C. IRRIGATION REQUIREMENTS

1. Irrigation Requirements

1-1 Calculation Procedures

Irrigation requirements are determined by multiplying crop water requirements (net irrigation requirements) by irrigation efficiency. The crop water requirements are calculated using the "Pan Evaporation Method[1]" on the basis of pan evaporation data, since this method is the most widely used in the world and values aquired by this method are very near to real evapotranspiration values. Climatic data, that is, evaporation, humidity and wind velocity used for study are from the nearest station located at Ismailia[2]. Calculation procedure is shown in Fig. IV.C.1 and major formulas are as follows:

(1) $ETo = Kp \times ET$

(2) $ETcrop = kc \times ETo$

where, ETo : reference crop evapotranspiration (mm/day)
Kp : pan coefficient
ET : pan evaporation (mm/day)
ETcrop: crop evapotranspiration (mm/day)
(Crop Water Requirements)
kc : crop factor

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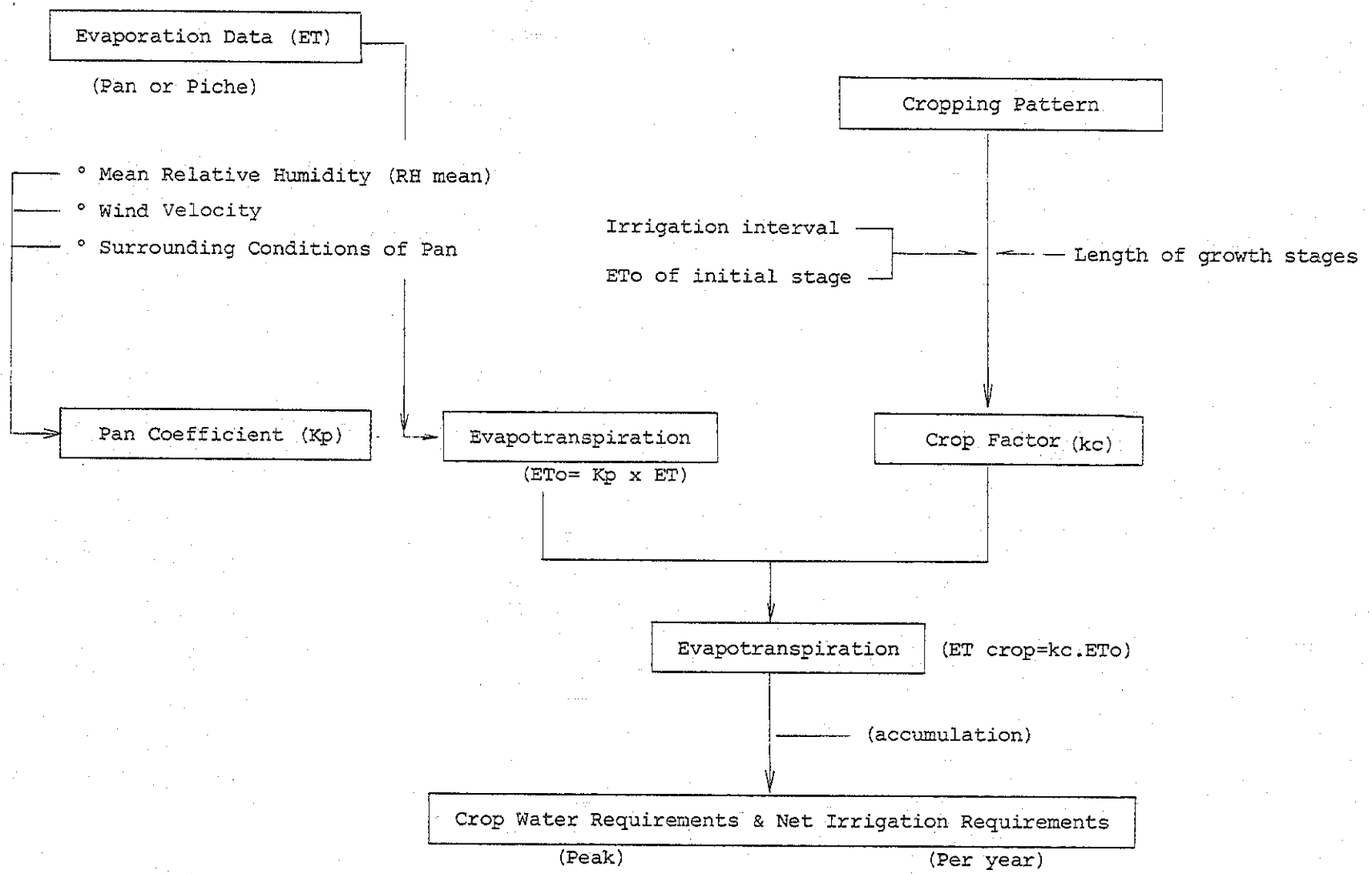
1) FAO IRRIGATION AND DRAINAGE PAPER 24, "CROP WATER REQUIREMENTS", Rome 1977, p.30

2) "CLIMATOLOGICAL NORMALS FOR THE ARAB REPUBLIC OF EGYPT UP TO 1975" Meteorological Authority, Cairo, July 1979, P. 116, 117

Fig. IV.C.1 Flow Chart of the Calculation for Irrigation Requirements



1-2 Crop Water Requirements

Crop water requirements calculated by the Pan Evaporation Method are shown as Table IV.C.1 and Fig. IV.C.1 and details are shown as related tables and figures in Appendix. These show that peak crop water requirements (weighted mean in June) reach 6.7 mm/day or 28.11 m^3/day/fed and the annual total is 5,900 m^3/year/fed. These amounts mean net irrigation requirements. The requirements by each cropping type are shown in Appendix and they differ slightly both in peak period and in annual total. Each crop water requirement varies 3.9 mm/day of barley to 9.7 mm/day of summer tomatoes and 7.9 mm/day of perennial alfalfa comparatively. In the procedure of field irrigation facilities design the amount of 9.7 mm/day is adoptable for vegetable and fodder fields and the 6.3 mm/day for fruit orchards separately.

Table IV.C.1 Crop Water Requirement (1)

Vegitation	Period	Crop	Fed. %	Month	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun	7 Jul	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Unit	NOTE (Peak) mm/day
				ETo	3.4	3.6	5.0	7.1	7.1	8.3	7.4	6.6	5.4	4.2	3.7	3.6	mm/day	
Fodder	Winter	Berseem	17	kc	1.05	1.05	1.05	0.95						0.71	0.88	1.05		
				ET crop	3.6	3.8	5.3	6.8						3.0	3.3	3.8	mm/day	6.8
Vegetable		Potatoes	14	kc	0.76	0.96	1.15	0.91										
				ET crop	2.6	3.5	5.8	6.5									"	6.5
		Tomato	14	kc	1.20	1.20	0.93							0.71	0.83	1.11		
				ET crop	4.1	4.3	4.7							3.0	3.1	4.0	"	4.7
Fodder		Barley	2	kc	1.15	1.03	0.22								0.77	1.09		
				ET crop	3.9	3.7	1.1								2.9	3.9	"	3.9
Vegetable		Straw-berry	0.4	kc	1.15	0.50									0.79	1.12		
				ET crop	3.9	1.8									2.9	4.0	"	4.0
		Beans	0.4	kc	1.15	0.50									0.79	1.12		
				ET crop	3.9	1.8									2.9	4.0	"	4.0
				kc														
				ET crop														
				kc														
				ET crop														
	Weighted Mean (Sub-total)			ET crop	1.5	1.7	2.2	2.0						0.9	1.0	1.2	mm/day	

NOTE: Above factors were calculated by "Pan Evaporation Method" which was authorized by F.A.O. of THE UNITED NATIONS.

Table IV.C.1 Crop Water Requirement (2)

Vegitation	Period	Crop	Fed. %	Month	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun	7 Jul	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Unit	NOTE (Peak) mm/day
				ETo	3.4	3.6	5.0	7.1	7.1	8.3	7.4	6.6	5.4	4.2	3.7	3.6	mm/day	
	Summer	Sorghum	10	kc					0.19	0.69	1.07	1.07	0.49					
				ET crop					1.4	5.7	7.9	7.1	2.7				mm/day	7.9
		Sesame	7	kc					0.18	0.69	1.07	1.10	0.93	0.08				
				ET crop					1.3	5.7	7.9	7.3	5.0	0.3			"	7.9
		Cucum-ber	15	kc					0.57	0.66	0.93	0.93	0.13					
				ET crop					4.1	5.5	6.9	6.1	0.7				"	6.9
		Water-melon	11	kc					0.18	0.62	0.92	1.0	0.58					
				ET crop					1.3	5.2	6.8	6.6	3.1				"	6.8
		Ground Nuts	3	kc					0.18	0.58	0.79	1.03	0.98	0.22				
				ET crop					1.3	4.8	5.9	6.8	5.3	0.9			"	6.8
		Tomatoes	0.4	kc					0.57	0.81	1.17	1.19	0.73					
				ET crop					4.0	5.8	9.7	8.8	4.8				"	9.7
				kc														
				ET crop													"	
				kc														
				ET crop													"	
Weighted Mean. (Sub-total)				ET crop					1.0	2.5	3.3	3.0	1.2	0.1			mm/day	

NOTE: Above factors were calculated by "Pan Evaporation Method" which was authorized by F.A.O. of THE UNITED NATIONS.

Table IV.C.1 Crop Water Requirement (3)

Vegitation	Period	Crop	Fed. %	Month	1 Jan.	2 Feb.	3 Mar.	4 Apr.	5 May	6 Jun	7 Jul	8 Aug.	9 Sep.	10 Oct.	11 Nov.	12 Dec.	Unit	NOTE (Peak) mm/day
				ETo	3.4	3.6	5.0	7.1	7.1	8.3	7.4	6.6	5.4	4.2	3.7	3.6	mm/day	
Fooder	Pere-nnial	Alfalfa	3	kc	0.6	0.6	0.6	0.88	0.95	0.95	0.95	0.95	0.95	1.05	0.87	0.7		
				ET crop	2.0	2.2	3.0	6.3	6.8	7.9	7.0	6.3	5.1	4.4	3.2	2.5	mm/day	7.9
		Nepia Grass	3	kc	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9		
				ET crop	3.1	3.2	4.5	6.4	6.4	7.5	6.7	5.9	4.9	3.8	3.3	3.2		7.5
Fruits		Citrus	49	kc	0.65	0.65	0.60	0.60	0.60	0.73	0.85	0.85	0.70	0.55	0.60	0.60		
				ET crop	2.2	2.3	3.0	4.3	4.3	6.1	6.3	5.6	3.8	2.3	2.2	2.2		6.3
Weighted Mean (Sub-total)				ET crop	1.2	1.3	1.6	2.4	2.4	3.4	3.4	3.0	2.1	1.3	1.2	1.2	mm/day	
Weighted Mean (Total)				kc														
				ET crop	2.7	3.0	3.8	4.4	3.4	5.9	6.7	6.0	3.3	2.3	2.2	2.4	"	1,400 mm/year
Net Water Demand (m^3/day/Fed.)					11.3	12.6	16.0	18.5	14.3	24.8	28.1	25.2	13.9	9.7	9.2	10.1		5,900m^3/year/Fed

NOTE: Above factors were calculated by "Pan Evaporation Method" which was authorized by F.A.O. of THE UNITED NATIONS.

1-3 Irrigation Requirements

Irrigation requirements are determined finally, considering the irrigation efficiency (Ei), consisting of conveyance efficiency (Ec) and field application efficiency (Ea), and have a great effect on the quantity of irrigation water, the capacity of various irrigation facilities and project cost.

Conveyance efficiency is estimated sufficiently as 95 per cent, by the factors of the pipeline system, it is difficult to suppose the differential settlement of pipelines and leakage of water flow, this considers achievement of good workmanship of construction and construction supervision.

Field irrigation effiency is considered for both the sprinkling system of the vegetable and fodder fields and the trickle system of the fruit fields, respectively. The efficiency of the sprinkling system is affected by the factors of climatic condition, topography and crops. In the Project area the slope is rather moderate (1:500) and the proposed windbreak would serve the purpose of decreasing the existing wind velocity (approximately 2 m/sec) especially during the sand storm season. After the Project construction, existing desert land with dry climate would be green fields of about 8,000 ha and the change of covered surface condition would result in a rather humid climate in the Project area. The efficiency, therefore, is estimated at 90 per cent.

The field application efficiency of the trickle system is generally designed at the level of 95 to 100 per cent in fields and in green houses. In the Project the efficiency is adopted at 95 per cent because of field cultivation.

The irrigation efficiency (Ei) is determined as follows;

$$Ei = Ec \cdot Ea = 0.95 \times 0.90 = 0.855 = 0.85 \text{ (sprinkling system)}$$
$$= 0.95 \times 0.95 = 0.903 = 0.90 \text{ (drip system)}$$

The irrigation requirements can be computed from the equation:

$$q = ET\ crop \times \frac{1}{Ei} \times \frac{1}{86.400} \times 4.2 \times A \times \frac{24}{Ti}$$

where: q = irrigation requirements (ℓ/sec/Fed)

ET crop = Crop water requirements (mm/day)

Ei = Irrigation efficiency (sprinkling 0.85, drip 0.90)

4.2 = Exchange rate

A = Irrigated acreage or acreage ratio (sprinkling 0.51, drip 0.49)

Ti = Working hours of main pump (24 hrs) or irrigation hours (sprinkling 18 hrs, drip 24 hrs.)

Therefore,

$$q_{24} = 6.7 \times 4.2 \times \frac{1}{86,400} \times \left(\frac{1}{0.85} \times 0.51 + \frac{1}{0.90} \times 0.49\right) \times \frac{24}{24} = 0.3728 \quad \ell/sec/Fed$$

$$q_{18} = 6.7 \times 4.2 \times \frac{1}{86,400} \times \left(\frac{1}{0.85} \times 0.51 \times \frac{24}{18} + \frac{1}{0.90} \times 0.49 \times \frac{24}{24}\right) = 0.4379 \quad \ell/sec/Fed$$

(q_{24}) is the quantity of (unit) irrigation requirements for design of water source facilities and main pipeline and (q_{18}) is that for terminal irrigation facilities from booster pump stations.

