24,822	10,016	(14,309)	14,806	(21,151)	
G. Total	84,515 (100%)	42,509 (50%)	(60,727)	42,006 (50%)	(60,009)	

Table IV-11 Disbursement Schedule of the Project Cost
(Financial Cost)

(Unit: 1,000 LE)

Description	Total		1982		1983		1984		1985		1986		1987		1988	
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
1. Civil Works																
1-1. Preparation	-	81	-	-	-	81	-	-	-	-	-	-	-	-	-	-
1-2. Pumping Station (Irrigation)	7,653	1,279	-	-	3,061	512	4,592	767	-	-	-	-	-	-	-	-
1-3. Pumping Station (Drainage)	1,257	125	-	-	1,131	113	126	12	-	-	-	-	-	-	-	-
1-4. Irrigation Canal																
Main Canal	540	1,998	-	-	-	-	81	300	135	500	135	500	108	400	81	298
Secondary Canal	919	1,736	-	-	-	-	138	261	184	347	184	347	184	347	229	434
1-5. Drainage Canal																
Main D. Canal	-	758	-	-	-	152	-	379	-	227	-	-	-	-	-	-
Secondary D. Canal	-	1,268	-	-	-	127	-	254	-	254	-	254	-	254	-	125
1-6. On-farm	-	8,002	-	-	-	800	-	1,600	-	1,600	-	1,600	-	1,600	-	802
1-7. Road	9	993	-	-	-	-	9	100	-	248	-	248	-	248	-	149
Sub-total	10,378	16,240	-	-	4,192	1,785	4,946	3,673	319	3,176	319	2,949	292	2,849	310	1,808
2. Land Acquisition and Compensation	-	90	-	90	-	-	-	-	-	-	-	-	-	-	-	-
3. Construction Equipment	16,192	810	-	-	8,096	405	8,096	405	-	-	-	-	-	-	-	-
4. Agricultural Development	484	3,440	-	-	-	-	-	-	-	516	-	1,032	-	1,032	484	860
5. Operation & Maintenance Cost	-	447	-	63	-	63	-	63	-	63	-	63	-	66	-	66
6. Project Facilities	89	600	89	300	-	300	-	-	-	-	-	-	-	-	-	-
7. Project Administration	-	1,730	-	36	-	204	-	331	-	300	-	324	-	316	-	219
8. Consultant Service	1,112	295	168	44	246	66	155	41	155	41	155	41	155	41	78	21
Total (1 to 8)	28,255	23,652	257	533	12,534	2,823	13,197	4,513	474	4,096	474	4,409	447	4,304	872	2,974
9. Contingency (15%)	4,238	3,548	39	81	1,880	423	1,980	677	71	614	71	661	67	646	130	446
Total (1 to 9)	32,493	27,200	296	614	14,414	3,246	15,177	5,190	545	4,710	545	5,070	514	4,950	1,002	3,420
10. Price Escalation	10,016	14,806	30	61	3,028	682	5,024	1,718	253	2,186	333	3,095	397	3,819	951	3,245
G.Total(1 to 10)	42,509	42,006	326	675	17,442	3,928	20,201	6,908	798	6,896	878	8,165	911	8,769	1,953	6,665

CHAPTER V PROJECT IMPLEMENTATION AND OPERATION AND MAINTENANCE PROGRAM

CHAPTER V. PROJECT IMPLEMENTATION AND OPERATION AND MAINTENANCE

V-1. Project Implementation

V-1-1. Executing Body

The South Hosainia Valley Agricultural Development Project is an integrated development project involving land reclamation and on-farm development as well as the construction of irrigation and drainage facilities and social infrastructures for settlers.

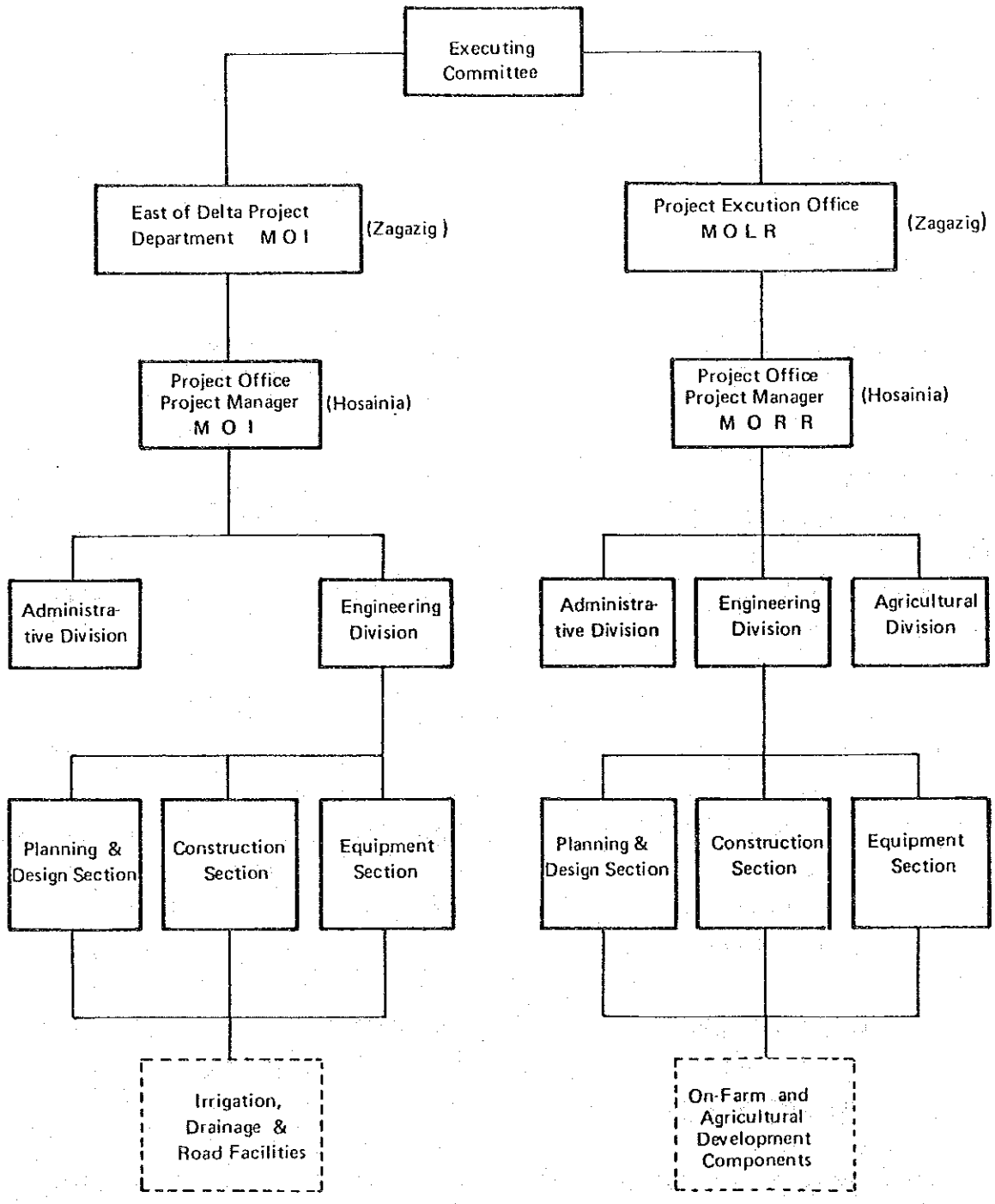
Therefore, the executing body of the Project will be organized by the Ministry of Irrigation and the Ministry of Land Reclamation. The former will be responsible for construction of major facilities for irrigation and drainage whereas the latter for on-farm development inclusive of the construction of tertiary canals and necessary social infrastructures for settlers. An executing committee consisting of the representatives of these two Ministries will be established for effective operation of the Project and for close coordination.

On the other hand, the both Ministries shall have their own Project offices at site, and assign Project Managers to carry out the works under the responsibility. The Project offices will have two to three divisions; that is, the construction division, administration division and agricultural division. The construction division will have three sections one of which will be the equipment section responsible for operation and maintenance of construction equipment and machinery during the implementation period.

The administration division will be responsible for personnel affairs, documents and records management, accounting, property custody, procurement of goods and materials and other miscellaneous services.

The agricultural division will be responsible for physical planning and design of agriculture-related works in the Project Area and for construction works of facilities concerned. (Refer to Fig. V-1)

Fig. V-1 Organization Chart for the Project Implementation



V-1-2. Construction Method and Implementation Schedule

1) Construction Method

The contract-basis construction is considered most recommendable in view of the Project components such as various construction works for irrigation and drainage system and road networks, etc., which should be completed in accordance with the construction schedule keeping close coordination among related organizations. It might be the most practical way to make a contract for construction works with the respective Ministries-related construction companies whose organization is illustrated in Figure V-2. On the other hand, it is deemed most effective that the respective Ministries will be responsible for import of various equipment and materials.

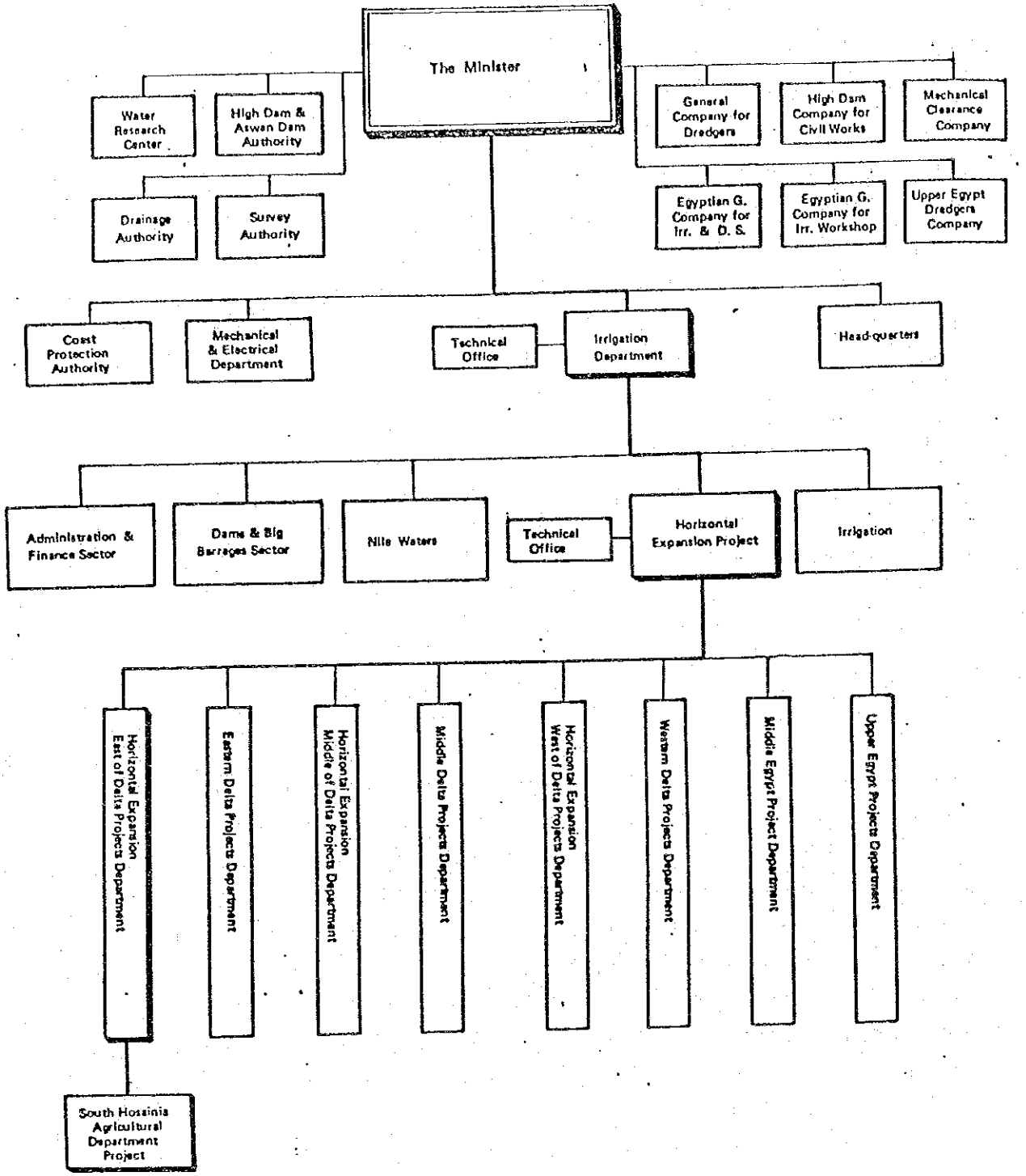
2) Implementation Schedule

Construction works for the Project will be roughly classfied in four, that is, the first one for construction of main and secondary canals for irrigation and drainage, the second one for construction of pumping stations, the third one for on-farm development and the fourth one for construction of roads.

In general, the construction period of a project depends upon meteorological conditions prevailing in the job sites, social environment surrounding the area and work volume. Advantageously, however, no obstacles nor difficulties are observed in the Project in these aspects. The construction period of seven years has been proposed inclusive of preparatory works. Two years out of the period will be required for financial preparation (actually about one year) to be made based on the feasibility study. The detail design will need about six months from September 1982. In parallel with these preparatory works, construction of the Project office buildings and other pre-engineering works will be proceeded.

The procurement of construction equipment and materials for irrigation and drainage canals (main and secondary) and pumping facilities should start in the early 1983 so that the construction could be commenced from August 1983. In the other words, it is most desirable that the Project could be