2. Drainage

As mentioned in the paragraph of Soil, the effective soil layer in the Project area is generally deep and the permeability of soil is large. Therefore, the possibility of excess water occurring caused by poor permeability is imperceptible. The groundwater in the Project area is generally unconfined aquifer. Most of the groundwater level ranges from 0.5 to 10.4 m below the ground surface, although it's high in some parts. Mean weight diameters of the soil which are derived from particle size distribution of soil are from 0.4 mm to 0.8 mm. Capillary rise of the soil, which is derived in the condition that soil particles are in rhomboidal packing in the soil depth range between 50 cm and 100 cm, is less than 40 cm. Consequently, the possibility of soil salinization caused by groundwater capillarity is imperceptible.

As the results of above mentioned studies, it is not necessary to consider about any special countermeasures for drainage in the Project area. The groundwater level is high in some parts of the Project area, however, the total area of these parts is small. And it is possible to carry out land leveling to fill the soil from the high land around to the depressed area where the groundwater level is high. At all events, it is inadvisable to make a large-scaled drainage plan.

3. Leaching

3-1 Objective

In desert agriculture salt accumulation occurs as a result of the application of irrigation water containing soluble salts. Generally, groundwater has a high rate of salinity and salt accumulation occurs on lands which have a high groundwater table. This is caused by capillary rising of saline water. The development of salt accumulation is harmful for plant growth due to alkalized soil, and weakens the suction ability of plant roots by decreasing capillary water potential. The salinity of irrigation sweet water of the project is between 170 and 190 ppm this value does not influence plant growth. When leaching is not adequate, deleterious salt accumulations develop gradually. Method for controlling soil salinity is as follows;

(1) Salt Tolerance of Crops

Crops were selected according to their resistance to high rates of salinity.

(2) Cultivation

Ridge to prevent the concentration of irrigation water and mulching to reduce ground surface evaporation.

(3) Sweet (high quality) Water Application

Application of low level salinity water.

(4) Irrigation Method

Surface irrigation, applies a lot of water, developing much salt accumulation compared with sprinkler irrigation and drip irrigation.

(5) Leaching and Drainage

Salts will be leached whenever water application exceeds evapotranspiration. Wherever the groundwater level rises as a result of irrigation, the drainage system must be improved.

As mentioned above, the irrigation water quality can not be improved, irrigation methods adopted by the Project are sprinkler irrigation and drip irrigation which can reduce salt accumulation. Consequently, only leaching is required for the Project. Groundwater is not considered because the groundwater level is about 5 m below the ground surface.

3-2 Leaching method

(1) Salt accumulation

Development of salt accumulation due to water salinity is caused by irrigation water volume increasing electrical conductivity (ΔECe) in the root zone. The formula can be expressed as follows.

$$\frac{Diw}{Ds} = \frac{ds}{dw} \cdot \frac{SP}{100} \cdot \frac{\Delta ECe}{ECiw}$$

where, Diw: water capacity which increases electrical conductivity (ΔECe) of saturation sampling water.

Ds : leaching Crop root zone (cm)
Vegetable: 60cm
Fruit : 120cm

$\frac{ds}{dw}$: apparent - specific gravity.
set at 1.7 from soil survey results (1.63-1.84)

Sp : water saturation degree (%)
set at 19% from soil survey results (15-23%)

ΔECe: electrical conductivity of saturation sampling water.

ECiw: set at 200 ppm (= 0.4 mmho/cm) from soil survey results (170-190ppm)

therefore, $\frac{Diw}{Ds} = 1.7 \times \frac{19}{100} \times \frac{\Delta ECe}{0.4}$

The crops Diw is from 1,000 mm to 2,000 mm as 10% decline in crop yield and is from 2,000 to 10,000 mm as 100% decline in it whenever the initial value chosen is zero.
The number of years to reach the rate of decline in crop yield can be obtained by Diw/Annual irrigation water capacity. The 100% decline in crop yield takes from 4 to 20 years, the 10% decline takes from 1 to 7 years.

(2) Leaching water

The water capacity for leaching can be obtained from the following formula.

$$LR = \frac{ECiw}{2(\max\ ECe)}$$

$$Ri' = \frac{ET}{1-LR}$$

$$LW = Ri'-ET$$

where, LR : rate of discharge against irrigation water capacity.

ECiw : electrical conductivity of irrigation water (= 0.4 mmho/cm)

max ECe: electrical conductivity of saturation sampling water against a 100% decline in crop yield. (mmho/cm)

Ri' : amount of water to be applied (mm)

ET : consumptive use (mm)

LW : amount of water to be drained (mm)

The amount of water is estimated at about 2% (29 mm per year) of consumptive use. Leaching must be carried out once a year between April and May and after cultivation in order to prevent salinity damage as much as possible.

D. IRRIGATION PROGRAM AND FACILITIES

1. Summary

The water conveyance system of the Project is designed as follows:

The water source is the Tolonbaht Canal which is diverted from the Salhya Canal. First, sweet water is conveyed from the main pump station via the main pipeline to the farm ponds of the ten water management blocks. Next, the sweet water stored in the farm ponds is pumped up and conveyed to hydrants in each field by the secondary pipeline. Water pressure has been planned to be sufficient for operating sprinklers. Both the main pipeline and the secondary pipelines are reticulate in design and power for pumps is supplied by diesel generators. (Fig. IV.D.1)

The above water conveyance system can be explained as follows:

(1) The main reason for selecting a pipeline system is that the water level at the pipe ends - sprinkler heads - is higher than the intakes, further, a pipeline system takes up less space, controls water loss from evaporation and is relatively simple to maintain.

(2) A two stage distribution system - main pumps and booster pumps - is proposed for reducing hazards as the pump stations cover a large irrigation area, also, a high level of water distribution efficiency, and ease of maintenance are considered.

(3) The main pipeline system is proposed to be a reticulate pipeline system, since it is a useful design for this Project which is located on slightly flat land, also equal water distribution and reduction of hazards are achievable.

(4) The Project area is divided into ten irrigation blocks for the farming and water management program.

(5) Diesel generators are proposed as power production is more economical than public utility electric power.

There are other points which were considered such as capacity of supply and starting date of supply. Power for cold storages is also supplied from diesel generators.

(6) A force pump system is proposed, since the elevation of the pump station is higher than that of the pipe ends and water pressure is set at 3.0 kg/cm^2 of the pipe ends for sprinkler method.

(7) The irrigation method adopted are sprinkler method for vegetables and drip method for fruits to reduce water requirements and salt accummulation.

(8) The irrigation area is determined as follows:

Distribution of farm land	18,000	fed.
Reserve area	1,088	"
Pilot farm	20	"
Testing farm	10	"
Training center	40	"
Demonstration farm	100	"
Animal breeding farm	300	"
Nursery	2	"
Total	19,560	fed.

And the irrigation requirement for this area is as follows:

$q = 0.3728\ \ell/sec/fed \times 19,560\ fed = 7.29\ m^3/sec.$

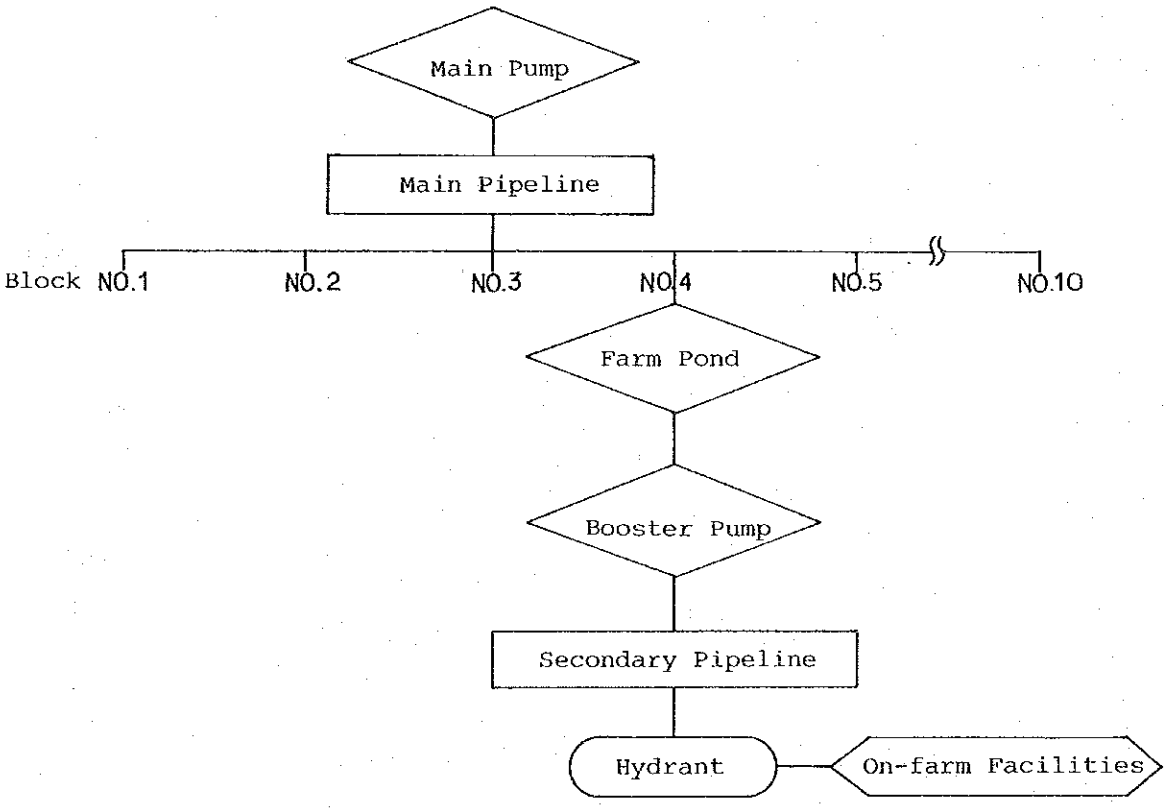


Fig. IV.D.1 Water Conveyance System Chart

2. Main Pump Station

2-1 General

The main pump station conveys sweet water from the Tolonbaht Canal through the intake structure to farm ponds in each irrigation block. The station is located on the right bank of the Tolonbaht Canal.

The elevation of the main pump station is about 15 m above sea level and the highest farm pond is Block No. 8 which is 22 m above sea level.

Power for the main pumps is supplied by diesel generators.

2-2 Main Pump Station

(1) Design Conditions

Capacity: $Q = 7.29\ m^3/sec = 437.4\ m^3/min$
(Irrigation Area = 19,260 fed)

Total Head: H = Actual head + Remaining Pressure + Loss of head
= (22.0 - 15.0) + 5.0 + 15.25
≒ 28 m

(2) Dimensions of Main Pump Station

Pump type	:	Volute pump
Number of sets	:	6 sets
Pump diameter	:	ø800 mm
Total discharge	:	7.29 m^3/min/set x 6 sets = 437.4 m^3/min
Total head	:	28 m
Total power of motor	:	600 kW x 6 sets = 3,600 kW
Power source	:	Diesel generators 2000 kVA x 3 sets = 6000 kVA

(3) Dimensions of Pump House

Structure	:	Reinforced concrete
Floor system	:	2 story
Size	:	33 m length/10 m width/ 9.15 m height

2-3 Design of Diversion Works

(1) Design of Intake Structure

The shape of intake which faces the Tolonbaht Canal is designed according to actual flow conditions.

Hand operated sluice type gates were selected from the viewpoint of maintenance and rough mesh screens were installed in front of the gates.

(2) Guiding Structure

A culvert box is designed for the guiding structure where it crosses under the road. Velocity of design discharge is below 0.5 m/sec, since the culvert box is installed in front of the second row of screens.

(3) Inlet Basin

The guiding structure (Box culvert) is shifted to an inlet basin, behind the second row of screens.

Length of the inlet basin is 24 m and is equal to the space necessary for pump installation.

Design water level can be calculated as follows:

Design water level = Value of drop in water level for first screens + Value of drop in water level for second screens = 0.30 + 0.20 = 0.50 m

This water level originates from the water level of Canal.

Consequently, the height of the suction pipe is designed from the water level of the inlet basin.

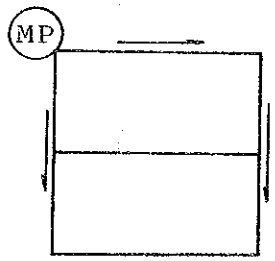
3. Irrigation Water Distribution Plan

3-1 Main Pipeline Design

(1) Study of Distribution Systems

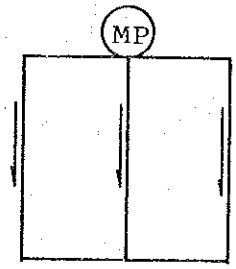
The irrigation water for each block is planned to be conveyed by the main pipeline, and the following 4 types of distribution systems were studied.

1) Case 1 The main pump is established upstream of the main pipeline area and along the Tolonbaht Canal.

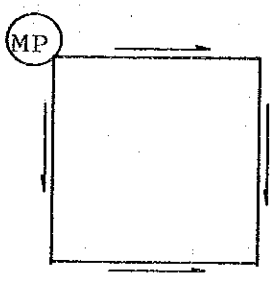


A reticulated pipeline system is adopted to satisfy the route of water conveyance in this case. This reticulated pipeline system reduces the suspension of water conveyance.

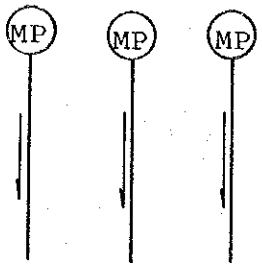
2) Case 2 The main pump is established at the diverging point of the main pipeline area and along the Tolonbaht Canal, and this system reduces the diameters of the pipes. The reticulated pipeline system is adopted to reduce the suspension of water conveyance the same as in Case 1.