Fig. V-2 Organization Chart of the Ministry of Irrigation



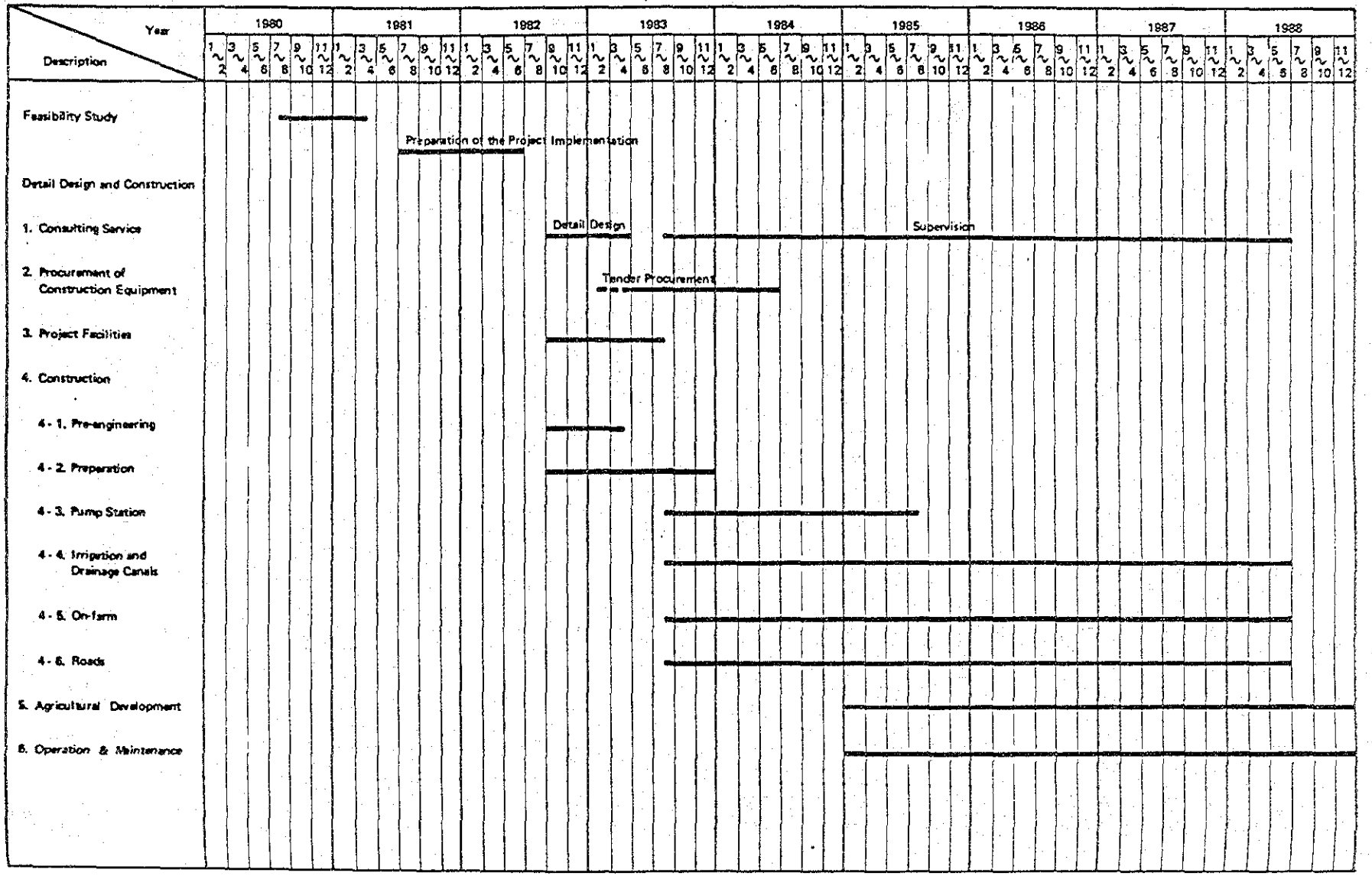
implemented coincidentally to the completion of construction works for the related part of El Salam Canal to the Project, which is scheduled in 1983. The construction works for the whole Project facilities will take five years. This construction period has been determined in consideration of the averaged period employed by international financing agencies to the construction works for similar natured projects (Commonly five to seven years).

The construction works shall be implemented on the block-to-block basis (three irrigation blocks) from the No.1 block at upstream of the El Salam Canal to the downstream blocks in order (No.2 and No.3). The earliest completion of construction works for the main drainage canal and drainage pumping station is required among others in order to start the leaching works in newly reclaimed farm lands. The construction works for on-farm facilities will start at the site where major facilities for irrigation and drainage have been already constructed.

The construction works for agricultural development will start in 1985 and complete in 1988. In the agricultural development plan, the animal breeding is scheduled to start around 1986 and be gradually increased in raising head to cope with a production increase of fodder crops.

The construction schedule is outlined in Figure V-3.

Fig. V-3 Proposed Implementation Schedule for the Project



V-2. Operation and Maintenance

V-2-1. Organization

The responsibility for operation and maintenance of all the Project facilities should be transferred to the Governmental office at site and farmers' organizations after the implementation of the Project. At present the provincial government office located at Zagazig has taken charge of local administration. The regional office of the central government has been directly responsible for operation and maintenance of irrigation and drainage systems. Under the situations, these two existing offices have been focused, to the maximum extent, in formulating the organization for operation and maintenance of agricultural facilities.

Taking into consideration the above-mentioned circumstances, the establishment of the irrigation system office has been planned. This office should be open for activities and services of not only the Ministry of Irrigation but also the Ministry of Land Reclamation and the Ministry of Agriculture. The maintenance of field offices, suborganization of the irrigation system office, has been planned specially in consideration of the importance of water management in the Project Area.

No field office of the Ministry of Land Reclamation will be established since, after the implementation of the Project, stress should be laid on the direct management of livestock centers, water management on the on-farm level, guidance to farmers for farm management and extension services, etc.

Furthermore, the responsibility for water management on the on-farm level would be gradually done through farmers' organization. Therefore, this kind of practices will come under the jurisdiction of field offices. In addition, the water management on the on-farm level should be carried out with the participation of all farmers in the Project Area, in one to two-year period shift, so that all farmers might fully recognize the necessity and importance of water management. In this sense, it is not desirable that some selected farmers will permanently take charge water management. The Ministry of Land Reclamation and the Ministry of Irrigation should make continuous effort to impart education on water manage-

ment to farmers so that every farmer would learn the importance of water management.

The irrigation system office will have the operation & maintenance section, engineering section and administration section. The field offices whose routine works will be the water management will be under the control of this operation & maintenance section.

As for farm management, agricultural extension services and water management on the on-farm level, the farmers' organization mentioned in the IV-3 Agricultural Development Plan will be effectively operated for this purpose. The organization chart is shown in Figure V-4 for clear understanding of the relationship between the water management organization and the farmers' organization.

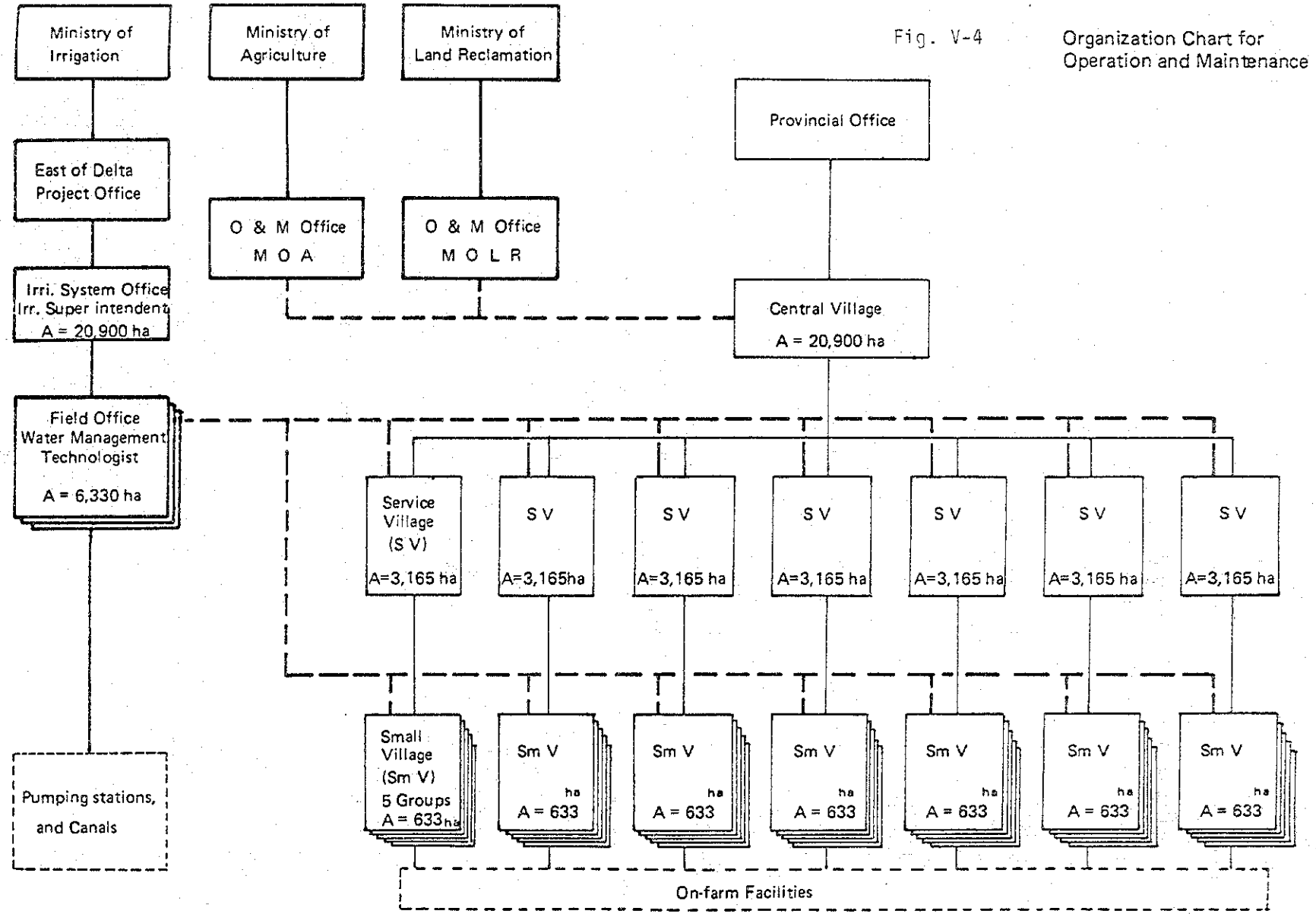
V-2-2. Operation & Maintenance of Facilities

The operation & maintenance of irrigation and drainage systems will be made by two organizations, that is, the Governmental organization and the farmers' organization.

The Governmental organization such as the Ministry of Irrigation and the Ministry of Land Reclamation will be responsible for the operation & maintenance of all facilities of main and secondary irrigation and drainage canals, pumping facilities and all roads exclusive of on-farm roads. The farmers' organization will take charge of the operation & maintenance of all facilities on the on-farm level.

The communication among offices for operation & maintenance will be made through the telephone system to be installed in connecting villages. Jeeps and motorcycles will be used for transportation necessary for operation and maintenance.

Fig. V-4 Organization Chart for Operation and Maintenance



V-2-3. Operation and Maintenance Cost

The cost to maintain and operate the facilities mentioned previously has been calculated as following Table V-1.

V-2-4. Consultants Services

The consultancy services required for implementation of the Project are divided into the three parts as follows;

1) Final design of the Project as well as preparation of tender documents. The service period would be 49 man-month period from September 1982. Highly qualified experts will be employed such as an irrigation engineer, a mechanical engineer, a design engineer and an economist, etc.

2) Construction supervision and training of local counterpart personnel in all phases of the Project activities. The service period would be from August 1983 to April 1988. The required experts would be a project engineer, a mechanical engineer and a civil engineer, etc.

3) Agri-institutional establishment covering all agricultural institutional development program and training will be make within a 15 man-month period highly qualified experts will required to participate in the services such as an agronomist, an agri-institutional expert, a water management expert and a farm management expert. The proposed schedule is shown in Fig. V-5.

Table V-1 Annual Operation and Maintenance Cost

1. Salary and Wages

1) Government Offices Staff

	No. Staff	No. Office	Salary/Month (LE)	Total/Year (LE)
(i) Irrigation System Office	5	2	150	18,000
(ii) Field Offices				
a) Water Management Technologist	10	3	150	54,000
b) Gate Keeper	10	3	100	36,000
c) Ditch Tender	60	3	100	18,000 1/
d) Pumping Station	20		100	20,000 2/
			Sub-Total	308,000

Note; 1/ 2/, 10 month/year

2) Labour's Cost (Main Canals, Secondary Canals)
L = 600 km Unit Cost 1.0 LE/m 600,000

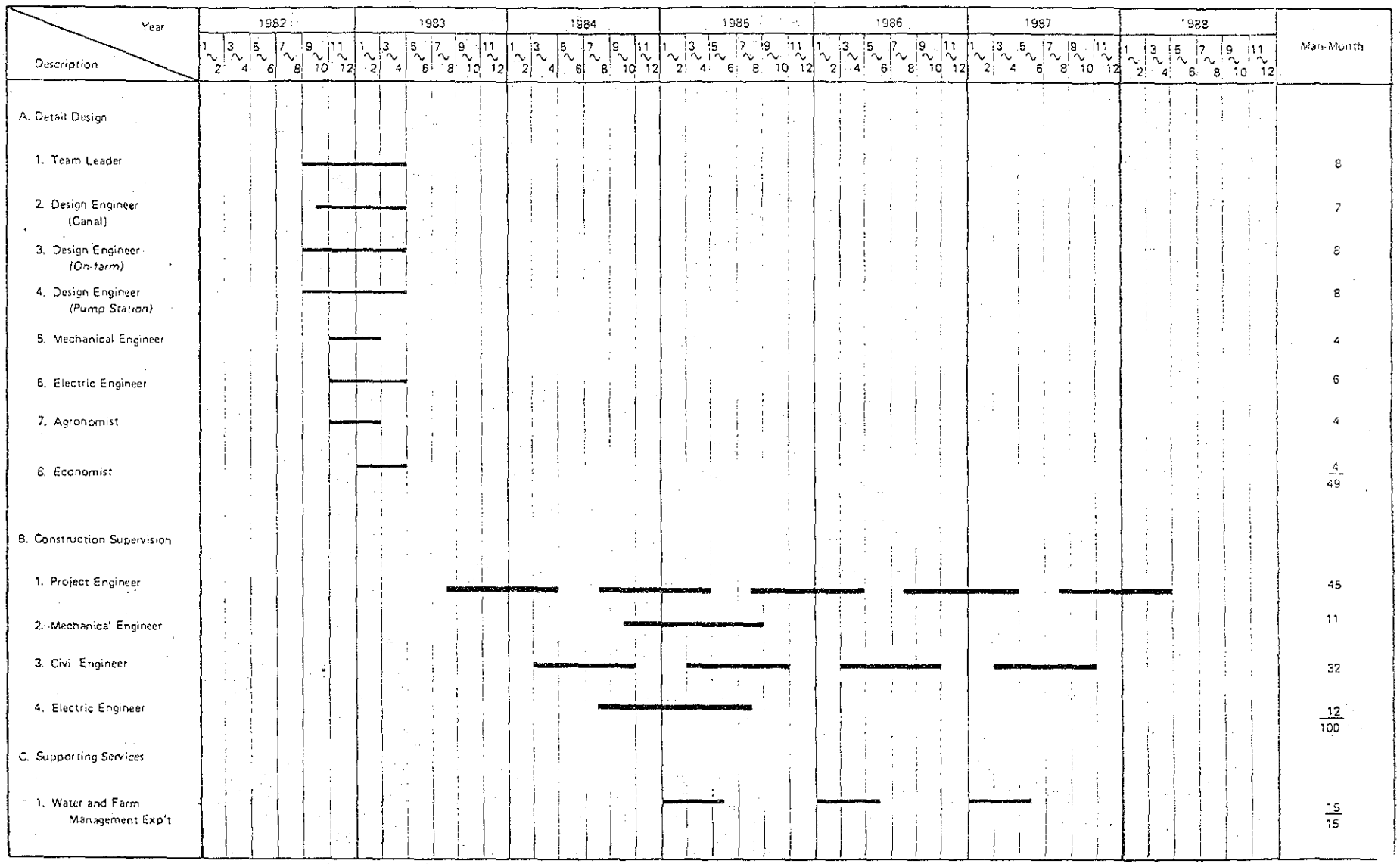
Sub-Total	600,000
Total	908,000

2. Electric Power Charge

(Unit Cost 2.5 PT/KWH)

1) Drainage Pumping Station (220 KW)	48,500
2) Return Flow Pumping Station (215 KW)	4,000
3) Booster Pumping Station (149 KW)	35,500
4) Office Equipment and Facilities (400 KW)	79,000
Total	167,000
G.Total	1,065,000 LE
51 LE/ha (21 LE/Feddan)	

Fig. V-5 *Proposed Schedule for Consultant's Services*



CHAPTER VI PROJECT EVALUATION

CHAPTER VI. PROJECT EVALUATION

VI-1. General Description

VI-1-1. Objective

The main objective of the proposed Project is an agricultural development for 74,700 feddans(31,400 ha) of desert land where no economic activity is prevailing except some limited cultivated land of 6,000 feddans(2,500 ha).