3) Case 3 The main pump is established upstream from the main pipeline area and along the Tolonbaht Canal. A circulating water type of reticulated pipeline system is adopted. Compared with case 1 and case 2, one line of pipes which crosses the middle of the area is not needed, however, there is one defect in that the pump head of the booster pump which is established at the fifth block becomes larger to some extent.



4) Case 4 This case offers three main pumps one for each pipeline, and they divide the irrigation water from the Tolonbaht Canal into three routes. This eliminates the necessity of transverse pipelines to connect the pipelines. However, in case the pipeline is damaged or ruptures at some point, suspension of the water supply will occur.



These 4 types of main distribution systems were considrered. As the irrigation area of each of the blocks is large and the security of irrigation water supply is the major premise, a reticulated pipeline system was adopted and multiple routes of water supply were planned. Consequently, case 4 was excluded from the planning.

Case 2 is lower in construction costs compared with Case 1, since the diameters of the main pipes are reduced in Case 2.

The construction cost of Case 2 was compared with that of Case 3 and the result of the comparative study proved that Case 2 is more economical than Case 3, and the distribution sysetm of Case 2 was adopted for this Project.

The comparison of construction costs is shown in Table IV.D.1.

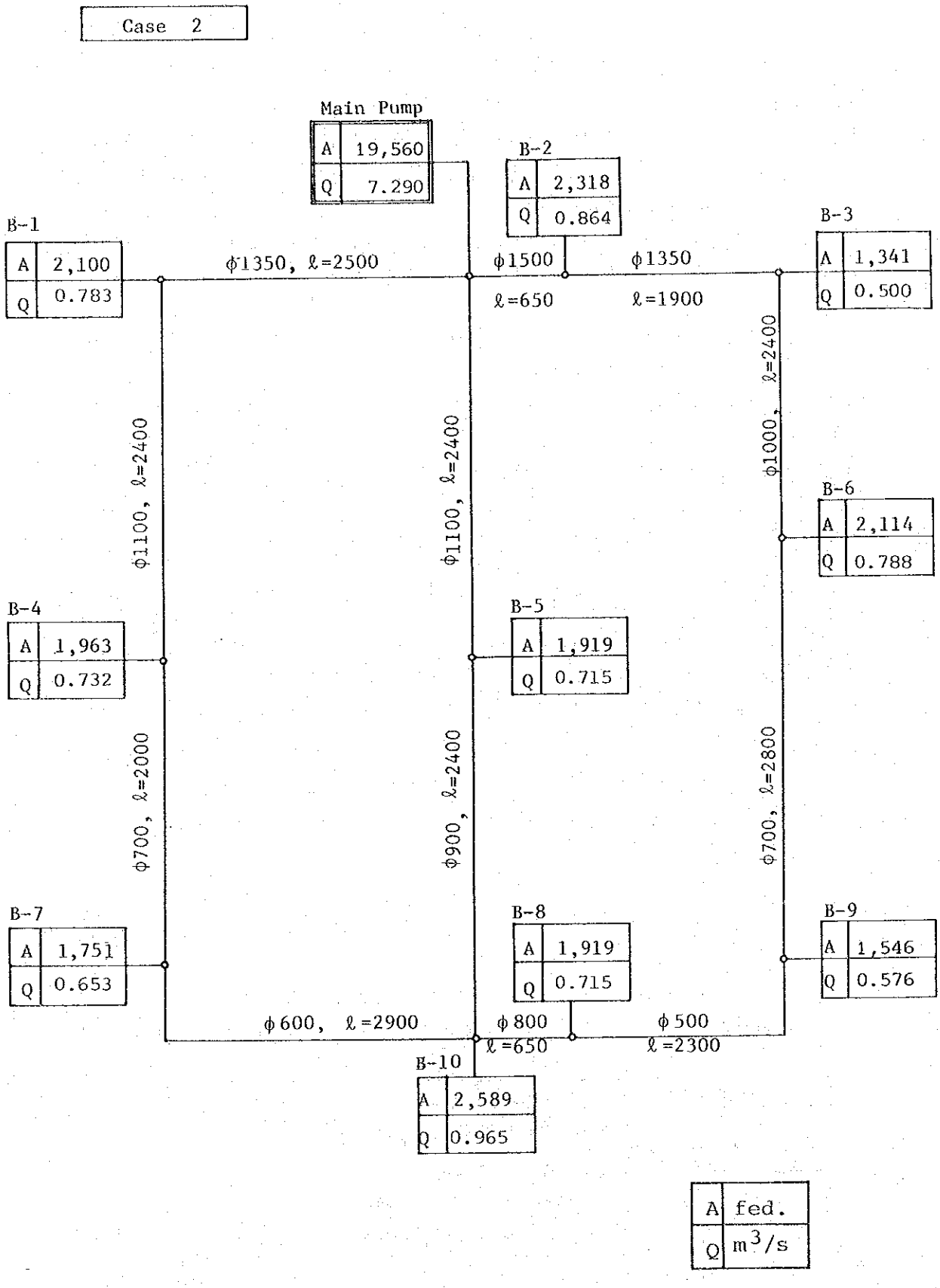
Table IV.D.1 Comparison of Construction Costs

(Unit:L.E.)

	Case 2	Case 3
Material Cost of Pipeline	5,281,000	6,673,000
Cost of Pump Facilities	2,500,000	2,500,000
Total	7,781,000 adopted	9,173,000

* The construction costs were compared for only the material costs, however, the transporation charges are included.

Fig. IV.D.2 Main Pipeline Distribution System



(2) Study of Pipe Material

Pipe material for the distribution system decided in the above item was studied as below.

i) Design Conditions

- Discharge : 4.42 $m^3/s \sim 0.12\ m^3/s$
- Hydrostatic pressure: 2.8 kg/cm^2
- Water hammer : 2.8kg/cm^2

ii) Study of Pipe Material

The following 6 kinds of pipe material were considered.

- Fiberglass-Reinforced Plastic Mortar Pipe (FRPM)
- Vinyl Chloride Pipe (VP.VU)
- Ductile Iron Pipe (DCIP)
- Steel Pipe (S.P.)
- Asbestos Cement Pipe (A.C.P.)
- Pre-stressed Concrete Pipe (P.C.P.)

iii) Selection of Pipe Material

The results of the comparative study on the above mentioned 6 kinds of pipe material strength, durability, workability, economical efficiency and the purpose of utilization proved that Fiberglass - Reinforced Plastic Mortar Pipe (FRPM) is the most appropriate pipe for the Project.
(Appe. Table IV.D.3)

iv) Specifications of Main Pipeline

Specifications of the Main Pipeline are shown below.

. Material of Pipe: Fiberglass-Reinforced Plastic Mortar Pipe (FRPM)

. Diameter : ϕ1500 ~ ϕ400

. Total Length : 37.95 km

v) The Hazen-William Formula shown below was used for the hydraulics accounts. Diameters of the pipes were determined according to the standard water velocity shown in Table IV.D.2.

$$V = 0.35464C\ D^{0.63} \cdot I^{0.54}$$

$$I = \frac{ht}{L} = 10{,}666C^{-1.85} \times D^{-4.87} \times Q^{1.85}$$

Where D: diameter (m)

ht: friction loss of water head (m)

Q: discharge (m^3/sec)

L: pipe length (m)

Table VI.D.2 Standard Value of Designed Water Velocity

Diameter (mm)	Designed water velocity (m/sec)
75 ~ 150	0.7 ~ 1.0
200 ~ 400	0.9 ~ 1.6
450 ~ 800	1.2 ~ 1.8
900 ~ 1,500	1.3 ~ 2.0
1,600 ~ 3,000	1.4 ~ 2.5

3-2 Farm Ponds

A farm pond is installed between the main pipeline and each irrigation block. Booster pumps lift water from the ponds into the secondary pipeline which conveys water to the fields.

(1) Mean Capacity of Farm Ponds

$$V = \frac{D}{8.64}(24 - T) \times 3.6Au$$

where, V: The minimum requested capacity of a farm pond (m^3)

Au: Irrigation Area covered by a farm pond (ha)

D: Weighted mean of gross consumptive use covered by a farm pond (mm/day)

T: Net irrigation hours per day (hr)

Dimensions are:

Au: 1,919 feddan (806 ha) as a standard block (B-8)

D : 7.9 mm/day (as this value can be obtained from the weighted mean of net water requirements (6.7 mm/day) and irrigation efficiency (0.85) 6.7/0.85 = 7.9)

T : 18 hrs for vegetables

24 hrs for fruits

Therefore,

$$V = \frac{7.9}{8.64} (24 - 18) \times 3.6 \times 807 \times 0.51 = 8,118$$

$\fallingdotseq$ 8,200 m^3

(2) Structure of Farm Ponds

There are several types of structures such as reinforced concrete, concrete lining and rubber sheet lining.

From the viewpont of workability, durability and material supply it is proposed that the farm ponds have concrete linings.

3-3 Booster Pump

Booster pumps are installed between the farm ponds and secondary pipelines in order to convey water under pressure to the end of each irrigation block. The inlet basin is located between the farm pond and the booster pump.

(1) Design Conditions

$Q = 0.715\ m^3/sec = 42.90\ m^3/min$ (as A = 1,919 fed)

H = Actual head + Remaining pressure + Loss of head
= 2.0 + 30.0 + (11.0 + 3.0) = 46.0 m

Q: Capacity
H: Total head
A: Irrigation area

(2) Dimensions of Pump Station

Pump type	:	Volute pump
Number of sets	:	3 sets
Pump dimension	:	ø350 mm
Total discharge	:	14.30 m^3/min/set x 3 sets = 42.90 m^3/min
Total head	:	46 m
Total power of motor	:	220 kW x 3 sets = 660 kW
Power source	:	Diesel generators 600 kVA x 2 sets = 1,200 kVA

(3) Dimensions of Pump House

Structure	:	Reinforced concrete
Floor System	:	2 story
Size	:	20 m length x 6 m width x 5.75 m height

3-4 Secondary Pipeline

Secondary pipelines are necessary for conveying water from the farm pond to hydrants located at the end of the pipelines. The pipeline system proposed is a reticulate pipeline system which ensures equal water distribution and safety of operation.

Pipeline system	:	Reticulate pipeline system
Pipe class	:	F.R.P.M. and V.P.
Pipe diameter	:	ϕ800 mm - ϕ200 mm
Pipe length	:	L = 120 km

3-5 Groundwater Utilization and Well Design

As mentioned in the paragraph of Groundwater, the permitted extraction of the grounwater in the Project area is considered to be within 8,400 m^3/ day.

On the other hand, it is necessary to open about 460 feddan for the pilot farm, the trial farm, the exhibition farm and for the rearing pasture at the first stage of the construction. And as the maximum water consumption, about 13,000 m^3/day must be obtained from the groundwater.

Moreover, granting that 200 ℓ, 60 ℓ and 1 ℓ are necessary as the daily livestock water consumption for each dairy cattle, beef cattle and layer respectively, about 1,800 m^3/day of the livestock water should be supplied, since 400 heads of daily cattle, 300 heads of beef cattle and 800,000 layers will be reared at the zenith and the daily livestock water consumption will be 800 m^3, 180 m^3 and 800 m^3 respectively.

Furthermore, the groundwater must be supplied for establishment and maintenance of the windbreak as well. Granting that the area of windbreak is 3% of the total Project area and the maximum daily water consumption is 30 m^3/day/fed, about 600 feddan must be supplied with about 18,000 m^3/day of the groundwater.

Consequently, the total water consumption of the miscellaneous water in the Project area is 33,000 m^3/day, and the consumption can be sufficiently supplied from the permitted extraction of the groundwater.

Wells used in the Project area are required to be superior in yield and durable years.

In order to do that, it is necessary to draft and construct wells with attention to the following:

from the viewpoint of yield,

(1) To set well diameter large enough to pump the yield which is estimated.

(2) To find an aquifer which has a good permeability.

(3) To select a screen which has a large opening ratio.

(4) To carry out sufficient well development after drilling.

from the point of durable years,

(1) To choose casing pipe and a screen which have enough intensity.

(2) To shroud the screen equally with gravel to make an artificial filter layer.

4. Field Irrigation System

4-1 Farm Block

A farming unit is basically set considering the area of one farm household (20 feddan) and the water management plan. These values are as follows.

Field lot of one farm household: 400 m x 210 m
(20 fed = 8.4 ha)

Farming unit: 12 No. households = 240 fed (= 100.8 ha)

Water management block: 108 No. households = 2,160 fed
(= 9,072 ha)

The farming unit is organized by 12 field households.

Further, a water management block is organized by a group of 9 farming units.

The Project area has 10 water management blocks.

The farming unit and water management block are shown in Figs. IV.D-3 and IV.D.4 respectively.