The objective follows the government's agricultural policy which aims both horizontal and vertical expansion, because the following agricultural outputs would be expected after full development of the Project.

Item	Production (ton)
Paddy	48,969
Cotton	20,691
Maize	18,831
Wheat	29,657
Beef	7,956

VI-1-2. Project Component

The Project component is mainly divided into two, namely, development of agricultural infrastructures and agricultural development (livestock), and the former is subdivided into pumping facilities, canals, roads and on-farm facilities. It is proposed in this report that the proposed livestock center will be operated and managed under the government.

VI-1-3. Project Benefit

Since the main objective of the proposed Project is an agricultural development of about 70,000 feddans of desert land by newly providing such agricultural infrastructures as irrigation and drainage facilities, on-farm facilities and so on with social infrastructures.

Its primary benefit would be measured through an incremental agricultural production between two cases of "with project" and "without project".

Beside the primary benefit, there would be some secondary and other benefit in the Project, and these benefits would be incorporated into the Project benefit as far as they can be measured in monetary terms. Usually, it is rather difficult to measure those benefits in monetary terms which are arising from such social infrastructures as hospital, school, polic station, mosque, etc.

VI-2. Economic Evaluation

VI-2-1. Method of Evaluation

For the economic evaluation of the Project, it seems presently most appropriate to compute an economic internal rate of return.

The Project life for economic evaluation is assumed to be 50 years including construction period. For pumping equipment, some replacement cost will be required once every 15 years after installation. Thus, the Project life is considered to be 50 years.

In the economic evaluation, an application of accounting prices has been recently theorized even for an agricultural development project. In order to compute accounting prices, it requires several conversion factors, but only a standard conversion factor has been estimated in this report due to limitation of data availability.

VI-2-2. Economic Price

1) Standard Conversion Factor

From the tariff table and the foreign trade statistics presently available in Egypt, a standard conversion factor (SCF) has been estimated at 0.835 (Refer to Annex J).

2) Foreign Trade of Selected Agricultural Products

In Egyptian agricultural export, raw cotton is playing very impor-

tant role followed by milled rice. On the other hand, Egypt is importing many basic foodstuffs, like, wheat, wheat flour, maixe, sugar, edible oils and meat to meet with their domestic demand. Both export and import prices depend largely on those in the world market (Refer to Annex J). As a result, all Project output, paddy, cotton, maize, wheat and beef are considered to be internationally traded goods.

3) Farmgate Prices

In Egypt, farmgate prices of both input and output are depending upon the government pricing policy. Recently, the government has introduced her economic policy of liberalization, hence, the government's controlled prices would be more closely reflected by the prevailing market condition.

Table VI-1 shows both financial and economic farmgate prices of Project output as well as input. For the financial prices, they are mostly based on current market price except agricultural chemicals which are derived from international prices with assumption that they must be subsidized by the government. For the economic prices, they are derived from IBRD Commodity Price Forecast. (For further details, see Annex J)

VI-2-3. Economic Benefit

1) Without Project

As mentioned in Annex D "Agriculture" there are presently 2,500 ha of cultivated land and its production is as follows:

Crop	Area (ha)	Yield (ton/ha)	Production (tons)
Cotton	800	1.1	880
Rice	1,600	2.9	4,640
Wheat	800	1.6	1,280
Vegetables[1/]	200	8.0	1,600

Note: 1/ Mainly tomatoes

Table VI-1 Projected Farmgate Prices (1980 constant price)

Item	Unit	Financial (L.E.)	Economic (L.E.)
Paddy	ton	65.00	212.50
Cotton (Raw)	ton	308.00	591.00
Maize	ton	78.00	176.00
Soiling Corn (Wet)	ton	12.00	10.00
Berseem (Wet)	ton	12.00	10.00
Wheat	ton	83.00	204.20
Tomatoes	ton	63.50	53.00
Beef	ton	1,800.00	1,202.30
Hide	piece	12.00	10.00
Urea (N: 46%)	ton	89.22	233.00
S.P. (P_2O_5: 15%)	ton	27.30	66.23
Captan	kg	1.73	7.86
MEP	ℓ	1.89	8.60
Kasugamycin	kg	0.11	0.51
Topzin-M	kg	3.42	15.56
DCPA	ℓ	1.23	5.57
Corbex	ℓ	2.98	13.55
CAT	kg	2.35	10.68
Gozaprim	kg	2.05	10.15
Diesel Oil	ℓ	0.03	0.13
Kerosene	ℓ	0.03	0.13
Operator	day	1.50	1.25
Common Labor	day	3.00	2.51

From these lands, L.E. 921 thousand of net production value is brought out as shown in Table VI-2, and further increase of N.P.V. is not expected, because these land is cultivated illegally and has limitation of water resources for irrigation.

2) With Project

i) Beneficial area

Although total project area is 31,400 ha, net irrigable area is estimated at 20,900 ha, and the balance is considered to be those area for canals, roads, new villages and so on. Cropping intensity for the net irrigable area would be 200 percent with both summer and winter cultivation (for further details, refer to Annex J)

ii) Net production value

Since benefit arising from such fodder crops as soiling corn and berseem is evaluated in the livestock development, total net production value of paddy, cotton, maize and wheat is estimated at L.E. 17,693 thousand after full development, of which details are given in Table VI-3.

As mentioned in Annex D "Agriculture", total 88,400 heads of beef cattle will be fed by the Project production of soiling corn, berseem and paddy straw after full development of the Project. It is planned to feed 100 heads of beef cattle as one herd, and thus total 884 herds will be fed, and composition per herd is 30 heads of calves, 30 heads of up-bringing cattle and 40 heads of cattle.

Net production value is estimated at L.E. 2,150 per herd, of which details are given in Table VI-4. Thus, total net production value of livestock development will be L.E. 1,900 thousand after full development of the Project.

iii) Economic benefit

An economic benefit after full development of the Project can be estimated as follows;

Table VI-2 Net Production Value without Project

I. N.P.V. per ha

	Paddy	Cotton	Wheat	Vegetables 1/
Yield (ton/ha)	2.9	1.1	1.6	8.0
Unit Price (L.E./ton)	212.5	591.0	204.2	53.0
G.P.V. (L.E.)	616.25	650.10	326.72	424.00
Production Cost (L.E.)				
Seed	29.40	82.60	36.00	2.50
Fertilizers	27.60	31.80	14.95	31.80
Agr. Chemicals	-	5.82	-	15.56
Fuel	4.11	3.08	3.65	3.08
Agr. Machinery 2/	17.54	13.54	15.56	13.54
Labor	203.35	158.66	79.94	126.32
Miscellaneous	28.20	29.55	15.01	19.28
Sub-total	310.20	325.05	165.11	212.08
N.P.V. (L.E.)	306.05	325.05	161.61	211.92

II. Total N.P.V.

	Paddy	Cotton	Wheat	Vegetables	Total
Cropped Area (ha)	1,600	800	800	200	3,400
N.P.V. per ha (L.E./ha)	306.05	325.05	161.61	211.92	-
Total N.P.V. (L.E.1,000)	490	260	129	42	921