Fig.IV.D.3 Farming Unit

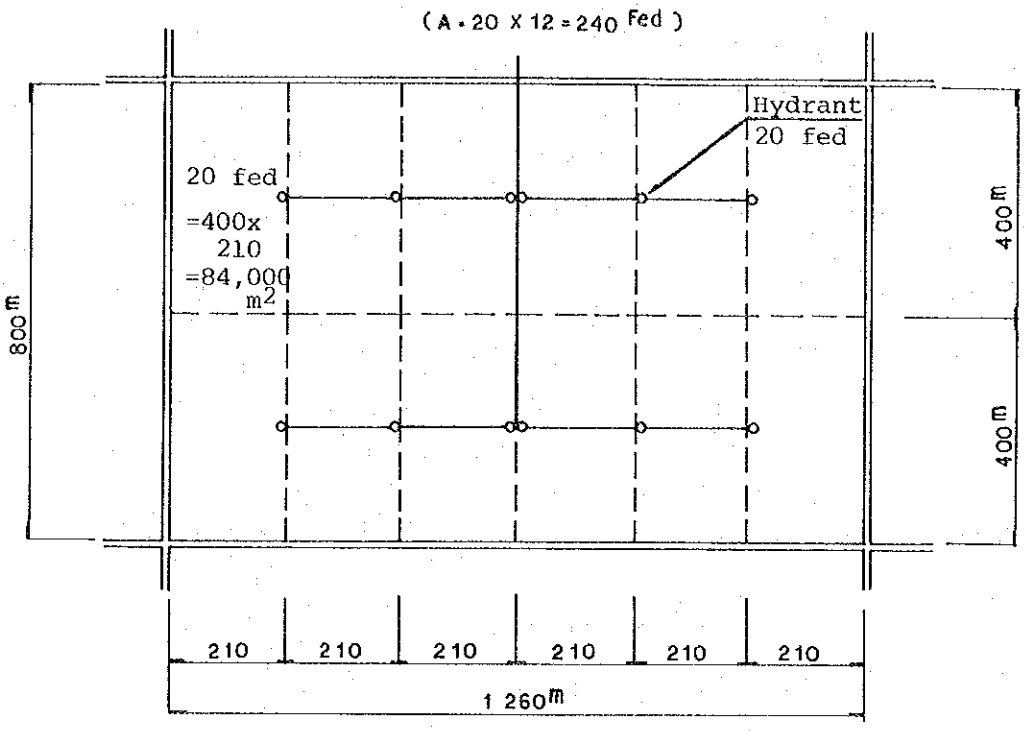
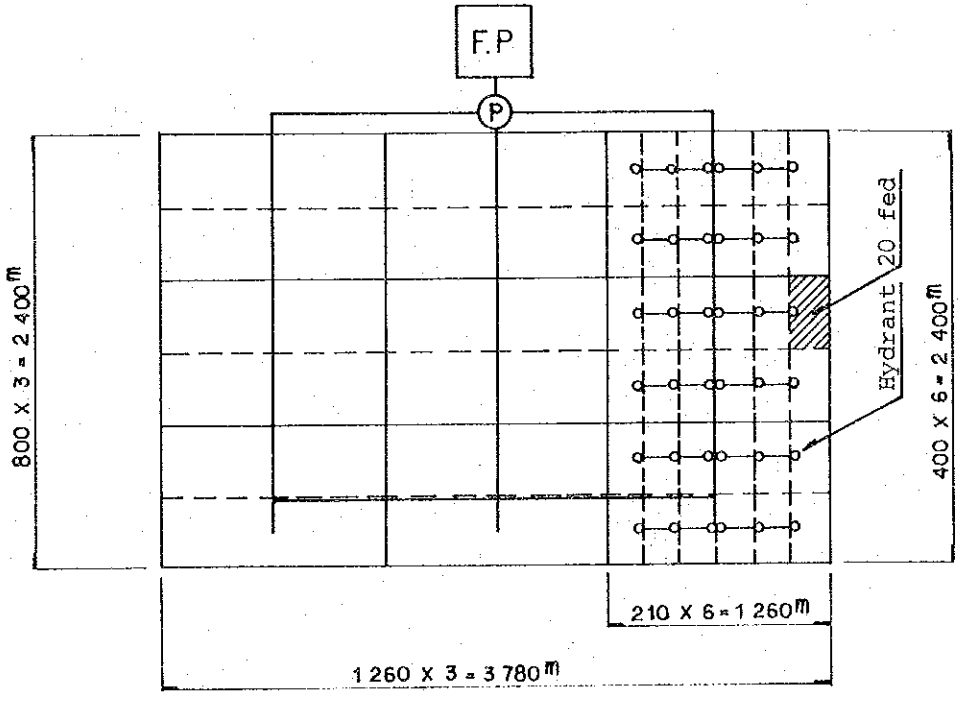


Fig.IV.D.4 Water Management Block



4-2 On-Farm Facilities Plan

(1) Basic Conditions

1) Water Requirements

All irrigation facilities are designed in relation to the maximum water requirements of 6.7 mm/day which is the net consumptive use for July in the Project area.

2) Soils

The soil survey Physical Characteristics of Soil and Cylinder Intake Rate, has been carried out at the 18 locations as the result of soil survey, it is found relatively low available Moisture and high permeability. Generally, the relation between TRAM and IB and the other in the south of the Project area. In the north the TRAM is from 8 to 30 mm and IB is from 150 to 600 mm/hr, in the south the TRAM is from 20 to 40 mm and IB is from 15 to 70 mm/hr, for a 60 cm deep root zone.

Therefore, it is said that the field capacity of the southern part of the Project area is larger than in the north.

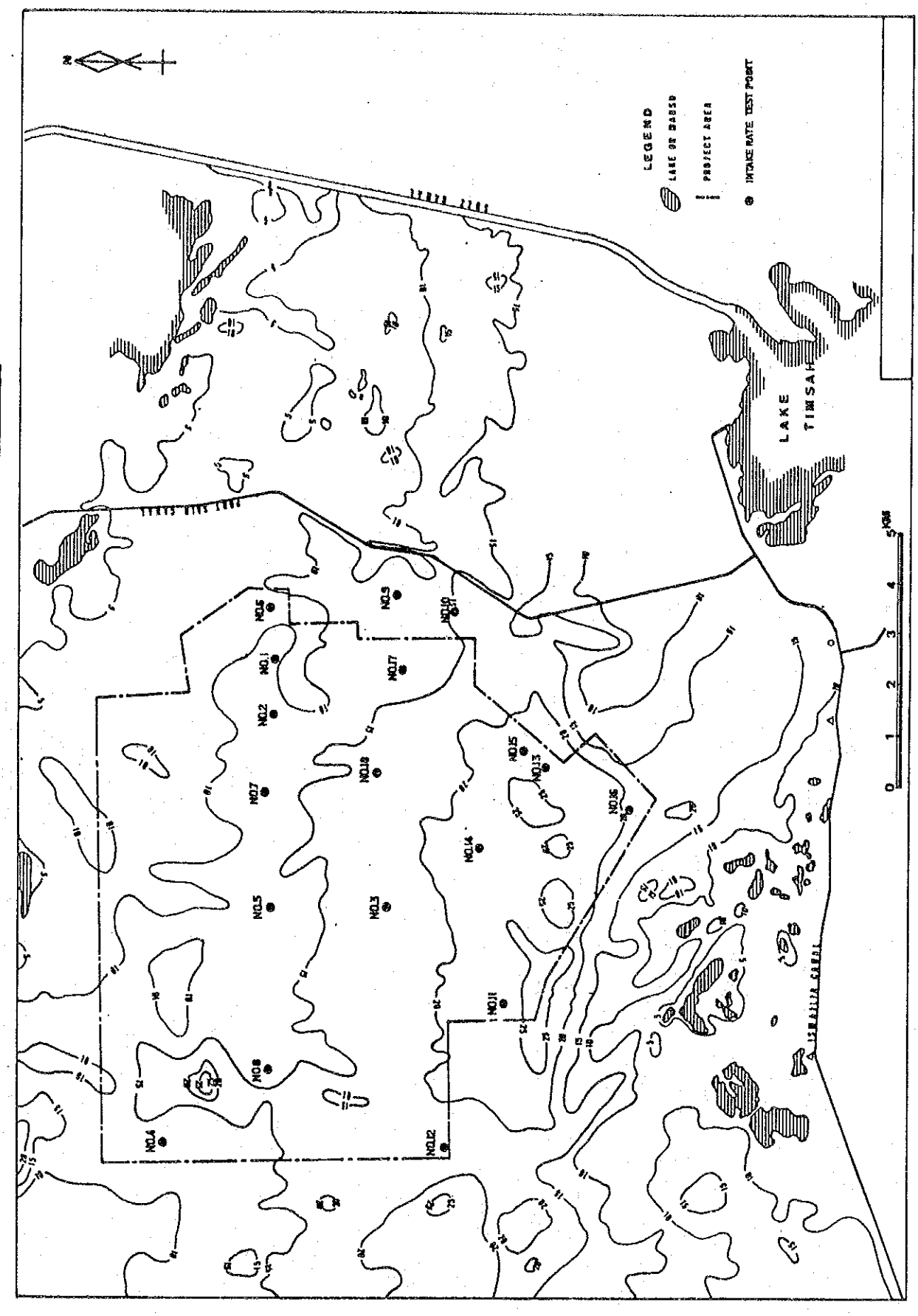
3) Water quantity per irrigation and intermittent days.

The water quantity per irrigation can be obtained by TRAM and consumptive use. The value of TRAM depends on the depth of the roots. The roots of barley, sorghum, watermelon, alfalfa and citrus are relatively deep.

The design root zones are divided into two types the vegetable type of 0.6 m depth and the fruit type (citrus) of 1.2 m depth.

The values of TRAM are vegetables, from 8 to 38 mm (mean = 20.0 mm) and Fruits from 27 to 66 mm (mean = 39.7 mm)

Fig. IV.D.5 Intakerate Test Point Map



There are a number of differences in TRAM depending on locations, besides, TRAM is gradually improved after planting or growing organic matter which results in changing of soil structure. Therefore, it is expected that the value of the TRAMs are about 30 mm for vegetables and about 40 mm for Fruits.

The intermittent days and the water quantity per irrigation can be calculated as follows.

Intermittent days

Vegetables: $\frac{\text{TRAM}}{\text{Consumptive use per day}^*} = \frac{30}{6.7} = 4.48$

$\fallingdotseq$ 4 days

* The value of consumptive use per day is the maximum mean value of crops.

Fruits : $\frac{40}{6.7} = 5.97 \fallingdotseq 5$ days

Water quantity per irrigation

Vegetables: Consumptive use per day x Intermittent day

6.7 x 4 = 26.8 mm

Fruits : 6.7 x 5 = 33.5 mm

4) Irrigation Hours

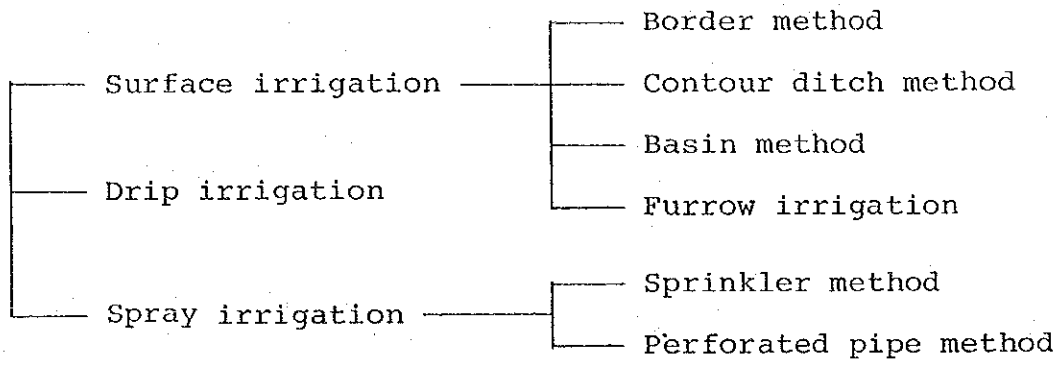
From the viewpoint of facilities' costs the longer the irrigation hours the more efficient. When utilizing the sprinkler irrigation method, it is necessary to allow for rest time for workers and rotation of sprinkler sets. In the peak irrigation periods estimated hours are obtained as follows.

Worker's rest hours ..... 1 hour
Sprinkler sets rotation hours ... 5 hours
Irrigation hours ..... 18 hours

Irrigation hours for the drip method are 24 hours/day because it is not necessary for rotation.

(2) Irrigation Methods

Irrigation methods are categorized below.



Sprinkler method for vegetables and fodder and Drip irrigation method for fruits have been proposed for the Project. The reasoning for such selection is as follows.

i) Border method and Furrow irrigation need a large quantity of irrigation water.

In areas such as this Project, that have high permeability rates and require large quantities of irrigation water, surface irrigation methods cannot be accepted. Also, irrigation using large amounts of water is a cause of salt accumulation.

ii) The perforated pipe method is disadvantageous due to a lack of uniformity in distribution resulting in irrigation in efficiency and salt accumulation. This method is constructed at relatively low cost.

iii) Drip irrigation as a fixed facility is not practical for cultivating vegetable and fodder crops since frequent planting and plowing are required.

iv) Drip irrigation is recommended for fruits as fixed facilities can be applied. An orchard cannot save water by using the sprinkler irrigation method because the proportion of planted area is lower than that for vegetables and fodder.

(a) Sprinkler Method

There are three types of pressure spraying methods, Low-pressure system, Intermediate-pressure system and High-pressure system.

There are several sprinkler systems, hand-moved system, permanent system, fixed surface system and self-moved system.

The Intermediate-pressure system was adopted for intensive farming of vegetables in the Project. Further, the high-pressure system is not suitable for vegetable because of large water droplets and the low-pressure system is estimated to be high in construction costs.

The transfer method adopted is the hand-moved system as it is the most inexpensive. Although 2 or 3 laborers are required to transfer the system, their employment is feasible.

The layout of sprinklers is adopted as shown in Fig IV.D6. The standard farmland block is 20 feddan in size and about 50% of one block is irrigated by the sprinkler method and the other 50% is irrigated by drip irrigation.

Dimensions of the sprinkler irrigation model are as follows:

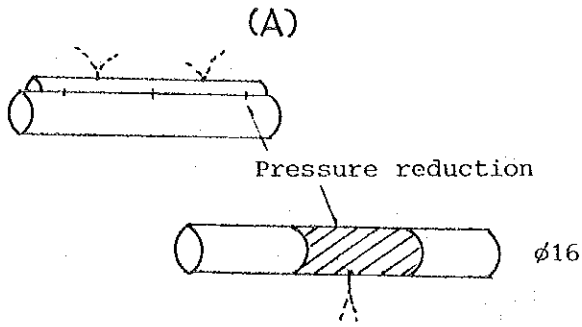
Average area of one rotation block	:	10 fed.
Distribution intervals of sprinklers	:	12 x 16 m
Type -- Spray pressure	:	3 kg/cm^2
Spray capacity	:	19.4 ℓ/min.
Irrigation diameter	:	28 m
Number of sprinkler sets in a line	:	8 sets
Irrigation hours per day	:	18 hr/day
Movement per day	:	3 times/day
Irrigation lines	:	2 lines
Irrigation hours per placement	:	5.33 hr/once
Spray intensity		
$\frac{19.4 \times 60}{12 \times 16}$	:	6.1 mm/hr
* Lower than Basic Intake Rate		
Intermittent days	:	4 days

(b) Drip Irrigation

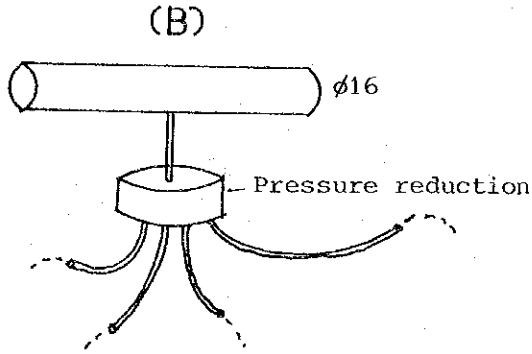
Drip irrigation has several advantages over other methods such as reduced transpiration, percolation and salt accumulation. Emitters are divided into two types by pressure reduction methods

Type (A) has double walled pipes and type (B) has a pressure reducer.

Type (A) is recommended for crops which are cultivated in long-narrow rows. Type (B) is applied to fruit trees which have very wide root zones.



Therefore, type (B) has been adopted for the drip irrigation area since fruits are designed to be planted at 5 m intervals.



Irrigation hours for drip irrigation are 24 hours as it is unnecsesary to move them.

For high production and prevention of salt accumulation daily irrigation is carried out. Layout of the drip irrigation is shown in Fig. IV.D.6.

Dimensions of the drip irrigation model.

Area of one rotation block : 10 feddan

Water capacity for one emitter (nozle): 20 ℓ/hr

Water capacity for one line : 20ℓ/hrx20 set = 40ℓ/hr

* Plant interval is 5m x 5 m

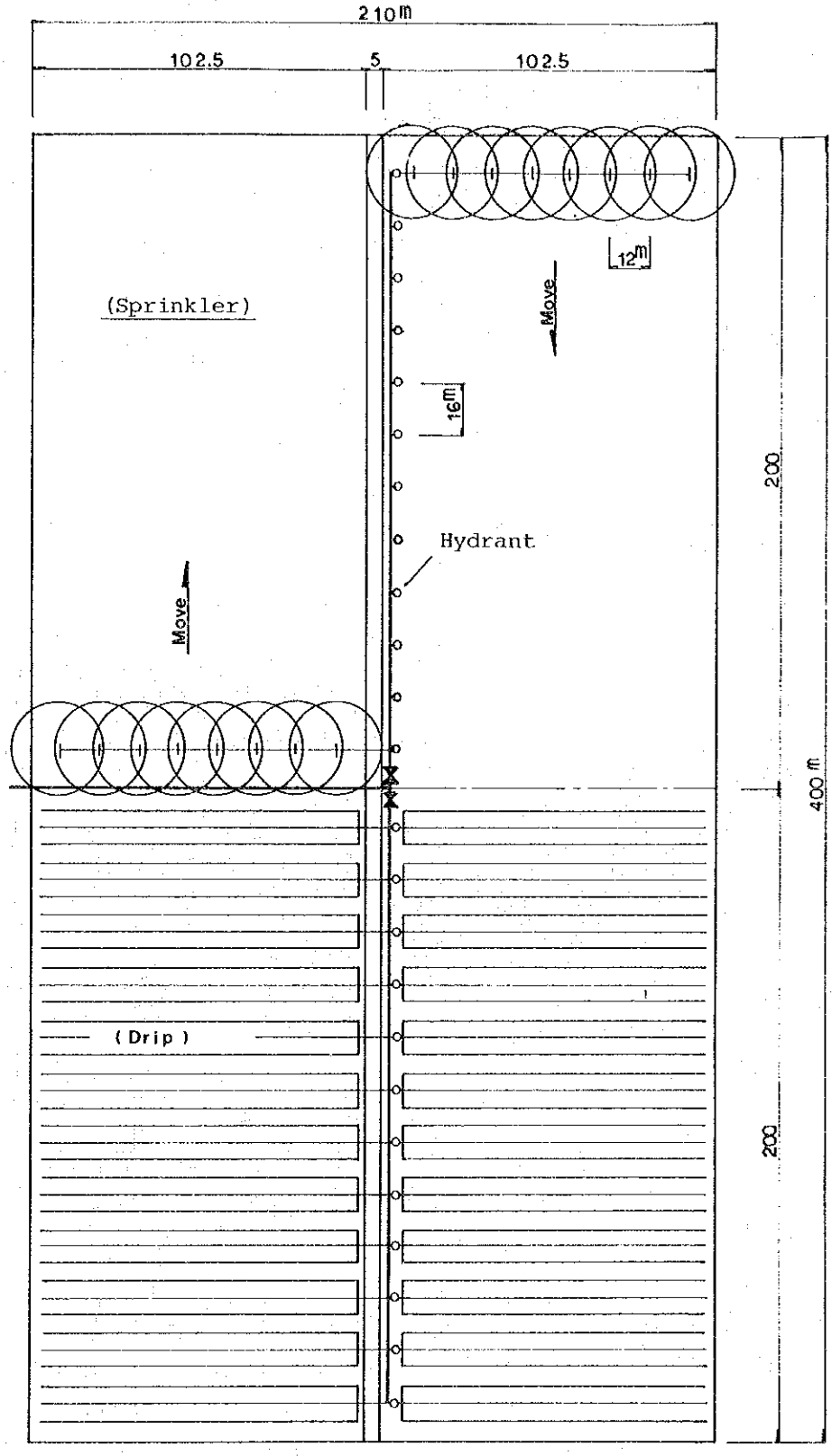
Area of one line : $5mx105m=525m^2=0.13$ feddan

Irrigation hours per application : $\frac{0.0067 \div 0.8 x 525}{0.4}$ = 11.0 hr

Irrigation lines : 36 lines

Movement per day : 2 times

Fig. IV.D.6 Layout of Sprinkler and Drip System



4-3 Windbreak

A windbreak of trees is planned to protect crops from heavy winds such as Khamasine which blow in early spring. The windbreak lies along each field lot and the kind of tree chosen is Casuarina equisetifolia.

5 Water Allocation Plan

The ground water is used for the pilot plan and the windbreak establishment during the construction period. Their water requirement are as mentioned before.

Relation between the water supply and the water requirement in the agricultural development period is considered as follows.

a) Amount of Water Supplies

Canal	5,900 m^3	x 21,524 fed	=	126,991,600 m^3
Groundwater	84,000 m^3	x 365 days	=	30,660,000 m^3

b) Amount of Water Requirement

Irrigation 6,743 m^3/fed x 19,560 fed = 131,893,080 m^3

(6,743 m^3/fed is the total irrigation requirement, and the bases of the value are 5,900 m^3/fed of the net irrigation requirement and 87.5% of the irrigation efficiency.)

Livestock	1,460 m^3/day x 365 days	=	532,900 m^3
Leaching	121.8 m^3/fed x 19,560 fed x 1 time	=	2,382,408 m^3

(29 mm x 4,200 m^3= 121.8 m^3/fed)

Total : 134,808,388 m^3

It is desirable to use sweet water from the Nile for irrigation and leaching, however, the amount of water supply from the Nile is somewhat short for their total amount of water requirement. Therefore, it will be required to supply with sweet water from the Nile and a certain amount of the groundwater mixingly during the summer time when the amount of irrigation water requirement will be at the zenith.

6. Road Network

Roads in the Project area are classified as main roads branch roads and farm roads depending on their respective function in the Project.

Main and Branch raods are paved with laterite soil which has been well compacted. The density of the road networks inclusive of farm roads, is equivalent to 65 m/ha. The main features and the total length of the proposed roads are summarized below:

Main Features of Roads

	Main Road	Branch Road
(1) Total width	7.0 m	6.0 m
(2) Effective width	6.0 m	5.0 m
(3) Height to be embanked	0.5 m	0.3 m
(4) Percentage of camber	4.0%	4.0%
(5) Total length	30.0 km	131.0 km

7. New Housing Village

7-1 General

(1) Planning for housing and infrastructure will be made according to the basic demands of the 900 cooperative member's house which will be required in the future.

(2) Location

The new housing village is located in the Sourthern corner of the Project area and about 5 km from the center of Ismailia City.

The village lies along the bypass road between Cairo and Port Said.

(3) Cost estimation items

Cost estimations are made for the following items, and summarized in the Appendix.

(a) Building cost of community facilities (Mosque, Health clinic, Principal School, etc.)

(b) Water distribution system in the village

7-2 Housing Village Plan

(1) Area and Population

The site is an area of 440 feddan which is roughly 2.0 percent of the total Project area. The housing project calls for the construction of houses for 900 cooperative members, 50 community facilities' employees and new members.

The total estimated population of 5,700 assumes that there are 6 persons per family.

(2) Land-use Plan

The various land-use allocations are made to meet the requirements of land-use, and summarized in Table 5-1 and Fig. IV.D.4.

(a) Residential Area

The 900 houses are divided into 19 divisions which are composed of 40 to 70 houses for individual families.

The area of each housing plot is 728 square meters.

The total residential area is about 38 percent of the housing village.

(b) Community Facilities Area

The community facilities scheduled for the housing village are summarized as follows;

Table IV.D.3 Land Use Area

	Item	Plot Area (m2)	Floor Area (m2)	Remarks
1.	Kindergarten	24,000	1,000	250 persons 8 classes
2.	Principal School	"	3,000	900 persons 30 classes
3.	Social & Cultural Center	32,000	1,000	
4.	Mosque	1,000	400	
5.	Health Clinic	4,000	500	
6.	Supermarket	11,000	-	
7.	Petrol Station	18,000	-	
8.	Parking Area	5,000	-	
	Total	95,000		

(c) Public Open Spaces

The areas around the new village and the center of the housing divisions will be covered with greenery such as a park and a shelter belt.

These green areas shall cover an amount equal to 82 square meters per person.

(d) Residential Roads Area

The roads in the New Village are under construction following the hierarchy system.

Table IV.D.4 Land Use Ratio

Item	Area	Ratio
Residential Area	165 feddan	38%
Community Facilities Area	23 "	5%
Public Open Space	111 "	25%
Road Area	141 "	32%
Total	440 feddan	100%

7-3 Water Supply System

(1) Existing Situation

(a) Organization

The Suez Canal Authority (SCA) and the Ismailia Governorate are responsible for the planning, design, construction, operation and maintenance of the water supply systems in the Ismailia area.

Generally, SCA has responsibilites within the city boundary and the Governorate for outside the city boundary, for this it is given technical assistance by the General Organization for Water Supply (GOWS).

(b) General background

There is no program for a water supply system to the Project site at present.

The program of Ismailia Waterworks and the Waste Water Facilities Master Plan has set forth the major features of Waterworks inside the city.

The Free Zone area, which is located on the west side of new village, is to be supplied according to the plan of the above mentioned report. However, the quantity of water and the transmission line are not definite at this time since sufficient guideline data such as the degree of development and types of industry are not available.

(c) Water Source

The following alternative sources are considered for the new village.

1) Groundwater
2) Sweet Water from Port Side Canal
3) From the distribution line program of Free Zone

Salinity of the groundwater in the vicinity of the new village was found to have about 3,000 ppm by the study team. It is therefore necessary to construct a water treatment facility, such as a desalination facility, for drinking water. Considering the construction cost and maintenance cost for a water treatment plant, the study team adopted to utilize the system from the distribution line program of the Free Zone area.

(2) Water Demand

The basic potable water demand in the future is estimated based on the following assumptions.

(a) The benefited population is estimated at 5,700 persons, based on 950 houses consisting of 6 persons on an average, residing in the new village in the future.

(b) For households, the water demand is calculated based on the unit demand of 200 liters per day per person.

(c) The water demand of community facilities, such as schools, social and educational center and health clinic, etc. are assumed to be included in the estimate for household use.

(d) The system will cover the cooperative office and processing facilities in the agro-industrial area. The water demand is estimated at 20 m^3/day.

(e) An additional 10 percent of total water requirement is applied to cover for the future expansion program and losses.

(f) Fire demand assumed to be covered by peak hour capacity.

Based on the above basic requirements, the basic daily water demands are computed using the following formulas;

Mean daily demand

= (200 liter/person x 5,700 persons + 20,000 liter) x 1.1
= 1,276,000 liters/day

Maximum daily demand

= 1,276 m^3/day x 1.5 = 1,914 m^3/day

Peak hour demand

= 1,914 m^3/day ÷ 24 hr. x 2.5 ÷ 200 m^3/hr.

(3) Water Distribution System

The design of the distribution network is based on several engineering requirements and selection of materials.

(a) Service pressure shall be so determined as to insure 1.5 kg/cm^2 throughout the distribution networks.

(b) The pipe size and velocity of flow shall conform basically to Hazen-William's formula.

(c) The basic velocity of flow shall be in the range of 0.8 m/sec to 1.4 m/sec to ensure economy.

(d) Pipes shall be laid as much as possible in road ways or pedestrian ways and other public zones.

(e) Pipes such as asbestos cement pipe of diameter smaller than 250 mm or others shall be determined after detailed studies.

(4) Irrigation water for landscaped area.

Water for landscape irrigation will be required in and around the new village.

Considering the construction cost of potable water facilities for the new village, irrigation water will be obtained from the project irrigation distribution system.