Note: 1/ In terms of tomatoes as representative
2/ Including cost for operator

Table VI-3 Net Production Value with Project

I. N.P.V. per ha

	Paddy	Cotton	Wheat	Vegetable [1]
Yield (ton/ha)	7.1	3.0	5.3	4.3
Unit Price (L.E./ton)	212.5	591.0	176.2	204.2
G.P.V. (L.E./ha)	1,508.75	1,773.00	933.86	878.06
Production Cost (L.E./ha) [1]				
Seed	29.40	82.60	9.00	36.00
Fertilizers	77.05	99.60	82.80	59.80
Agr. Chemicals	145.21	90.74	64.88	63.12
Fuel	31.49	24.58	31.08	27.43
Agr. Machinery [2]	189.44	144.02	181.31	150.16
Labor	127.87	212.83	90.55	62.32
Miscellaneous	56.97	65.44	45.96	39.88
Sub-total	657.43	719.81	505.58	438.71
N.P.V. (L.E./ha)	851.32	1,053.19	428.28	439.35

II. Total N.P.V.

	Paddy	Cotton	Maize	Wheat	Total
Cropped Area (ha)	6,900	6,900	3,550	6,900	24,250
N.P.V. per ha (L.E./ha)	851.32	1.053.19	428.28	429.35	-
Total N.P.V. (L.E.1,000)	5,874	7,267	1,520	3,032	17,693

Note: 1/ Details are referred to Appendix J-2.
2/ Including cost for operator

Table VI-4 Net Proudction Value per Herd

I. Gross Production Value (per herd)

Beef Production	
Number of cattle to be slaughtered	40 nos
Live weight	450 kg
Yield of meat	50 %
Beef production	9 tons
Unit price of beef	L.E. 1,200 per ton
G.P.V.	L.E. 10,800
Hide Production	
Number of hide	40 peices
Unit price of hide	L.E. 10 per peice
G.P.V.	L.E. 400
Total G.P.V.	L.E. 11,200

II. Production Cost

	Requirement/herd (ton)	Unit Cost (L.E./ton)	Total Cost (L.E.)
Feed 1/			
Soiling Corn	241	7.13	1,718
Full-term Berseem	445	6.09	2,710
Catch-cropping Berseem	229	10.03	2,297
Sub-total	-	-	6,725
Labor	-	-	700
Artificial Insemination	-	-	467
Medicine, etc	-	-	333
Miscellaneous	-	-	825
Total	-	-	9,050

III. Net Production Value per herd L.E. 2,150

Note: 1/ Direct economic production cost and see Appendix J-2.

	(L.E. thousand)
N.P.V. with project	
crop production	17,693
livestock production	1,900
Sub-total	19,593
N.P.V. without project	921
Incremental N.P.V.	18,672

Thus, it is expected that L.E. 18,672 thousand will be arising from the Project as the economic benefit after its full development.

iv) Benefit accrual

It is planned to develop 31,400 ha of the Project area by phasing, and it is expected to obtain the first project output in the 5th project year. In the economic evaluation, the following benefit accrual is assumed to reach its full benefit.

Project Year	Percent to Full Benefit (%)
5	5
6	15
7	30
8	40
9	50
10	60
11	70
12	80
13	85
14	90
15	95
16	100

VI-2-4. Economic Cost

1) General

An economic cost to be used in the economic evaluation must be real cost to the national economy, and then transfer payments such as taxes, subsidy, cost for land acquisition and compensation, price contingency and so on, are deducted from the financial cost.

In the financial cost, costs of construction equipment are valued from their purchasing prices, but in the economic cost, such equipment costs are valued at their depreciation costs.

Further, a local currency portion in the financial cost is converted into its border price by applying the standard conversion factor.

2) Initial Cost

The initial cost consists of those costs for civil works, agricultural development (livestock development), operation and maintenance during construction period, project facilities, project administration, consulting services and physical contingency.

The estimated total economic cost is L.E. 51,111 thousand of which about 57 percent or L.E. 29,332 thousand is foreign currency portion and the rest, L.E. 21,779 thousand is local currency portion (See Table VI-5).

Table VI-6 shows annual disbursement schedule of the economic cost over seven years of construction period.

3) Operation and Maintenance Cost

To successfully manage the Project, an operation and maintenance cost will be recurrently required, which is estimated at L.E. 1,065 thousand, and it is assumed to expend the O & M cost by the following schedule;

Project Year	4th	5th	6th	7th	8th	9th & further
Percent of O & M cost (%)	5	10	25	50	90	100
O & M cost (L.E. thousand)	53	107	266	533	959	1,065

Table VI-5 Economic Project Cost

(Unit: 1,000 LE / US$)

Description	Total (LE)	Foreign Currency (LE)	Foreign Currency (US$)	Local Currency (LE)	Local Currency (US$)	Remarks
1. Civil Works						
1-1. Preparation	151	83	(119)	68	(97)	Exchange Rate
1-2. Pumping Station (Irrigation	8,831	7,763	(11,090)	1,068	(1,526)	LE = 0.7 US$
1-3. Pumping Station (Drainage)	1,368	1,264	(1,806)	104	(149)	
1-4. Irrigation Canal						
Main Canal	3,028	1,360	(1,943)	1,668	(2,383)	
Secondary Canal	3,836	2,386	(3,408)		(2,071)	
1-5. Drainage Canal						
Main D. Canal	2,086	1,453	(2,076)	633	(904)	
Secondary D. Canal	2,472	1,413	(2,019)	1,059	(1,513)	
1-6. On-farm Facilities	14,562	7,880	(11,257)	6,682	(9,546)	
1-7. Road	1,048	219	(313)	829	(1,184)	
Sub-total	37,382	23,821	(34,031)	13,561	(19,373)	
2. Land Acquisition and Compensation	-	-	(-)	-	(-)	
3. Construction Equipment	-	-	(-)	-	(-)	
4. Agricultural Development	3,356	484	(691)	2,872	(4,103)	
5. Operation and Maintenance Cost	373	-	(-)	373	(533)	
6. Project Facilities	590	89	(127)	501	(716)	
7. Project Administration (8%)	1,385	-	(-)	1,385	(1,979)	
8. Consultant Services	1,358	1,112	(2,029)	246	(351)	
Total (1 to 8)	44,444	25,506	(36,438)	18,938	(27,055)	
9. Contingency (15%)	6,667	3,826	(5,466)	2,841	(4,059)	
Total (1 to 9)	51,111	29,332	(41,903)	21,779	(31,114)	

Table VI-6 Disbursement Schedule of the Economic Cost

(Unit: 1,000 LE)