7-4 Sewerage System

(1) Existing Situation

(a) Organizations

The General Organization for Sewerage and Sanitary Drainage (GOSSD) is responsible for the planning, design and construction of water-borne waste water facilities.

(b) General Background

There is no sewerage system program for the project site at present.

There is the possibility of a new sewerage treatment facility, however, the study team adopted a basic waste water system, utilizing the system already operating in the vicinity with modifications on a short or medium term, and the application of tertiary water for forage irrigation purposes.

(2) Waste Water Treatment

All houses and community facilities will be provided with septic tanks and leach fields. Septic tanks contain obnoxious odors since ventilation is provided via roof top vent pipes on domestic waste water pipe works. Septic tanks shall be constructed from fiberglass, plastic, precast concrete, cast-in-place concrete, or bricks.

Liquids will drain away through the buried leach fields, solids and sludge will accumulate in the septic tank. These will require periodic collection by vacuum tanker. The sludge may be used as an organic fertilizer.

(3) Solid Waste

The trucks will be used to collect solid wastes. Solid wastes will be disposed of in a sanitary land fill.

Combustible materials shall be destroyed in an incinerator.

7-5 Electric Power Supply System

(1) Existing Situation

(a) Organization

The Ismailia Section of the Suez Canal Organization for Electricity (SCE) is responsible for the planning, design, construction, maintenance and operation of electricity networks, including street lighting. The Governorate identifies and advises on local needs; basic policies are formulated by the Ministry of Electricity and Power operating through the Egyptian Electricity Authority. The SCE obtains revenue from user charges.

(b) General Background

Electric power is now supplied by 220 kV transmission line from Aswan High Dam through Cairo Substation and Zagazig sub-station which steps down to voltage to 66 kV to supply the Ismailia area. Electric power of 66 kV is again stepped down to 11 kV distributed voltage at Ismailia sub-station then it is distributed to houses, shops, etc.

c) Distribution

A new electric sub-station of 11 kV, is now under construction in the Free Zone area.

This sub-station is scheduled to distribute 16 feeder lines of 11 kV.

The electric power will be supplied to the new village from the new sub-station through a transformer.

(2) Forecast of Power Demand

In the planning of the electric power supply system to the new village, the power demand for the agro-industrial area is included.

The power demand will be forecast by consumers according to the following items.

Table IV.D.5 Distribution Plan

Item	Quantity	Demand load	Total demand load
Houses	950 houses x 100 m^2/house	@25 VA/m^2	2,375,000 VA
Kindergarten	1,000 m^2	@30 "	30,000 "
Principal School	3,000 "	@30 "	90,000 "
Social and educational center	1,000 "	@30 "	30,000 "
Mosque	400 "	@35 "	14,000 "
Health clinic	500 "	@45 "	22,500 "
Supermarket	800 "	@40 "	32,000 "
Petrol station	400 "	@35 "	14,000 "
Cooperative office	800 "	@40 "	32,000 "
Workshop	1,200 "	@35 "	42,000 "
Street lighting	600 sets	@400 VA/set	240,000 "
Processing facilities		L.S.	678,500 "
Total of demand loads			3,600,000 VA

(3) Distribution System

Power supply to the new village and agro-industrial area will be fed from the new sub-station in the Free Zone area by 3 phase, 50 Hz, 11 kV cable.

The 11 kV cable will be connected to a series of distribution transformers where the supply will be reduced to 380/220 volts for secondary distribution.

The low voltage network will radiate from each transformer and the length of the branches will be adjusted as necessary to keep voltage drop within acceptable limits.

(4) Service Lines

Service lines to houses and community facilities will be supplied through handholes or manholes from the distribution board. Low tension power, which is 380 V by line voltage and 220 V by phase voltage, will be served through distribution switches to houses, community facilities and street lighting fixtures.

E. AGRICULTURAL DEVELOPMENT

1. Crop Yield

(1) Considering the natural conditions of the Project area, the marketing and transportation conditions, the public requirements of the Government and the Governorate and moreover, of the people concerned, the agriculture of the Project area will necessarily be required to be 1) diverse farming with animals, 2) mechanized farming, 3) cash crop production, especially export-oriented agriculture, and 4) intensive agriculture. Also, it is inevitable to be 5) semi-enterprisetic agriculture which employs few labourers in the developing stage.

(2) Considering the above mentioned agricultural production types, appropriate crops are selected among the crops now cultivated around the Ismailia District, and are given below.

1) Oranges, lemons, mangoes, grapes and date palms are cultivated as tree fruits. Among them, oranges and mangoes are typical special fruits in the district. They are exported to Europe and the Middle East as well as consumed domestically. Mangoes, especially, provide a high rate of income, and the variety which bears large-sized fruits every year is recommended for the Project.

2) Tomatoes, strawberries, watermelons, melons, cucumbers, cabbages and lettuce are the main vegetables. Among them, tomatoes, watermelons, melons and cucumbers are special vegetables in the district. Tomatoes and cucumbers are the main vegetables for the overseas market as well, and tomatoes are able to provide three crops a year. Since these vegetables are not hampered by diseases in the desert and no special insect damage exists, high yields are expected from the first year of reclamation. Exports for Europe provide a special

benefit, the winter crops can be forwarded in early spring, and profitable marketing is expected if green house culture is introduced as well. Strawberries were just introduced to this district in 1981, however, the result of their cultivation is splendid and they are sold at extremely high prices. Moreover, the year-round fruit bearing variety is now undergoing trial after introduction from the United States of America. Proper renewal of runners, proper weeding and proper control of viral diseases, expectably offer much larger expansion of strawberry cultivation in the future.

3) Ground nuts, onions, potatoes, field beans, peas and sesame are the remaining field crops. Among them, potatoes are for export to Great Britain, onions have been exported continuously from olden times and ground nuts are for export as well. Field beans and peas are not only cash crops but also useful for fixing nitrogen from the air. Sesame is an indispenable crop since it is an ingredient of typical Egyptian food, and its introduction to the Project will help the retrenchment of importation.

4) Berseem is the main fodder crop now, and alfalfa and napier grass are introduced as well. Alfalfa and napier grass which are harvested year-round should be expanded and green maize and green sorghum should necessarily be introduced as summer crops, for the sake of increase in cattle productivity by means of the dissolution of fodder crops shortage during the period and the exclusion of rice straw which is low in nutrition. According to the above mentioned means, the fodder crops are made useful for the improvement of the protein food condition in Egypt. Moreover, barley will be considered to be used positively as manure-required crops or green fodder crops.

(3) Various cultivating processes are considered depending on each stage of development, as the Project area is a new reclamation area. For instance, the process of recovering preinvestment funds, and the improvement of soil productivity. And the cropping pattern of the fruit trees is variable depending on certain factors including space usage and the changing of the varieties considering the different maturing years, (such as from oranges to mangoes). Apart from these transition processes, the cropping patterns of the before mentioned 4 agricultural production types, at the completion stage, are set up as follows.

1) Compound Type

This type is a mixed type including fruit trees, vegetables and dairy cattle. 5 milking cows (7.0 LU including calves) are reared as dairy cattle. The farm is divided into three parts which are 10 feddan for fruit trees, 1 feddan for perennial alfalfa and napier grass and the other 9 feddan. The other 9 feddan are equally divided into three parts, and vegetables, fodder crops and field crops are cultivated using a three year rotation period. (Table IV.E.1)

2) Fruit Type

Fruit trees are the main item in this type with beef cattle for fattening and some vegetables. 10 heads of beef cattle are normally reared, and 5 heads are sold every year. The farm is divided into three parts which are 13 feddan for fruit trees, 1 feddan for perennial fodder crops and the other 6 feddan. The other 6 feddans are equally divided into 2 parts, and fodder crops and vegetables are cultivated rotationally. (Table IV.E.2)

3) Dairy Type

This type consists of 10 milking cows (14.0 LU) as dairy cattle, fruit trees and vegetables. The farm is divided into three parts which are 6 feddan for fruit trees, 2 feddan for perennial fodder and the other 12 feddan. The other 12 feddan are divided into three parts, and fodder crops and vegetables are cultivated using a three year rotation. (Table IV.E.3)

4) Vegetable Type

Vegetables are the main item in this type with fruit trees and beef cattle. 20 head of beef cattle are normally reared, and 10 head are sold every year. The farm is divided into three parts which are 4 feddan for fruit trees, 2 feddan for perennial fodder crops and the other 14 feddan. The other 14 feddan are divided into two parts, and vegetables, field crops and fodder crops are cultivated using a two year rotation. (Table IV.E.4)

5) Yield of the crops mentioned per feddan must rely on estimations, since statistics for desert districts are very rare. So, according to the Governorate statistics, the view of the specialist in the Agricultural Department and the yield results of the existing arable lands and the reclaimed land where the study team visited and carried out studies, the proposed yield of the crops per feddan is shown in Table IV.E.5.

6) The calculation of the available stall manure produced by livestock and the necessary manure for the farm for the four agricultural production types provide the following values. 124 tons of manure are required against 110 tons of stall manure provided by the compound type. 120 tons of manure required agaist 55 tons of stall manure provided by the fruit type. 110 tons

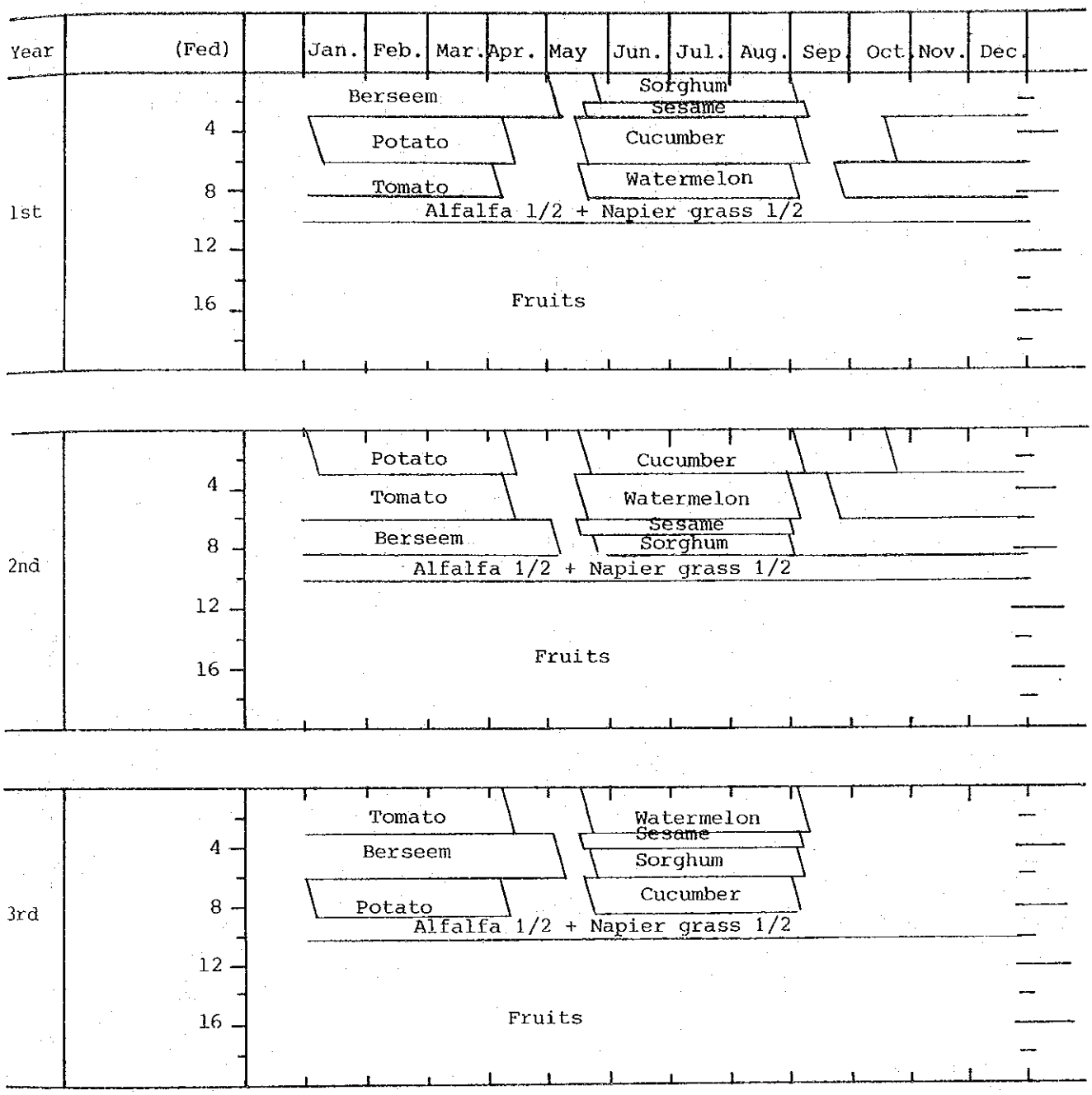
required against 200 tons supplied in the livestock. 113 tons required 130 tons supplied in the vegetable type. The result is that the difference between the fruit type and the others is very great.

Therefore, further study of the fruit type is necessarry at this point.

CROPPING PATTERN

Fig. IV.E.1

MODEL: 1 Compound Type



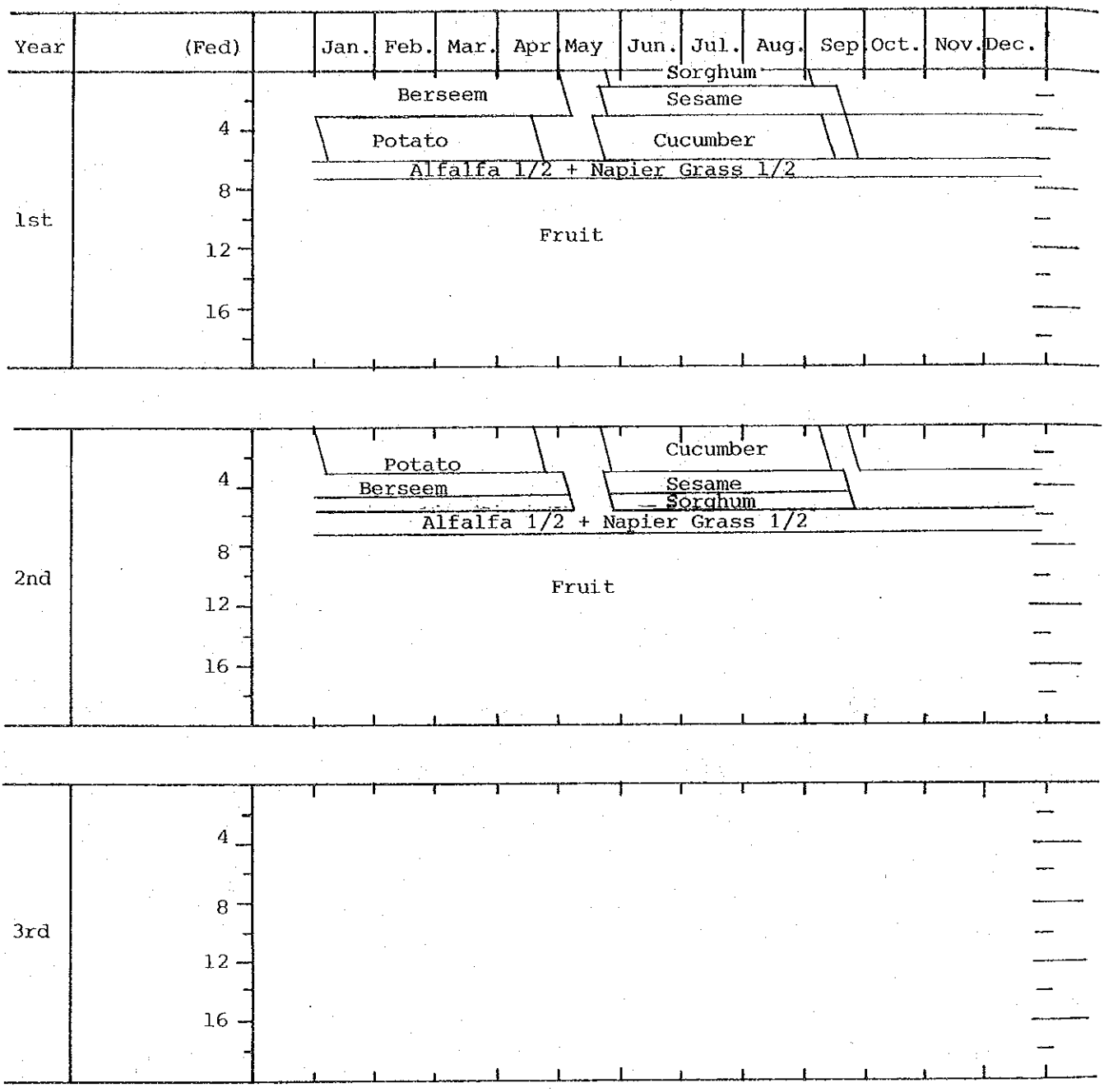
NOTE:

Crops	Winter		summer		Perenial	
Berseem	3.0	fed.	Sorghum	2.0 fed	Alfalfa	0.5
Patato	3.0		Sesame	1.0	Napier Grass	0.5
Tomato	3.0		Cucumber	3.0	Fruit	10.0
	(9.0)		Watermelon	3.0		
				(9.0)		(11.0)

Fodder Crop: for Dairy Cattles (5+ followers L.U.7.3)

CROPPING PATTERN

MODEL: 2 Fruit Type



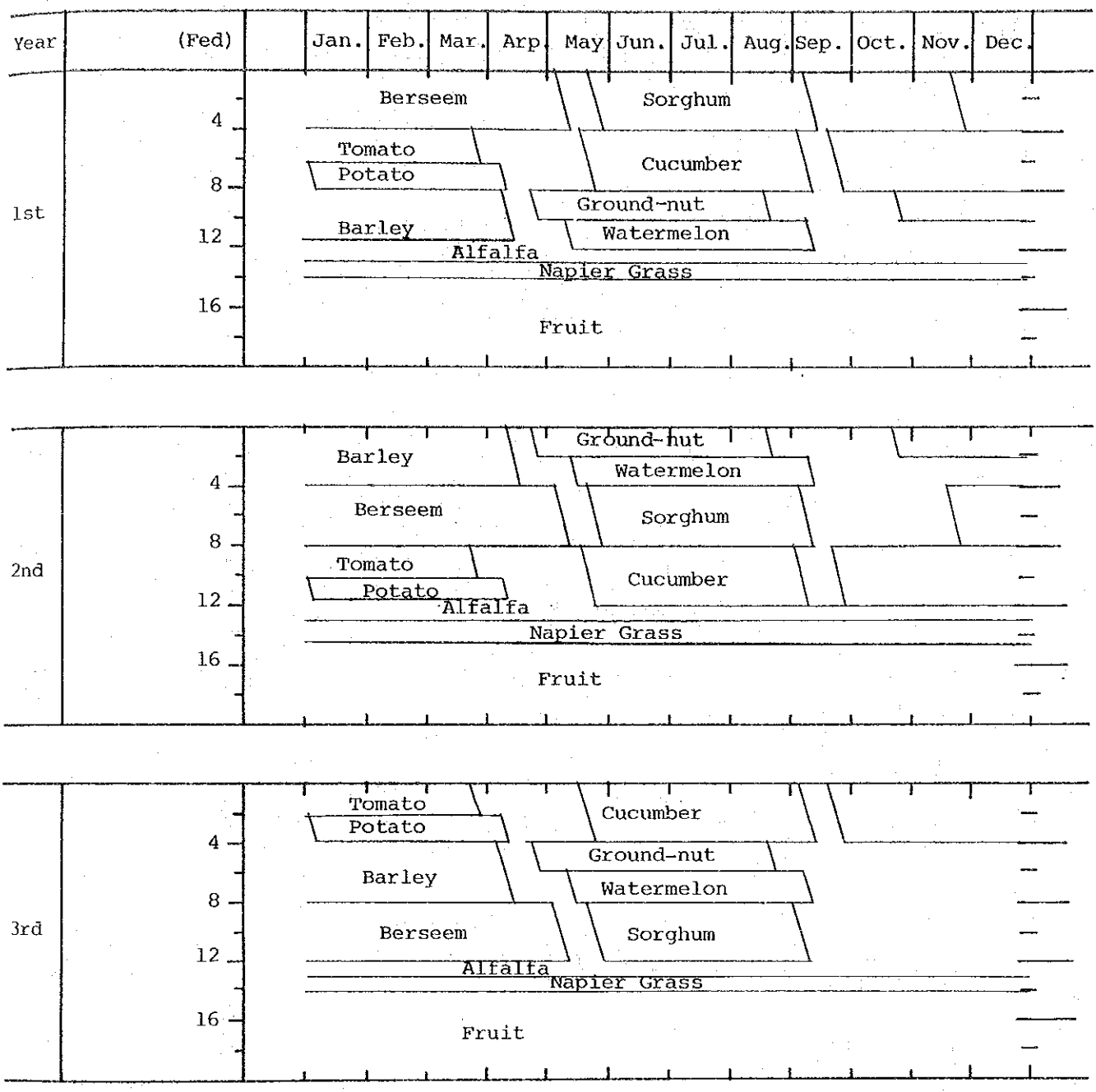
NOTE:

Winter		Summer		Perenial	
Berseem	3.0 fed	Sorghum	1.0 fed	Alfalfa	0.5 fed
Potato	3.0	Sesame	2.0	Napier Grass	0.5
	(6.0)	Cucumber	3.0	Fruit	13.0
			(6.0)		(14.0)

Fodder Crops for Beef Cattle (1.5 - 2.5 years 5 0.5 - 1.5 years 5)

CROPPING PATTERN

MODEL: 3 Dairy Type



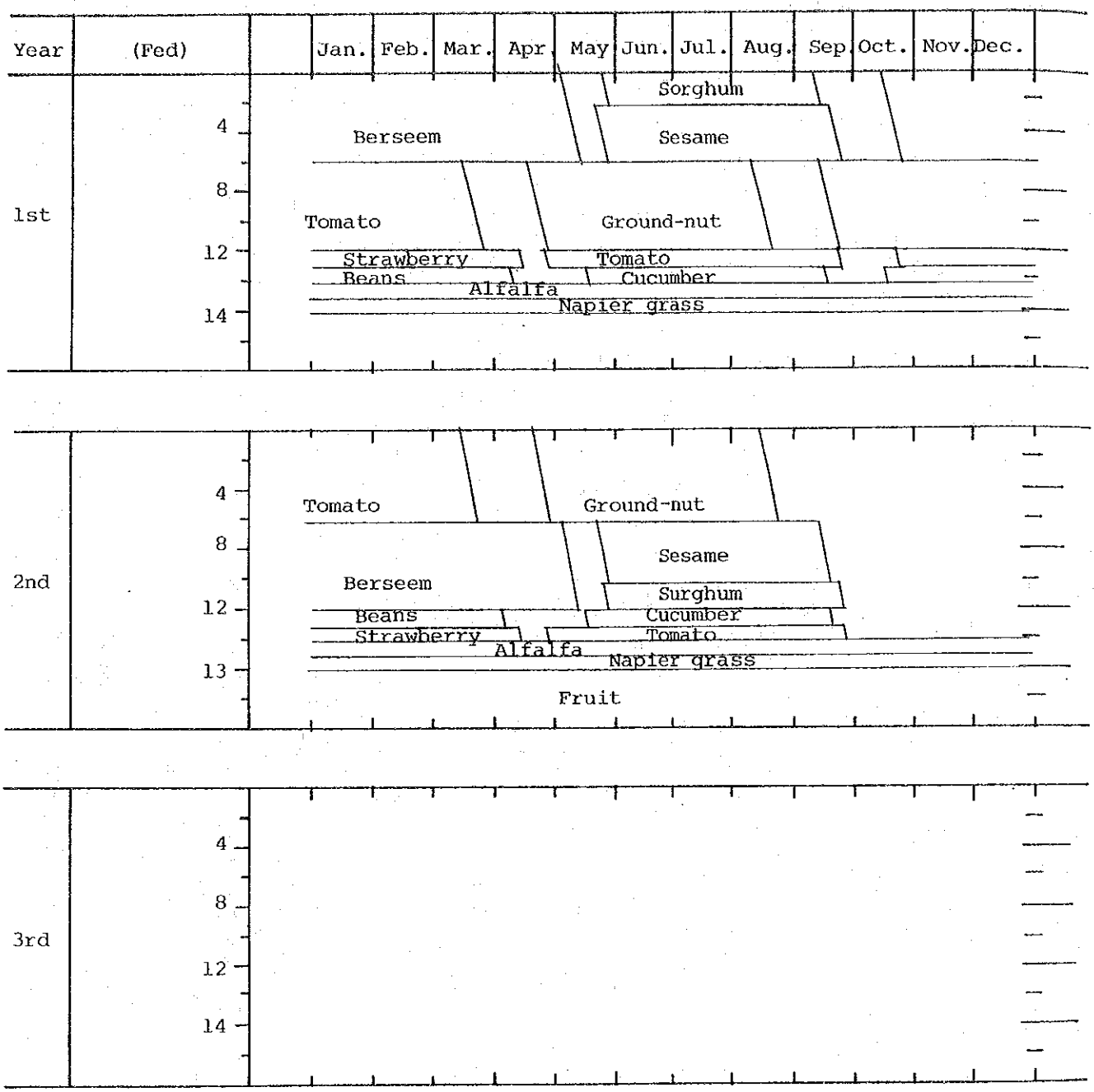
NOTE: GROPS

Winter		Summer		Perenial	
Berseem	4 fed	Sorghum	4 fed	Alfalfa	1 fed
Barley	4	Cucumber	4	Napier grass	1
Tomato	2	Ground-nut	2	Fruit	6
Potato	2	Watermelon	2		(8)
	(12)		(12)		

Fodder Crops for Dairy Cattles (10+ followers L.U. 14.6)

CROPPING PATTERN

MODEL: 4 Vegetable Type



NOTE: Crops

Winter		Summer		Perenial	
Berseem	6.0 fed	Sorghum	2.0	Alfalfa	1.0 fed
Tomato	6.0	Sesame	4.0	Napier grass	1.0
Strawberry	1.0	Groundnut	6.0	Fruit	4.0 (6.0)
Beans	1.0 (14)	Tomato	1.		
	(14)	Cucumber	1.0 (14)		

Fodder crops for Beef Cattle 20 heads (1.5 - 25 years 10, 1.5 - 1.5 years 10)

Table IV.E.1 Cropped Area and Production by Crop in Total Area

Crop	Unit Yield (ton/feddan)	Acreage (feddan)	Production (ton)
Berseem (forage)	20.0	3,060	61,200
Barley (")	10.0	360	3,600
Sorghum (")	20.0	1,845	36,900
Alfalfa (")	40.0	540	21,600
Napier Grass (")	75.0	540	40,500
Potatoes	7.9	2,340	18,486
Tomato (winter)	5.6	2,475	13,860
" (summer)	7.3	90	657
Cucumber	7.2	2,610	18,792
Watermelon	12.7	1,935	24,575
Beams	0.6	90	54
Groundnut	1.6	720	1,152
Sesame	0.5	1,215	608
Strawberry	8.0	90	72
Orange	6.6	8,505	56,133

2. Livestock

2-1 Livestock rearing is on indispensable sector in the management of agriculture production especially in desert areas which are very lacking in organic matter since decomposition is very rapid due to extremely high temperatures.

Livestock production not only leads to expectation of constant income but also contributes to the supply of protein food which is apt to be in short supply as the living standard of the Egyptian people improves.

Considering the trend of livestock production in Egypt and Ismailia Governorate and also the conditions in the Project area, the following items are planned.