Description	Total		1982		1983		1984		1985		1986		1987		1988	
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
1. Civil Works																
1-1. Preparation	83	68	-	-	83	68	-	-	-	-	-	-	-	-	-	-
1-2. Pumping Station (Irrigation)	7,763	1,068	-	-	3,105	427	4,658	641	-	-	-	-	-	-	-	-
1-3. Pumping Station (Drainage)	1,264	104	-	-	1,138	94	126	10	-	-	-	-	-	-	-	-
1-4. Irrigation Canal																
Main Canal	1,360	1,668	-	-	-	-	204	250	340	417	340	417	272	334	204	250
Secondary Canal	2,386	1,450	-	-	-	-	358	218	477	290	477	290	477	290	597	362
1-5. Drainage Canal																
Main D. Canal	1,453	633	-	-	291	127	726	316	436	190	-	-	-	-	-	-
Secondary	1,413	1,059	-	-	140	107	283	212	283	212	283	212	283	212	141	104
1-6. On-farm	7,880	6,682	-	-	788	668	1,576	1,336	1,576	1,336	1,576	1,336	1,576	1,336	788	670
1-7. Road	219	829	-	-	-	-	30	84	53	207	52	207	52	207	32	124
Sub-total	23,821	13,561	-	-	5,545	1,491	7,961	3,067	3,165	2,652	2,728	2,462	2,660	2,379	1,762	1,510
2. Land Acquisition and Compensation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Construction Equipment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4. Agricultural Development	484	2,872	-	-	-	-	-	-	-	431	-	862	-	862	484	717
5. Operation and Maintenance Cost	-	373	-	53	-	53	-	53	-	53	-	53	-	54	-	54
6. Project Facilities	89	501	89	250	-	251	-	-	-	-	-	-	-	-	-	-
7. Project Administration	-	1,385	-	24	-	144	-	250	-	251	-	270	-	264	-	182
8. Consultant Service	1,112	246	168	37	246	55	155	34	155	34	155	34	155	34	78	18
Total (1 to 8)	25,506	18,938	257	364	5,791	1,994	8,116	3,404	3,320	3,421	2,883	3,681	2,815	3,593	2,324	2,481
9. Contingency (15%)	3,826	2,841	39	55	869	299	1,217	511	498	513	432	552	422	539	349	372
Total (1 to 9)	29,332	21,779	296	419	6,660	2,293	9,333	3,915	3,818	3,934	3,315	4,233	3,237	4,132	2,673	2,853

4) Replacement Cost

Since some of pumping facilities have lesser durable life than the project life, total amount of L.E. 1,427 thousand would be required as a replacement cost once every 15 years after their installation.

5) On-farm Cost (Farm Drains)

It is assumed that costs for digging farm drains on-farm level are born by farmers themselves, of which unit cost is estimated at L.E. 230.7 per ha (L.E. 96.9 per feddan) for gross irrigable lands (26,800 ha), and the total cost would be L.E. 6,183 thousand.

All the costs of L.E. 6,183 thousand are considered local currency portion, thus the total economic cost would be L.E. 5,163 thousand by applying the standard conversion factor which will be equally disbursed in five years after the 3rd project year.

Also, it is assumed that the government will expend these cost in the beginning and be repaid by farmers in four years after the second year of farmers' settlement.

VI-2-5. Economic Internal Rate of Return (EIRR)

By discounting both streems of economic benefit and cost at several discount rates, the economic internal rate of return can be worked out. Table VI-7 shows streams of economic benefit and cost over project life. Summarizing the total present worth of benefit and cost, 16.3 percent of economic internal rate of return for the project has been worked out as shown in Table VI-8 and Figure VI-1 (For further details, see Annex J).

The EIRR of 16.3 percent shows definitely that the proposed project is economically feasible.

Table VI-7. ***** STREAMS OF PROJECT COST AND BENEFIT *****

(UNIT: L.E. THOUSAND)

PROJECT YEAR	PROJECT COST				PROJECT BENEFIT	NET BENEFIT
	INITIAL COST	REPLACE. COST	O & M COST	TOTAL		
1	715	-	-	715	-	-715
2	8953	-	-	8953	-	-8953
3	14280	-	-	14280	-	-14280
4	8784	-	53	8837	-	-8837
5	8580	-	107	8687	934	-7753
6	8401	-	266	8667	2801	-5866
7	6561	-	533	7094	5802	-1292
8	-	-	959	959	7469	6510
9	-	-	1065	1065	9336	8271
10	-	-	1065	1065	11203	10138
11	-	-	1065	1065	13070	12005
12	-	-	1065	1065	14938	13873
13	-	-	1065	1065	15871	14806
14	-	-	1065	1065	16805	15740
15	-	-	1065	1065	17738	16673
16	-	-	1065	1065	18672	17607
17	-	-	1065	1065	18672	17607
18	-	-	1065	1065	18672	17607
19	-	1427	1065	2492	18672	16180
20	-	-	1065	1065	18672	17607
21	-	-	1065	1065	18672	17607
22	-	-	1065	1065	18672	17607
23	-	-	1065	1065	18672	17607
24	-	-	1065	1065	18672	17607
25	-	-	1065	1065	18672	17607
26	-	-	1065	1065	18672	17607
27	-	-	1065	1065	18672	17607
28	-	-	1065	1065	18672	17607
29	-	-	1065	1065	18672	17607
30	-	-	1065	1065	18672	17607
31	-	-	1065	1065	18672	17607
32	-	-	1065	1065	18672	17607
33	-	-	1065	1065	18672	17607
34	-	1427	1065	2492	18672	16180
35	-	-	1065	1065	18672	17607
36	-	-	1065	1065	18672	17607
37	-	-	1065	1065	18672	17607
38	-	-	1065	1065	18672	17607
39	-	-	1065	1065	18672	17607
40	-	-	1065	1065	18672	17607
41	-	-	1065	1065	18672	17607
42	-	-	1065	1065	18672	17607
43	-	-	1065	1065	18672	17607
44	-	-	1065	1065	18672	17607
45	-	-	1065	1065	18672	17607
46	-	-	1065	1065	18672	17607
47	-	-	1065	1065	18672	17607
48	-	-	1065	1065	18672	17607
49	-	-	1065	1065	18672	17607
50	-	-	1065	1065	18672	17607

Table VI-8.

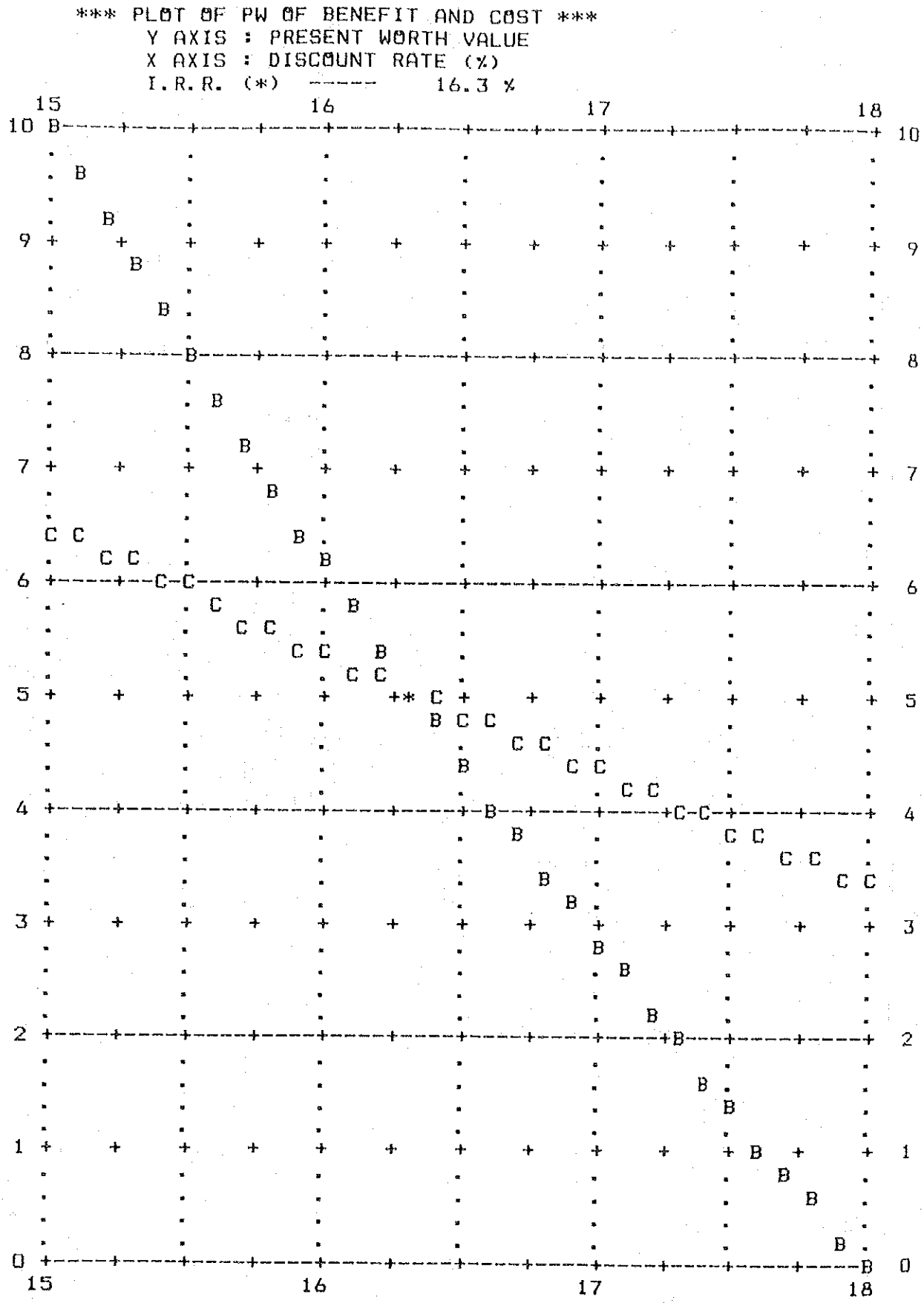
***** CALCULATION OF INTERNAL RATE OF RETURN *****

(UNIT: L.E. THOUSAND)

DISCOUNT RATE	+++++ PRESENT WORTH BENEFIT	+++++ COST	B/C RATIO
5.00 %	213361.	60768.	3.51
7.50 %	128371.	51068.	2.51
10.00 %	82620.	44355.	1.86
12.50 %	56060.	39311.	1.43
15.00 %	39640.	35307.	1.12
17.50 %	28958.	32008.	0.90
20.00 %	21716.	29221.	0.74
22.50 %	16638.	26824.	0.62
25.00 %	12978.	24736.	0.52
27.50 %	10279.	22899.	0.45

INTERNAL RATE OF RETURN ---------- 16.3 %

Fig. VI-1.


*** PLOT OF PW OF BENEFIT AND COST ***
Y AXIS : PRESENT WORTH VALUE
X AXIS : DISCOUNT RATE (%)
I.R.R. (*) ----- 16.3 %
15
16
17
18
10
9
8
7
6
5
4
3
2
1
0

VI-2-6. Sensitivity Analysis

Sensitivity analysis is an effective measure the examine riskness of the proposed project. The analysis is usually made on change of key factors in the Project. In this report the following items are taken for the sensitivity analysis.

I.	Initial Investment Cost	10% increase
II.	Construction Period	1 year extension
III.	Crop Yields	10% decrease
IV.	Prices of Project Outputs	10% decrease
V.	Including Costs of El Salam Canal	

By calculating EIRRs for the above items, results of the sensitivity analysis are summarized below;

Case	Item	EIRR (%)
I	10% increase of initial cost	15.4
II	one year extension of construction period	15.4
III	10% decrease of crop yields	13.6
IV	10% decrease of project output prices	13.6
V	Including Costs of El Salam Canal	11.8

VI-3. Farm Budget Analysis

VI-3-1. Farm Size and Family Size

In the proposed project, most of all cultivable lands is newly reclaimed, and it is planned to provide five feddans of gross cultivable area to every new settlers under the government policy. Therefore, a representative farm size can be considered 2.1 ha (5 feddans) of gross area, of which net irrigable are is 1.64 ha (3.9 feddans).

On the basis of interview to farmers who are dwelling nearby the Project Area, an average family size is six and workable person can be accounted for two in a family during peak period for cultivation and 1.5 during usual period.

VI-3-2. Labor Balance

According to monthly labor requirement per farm with the proposed cropping pattern for 1.64 ha of net irrigable area, peak requirement happens month of September, accounting for 363 man-hours, which can be met by two men with workable days of 25 per month and working hours of eight per day. Therefore, each family does not require any hired labor in his cultivation throughout a year (For further details, refer to Annex J).

VI-3-3. Farm Income and Off-Farm Income

On the basis of financial crop returns per ha, farm size and the proposed cropping pattern, total amount of L.E. 1,009 per farm will be gained through their cultivation of proposed crops (See Table VI-9).

It is planned to take two years for leaching after settlement and three years for the tentative cropping pattern, during which farmers will have chance to work for construction works of the Project as an unskilled labor.

Table VI-9 Farm Budget after Full Development

I. Farm Size : 2.1 ha (5 feddans)

II. Faily Size : 6

III. Net Irrigable Area : 1.64 ha (3.9 feddans)

IV. Farm Income

	Cropped Area (ha)	G.P.V. (L.E.)	Farm Cost (L.E.)	Net Income (L.E.)
Paddy	0.54	249	164	85
Cotton	0.54	499	128	371
Maize	0.28	116	75	41
Soling Corn	0.28	202	72	130
Berseem (F)	0.54	369	136	233
Berseem (C)	0.56	192	111	81
Wheat	0.54	193	125	68
Total	3.28	1,820	811	1,009

V. Other Expenses

Mortgage Repayment (Land & House)	L.E. 278
Land Tax	L.E. 25
O & M Cost	L.E. 107
Sub-total	L.E. 410

VI. Disposal Income L.E. 599 (L.E. 877)[1/]

VII. Cost of Living

Subsistence Level	L.E. 444
Desirable Level	L.E. 804

Note: 1/ Disposal income of L.E. 877 will be obtainable at 27th year and further after settlement.

Assuming that one and half man-day per family is considered workable for 25 days per month, it is expected that one farm family will obtain L.E. 675 of wage in the first two years after settlement and L.E. 467 in the following three years.

VI-3-4. Other Expenses

Assuming that farmers will purchase their farm land at cost of L.E. 1,000 per feddan and their house at L.E. 1,000 per house, their mortgage repayment would be L.E. 278 as full burden from the 8th year after settlement. The payment upto 7th year is shown in Table VI-10 by following the Cabinet Decree Nr. 288.1979.

Loan repayment for the costs of on-farm drains will be L.E. 121 annually in four years from the second year after settlement. The loan is expected to be made through the Principal Bank for Development and Agricultural Credit.

Land tax will be chargeable from the 7th year after settlement as verified in Table VI-10, of which total amount is L.E. 25 per farm or L.E. 5 per feddan.

The operation and maintenance cost has been estimated at L.E. 1,065 thousand annually, which is equivalent to L.E. 51 per ha or L.E. 107 per farm. Farmers will be able to bear the amount of L.E. 107 from the 9th year after settlement.

VI-3-5. Conclusion

As shown in Tables VI-9 and VI-10, farmers can maintain their subsistence level of living (L.E. 444 per year) upto 26th year after settlement and enjoy the desirable level of living L.E. 804 per year from 27th year and further.

Table VI-10 Summary of Financial Cash Flow

(Unit: L.E.)

	Years after Settlement								
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Gross Farm Income	-	-	502	728	954	976	1,336	1,665	1,820
Farm Cost	-	-	355	525	641	626	758	811	811
Net Farm Income	-	-	147	203	313	350	578	844	1,009
Off Farm Income	675	675	467	467	467	-	-	-	-
Total Farm Income	675	675	614	670	780	350	578	844	1,009
Subsistence Living	444	444	444	444	444	444	444	444	444
Surplus	231	231	170	226	336	-94	134	400	565
Mortgage Repayment		60	60	120	120	180	180	278	278
Loan Repayment		121	121	121	121	-	-	-	-
Balance	231	50	-11	-15	95	-274	-46	122	287
(Balance Accumulated)	(231)	(281)	(270)	(255)	(354)	(80)	(34)	(156)	(443)