(1) Choice breeds of livestock shall be introduced which directly follows the policy of the Government.

(2) Although Friesian is the common breed used for dairy cows in Egypt, Brown Swiss which can be reared for both milk and beef shall be bred directly following the policy of the Governorate.

(3) Baladi which is noted as a local breed is unavoidably introduced during transition stage of the Project, however, bull calves of Brown Swiss shall be phased in gradually.

(4) Since sheeps and goats can possibly introduce deterioration of pasture, they are not especially considered for this Project.

(5) Concerning poultry, although the improvement and the breeding of broilers and layers is now gaining popularity, except for the initial stages integration of broiler production is expected to be led by national or company systems, therefore, in the Project layers shall be adopted.

(6) In addition to the above mentioned items, pigeon rearing and bee culture were considered, but they were excluded from the Project as both are prevalent in Egypt.

2-2 Although a unit of livestock will depend on the preferences and the ability of the farmers, the following ideas for standard livestock units are set as follows:

(1) Dairy Cattle

A standard unit of dairy cattle normally consists of 5.0 cows, 1.7 heifers and 2.0 heifer calves. The conversion rates of livestock units (LU) are 1.0 for a cow, 0.7 for a heifer and 0.4 for a heifer calf, therefore an LU of dairy cattle is cows 5.0 x 1.0 = 5.0 LU, heifers 1.7 x 0.7 = 1.2 LU and heifer calves 2.0 x 0.4 = 0.8 LU, giving a total of 7.0 LU. The amount of milk is 3,600 kg per cow.

(2) Beef Cattle

For the annual target production of 5 fattening cattle, each weighing 450 kg it will be necessary to raise 5 bullocks and 5 bull calves. The conversion rates of livestock units (LU) are 0.7 for a bullock and 0.4 for a bull calf, therefore an LU of beef cattle is bullocks 5.0 x 0.7 = 3.5 LU and bull calves 5.0 x 0.4 = 2.0 LU, giving a total of 5.5 LU.

(3) Layers

Layers start egg laying 160 days after hatching and are reared for 14 months. One layer lays 240 eggs per year and the mortality rate of the layers is assumed to be 15%. The plan of the Project calls for a unit of 1,000 layers.

2-3 All feed for the layers is planned to be purchased and, as a principle, all roughage out of the feed for cattle is planned to be self-supported. Yield of fodder crops,

nutrient requirements for cattle and acreage of fodder crops are shown in the following Table IV.E.6 , Table IV.E.7 , and Table IV.E.8.

Table IV.E.2 Yield of Fodder Crops per Feddan

t/year

	Green Forage	Dry Matter	TDN	DCP
Berseem	20	4.0	2.4	0.5
Green Barley	10	1.9	1.3	0.1
Sorghum or Maize	20	2.9	2.0	0.3
Napier Grass	75	11.5	6.9	0.8
Alfalfa	40	8.3	5.1	1.3

Table IV.E.3 Nutrient Requirement per Unit/per Year

t/year

Unit	Dry Matter	TDN	DCP
Dairy Cattle 7.0 cows	25.6 (21.6)	19.5 (16.3)	1.9 (1.5)
Beef Cattle 5.5 bulls	20.5	13.2	1.8

* Supply by roughage is shown in parentheses

Table IV.E.4 Acreage of Fodder Crops per Unit

fed.

	Dairy Cattle		Beef Cattle	
		Summer	Winter	Summer
Berseem	2.0	-	3.0	-
Green Barley	2.0	-	-	-
Sorghum or Maize	-	2.0	-	1.0
Napier Grass	0.5	0.5	0.5	0.5
Alfalfa	0.5	0.5	0.5	0.5

2-4 From the dairy and beef units mentioned above, the following livestock products will be produced per year.

(1) Dairy Cattle Unit

Milk	1.8	tons
Culled Cow	1.0	head
Bull Calf	2.0	heads
Stall Manure	100	tons
Urine	50	tons

(2) Beef Cattle Unit

Fattened Cattle (450 kg)	5.0	heads
Stall Manure	55	tons
Urine	27	tons

(3) Layer

Hen Eggs	19,000	dozens
Chicken Meat (Culled Chicken 1.8 kg)	650	birds
Stall Manure	50	tons

2-5 Loose housing is properly adopted for livestock housing. However, walls and sheds should necessarily be established for protection from hot winds and strong rays of the sun.

Enough litter is important for collecting valuable stall manure.

Concerning poultry production, 6 layers are reared per 1 m^2 by floor feeding, and the chicken stalls are planned as 2 story buildings utilizing the all in all out method.

Also disinfection should be carried out sufficiently.

Further, bulk coolers should be adopted as public facilities to avoid spoiling of milk.

2-6 Breeding of dairy cattle is carried out with liquid semen at present in Ismailia. However, with the increase in cattle rearing and future prospects for the introduction of superior genes from abroad, utilization of frozen semen and strengthening of such service will certainly become an issue to be dealt with by the Governorate.

The hatchery houses and the breeding houses for chickens are not provided in Ismailia, and the smooth supply of chicks including preventive measures against epidemics will also be an important issue to be considered by the administration of the Governorate.

3. Marketing, Storage and Processing

(1) The Town of Ismailia is situated in an advantageous position geographically. It is blessed by three large domestic markets nearby, 80 km to the north, Port Said City with a population of 263,000, 80 km to the south, Suez City population 190,000, and 120 km to the west, the metropolis of Cairo with a burgeoning population of 9 million people. Moreover, Port Said and Suez do not have any agricultural support. A railroad and two highway routes are available to transport commodities to all three cities. The cost per ton for transporting goods by truck is LE 6 to Cairo and LE 5 to Port Said. Furthermore, export of agricultural products to European and Middle East countries is possible through both Port Said and Suez sea ports.

(2) The Ismailia area is traditionally a vegetable and fruit growing region. For example, the acreage of mango, orange, watermelon and tomatoes occupies 21%, 6%, 10% and 5% of the total land cultivated by these crops in the entire country, whereas the Nation's total farm land is only 0.9% of total land area. However, the cooperative marketing system of vegetable and fruits in Ismailia is almost non-existent with only a small amount of produce passing through the specialized Joint Society to the public market of Ismailia. The greater portion of the produce is shipped to Cairo and other markets by merchants.

Also, when a good crop of tomatoes, etc. are harvested all at once a considerable amount are spoiled during transportation and in the market itself.

(3) Therefore, in the case of such fresh produce, it is necessary to plan cultivation to fit the market and at the same time preservation by means of storage control and further processing of crops are necessarily to be considered. The Project area borders on the Ismailia industrial area and the free-zone where overseas factories are located. At present the freezone is a factor in the planning of Project infrastructure, and

although it is said there are plans to lure crop processing factories there is nothing definite as yet. Fortunately, Ismailia National Company for Marketing and Export (ISMAMEX) was established completely by private investment in 1981, and the company is intending to construct a factory for processing and exportation of potatoes, ground-nuts and tomatoes this year. When it is completed and ready for operation favorable conditions for the Project can be expected.

(4) In the case of livestock, the construction of a new slaughterhouse having a capacity of 600 head/day is nearly completed and will replace the existing slaughterhouse which has a capacity of 100 head/day, and therefore, the conditions are expected to improve. Considering milk processing, a factory having a capacity of 50 t/day is processing milk, yogurt and cheese, however, only 20 t of milk is processed at present, leaving a 30 t capacity unused. Consequently, it is adequate to rely on this factory for milk processing.

(5) Considering the above mentioned conditions, there are no plans for processing agricultural products from this Project for the time being. However, cold storage facilities should be planned for fresh produce, and more basically, planning crop cultivation to meet market demands should be carried out.

However, it is anticipated that the agricultural system will increasingly be improved as time goes by, and overall consideration of a counterplan of Governorate policy will be necessary in future, under the circumstances.

4. Agricultural Development

(1) Agricultural development of the Tenth of Ramadan Project area can mainly be divided into 4 proceeding stages. The first stage is the preparatory stage which is correspondent to the construction stage, and lasts for 4 to 5 years. The second stage which is the development stage lasts for about 5 years, the third stage which is the interim stage lasts for about 5 years and the fourth stage is the mature stage.

(2) At the first stage, some preparatory measures are needed together with a progress of construction. There should be 1) fostering of the spirits of cooperation and mutual aid for the cooperative activities, 2) learning practical knowledge of crop and animal production, mechanization, irrigation and marketing, 3) nursing seedlings of fruit trees and trees for windbreaks, and 4) organizing the internal structure of the cooperative and planning individual farming to cope with the coming stages. Of course, it is necessary to provide individual farming facilities at this stage.

(3) The second stage begins immediately after completion of construction. This stage provides making a foundation for agricultural development when fruit trees are transplanted, forage and green manure crops are grown for escalating soil productivity and some animals are initially introduced. At the same time, there should be taken into consideration introducing profitable crops and animals such as vegetables and chickens in order to accelerate recovery and return of a great deal of the initially invested funds. The construction works are planned to end in summer, making it possible to transplant fruit trees, to sow barley seeds and to grow berseem, alfalfa and other fodder crops in the fall, and to accomodate some cattle in the early spring. Furthermore, the growing of vegetables and forage crops as inter crops to utilize idle orchard space, and planting mango trees between citrus trees until their maturity after 10-15 years. It would be indispensable to keep bees for facilitating pollination. At any rate, the main income will derive from vegetables and chickens for this 5 year period.

(4) At the third transitional stage, citrus trees will begin to bear fruit. The number of dairy and beef cattle will almost reach the planned numbers and yields of vegetables will increase more and more because soil fertility will be greatly improved. At this stage, three production sectors of farming will be established namely, vegetable, fruits and livestock. Also, marketing will become increasingly more important, and efforts should be made to organize such activities.

(5) After 10 years the Project will reach the maturity stage, the various types of farming will form their final shape, at this point mangoes will start to play an important role in production. Types of farming are going to be diverse, some farms will tackle green house farming and others will challenge new profitable crops. In all events, the planned production and marketing to meet the demand of the market place add to the importance of this large Project area with more than 20 thousand feddans and 900 farms, so the overall cooperative activities including agro-industry will be required along with the progress of its administrative ability.

5. Pilot Plan

(1) Approximately 30% of the cooperative's members are agricultural administrators and technologists of land reclamation cooperations and 70% are inexperienced members interested in agriculture. These cooperative members can manage the farming plan and production work can be done by laborers. It is concluded that, people who are employed have experience in agricultural techniques. Therefore, the cooperative members who are going to be agricultural administrators should be imparted knowledge about general agricultural techniques and be trained in farming management concerning marketing and agricultural finance. Further, in order to carry out the Project smoothly, there are many things to certify, both elements of the human side and various technical possibilities.

(2) The main points to be carried out under the pilot plan are as follows.

(a) Establishment of water saving methods through modern irrigation facilities and techniques.

(b) Establishment of fertilization management and planting system techniques on a commercial scale.

(c) Establishment of fodder management techniques for high grade livestock.

(d) Establishment of agricultural administration management techniques for a farm of 20 feddans.

(3) The pilot plan is divided into three organization blocks.

(a) The first block, a 20 feddan farm, is established near the settlement village (Soil classification should be of a mean class in the Project area).

This will serve as both a model of the farm management patterns to confirm the projected output and as a demonstration farm for management training of the co-operative members.

(b) The second block, a demonstration farm (100 feddan), a testing farm (10 feddan) and a training center (50 feddan) will be established in this block. The cooperative constructs and manages this pilot plan and establishes facilities and machinery for the training center. To receive high efficiency from the demonstration and testing farm, employees must be trained in agricultural techniques.

(c) The third block, a seedling farm (2 feddan) and livestock breeding farm (300 feddan) are established. In advance of agricultural development, seedlings for windbreaks and seedlings for orchards are produced, and high grade livestock are introduced from other parts of the country and also imported from overseas. These facilities are to be appropriated as cooperative facilities for smooth farm management after crop production.

(4) To successfully carry out the pilot plan, assistance of the consultant and agricultural advice of the Governorate are needed. In addition, to continue an organized development plan, experts of the Agricultural and Veterinary Departments must reside at the pilot scheme site and also guidance of the Irrigation and Land Reclamation Departments are necessary.

Further, close cooperation with Ismailia Agricultural Research Station and carrying out of additional tests as well as practical use of the study reports is necessary.

Machinery and facilities of this pilot plan have been mentioned previously.

V PROJECT IMPLEMENTATION

V PROJECT IMPLEMENTATION

A. PROJECT ORGANIZATION

1. Executing Agency

Ismailia Governorate[1/], which is responsible for the overall planning, programming and executing of all major irrigation projects in the Governorate, would be the Executing Agency for the implementation of the Project, with the assistance and cooperation of Ministry of Economy and Economic Cooperation and other central government agencies concerned in their respective fields.

Ismailia Governorate is a large organization with more than 10,000 officers. The Governorate is organized into a number of administrative and technical departments. Key technical and administrative staff would be assigned to the Project from their parent departments.

The project organization will operate essentially as a Semi - autonomous independent organ of the Governorate but the line organ would provide special technical support in certain fields like surveys, agricultural extension, marketing, operation and maintenance. The secretary-general would be appointed as Project Director in which position he would be responsible for overall direction of the Project within the Governorate and coordination with central government concerned.

1/: Governorates as well as Markaz (district), town and villages are units of local government in Egypt. Public Law 52 of 1975 requires each unit to be governed by popularly elected councils.
Governor and Minister of State for Local Government designate executive officers for each level to assist the elected councils. And executive officers act as chairman of local executive committee, comprising personnel representing various ministries (Education, Health, Agriculture, Housing, Interior, Social Affairs, and others).
According to the Public Law 52, Article 30, the Governor is appointed by the President and has "the power of Minister in the financial and administrative matters relating to the local government units, their budgets and the utilities to be transfered. And a strong governor is in a good position to coordinate the efforts of all the agencies working in his area.

2. Coordination Committee

An Inter-Ministeral Coordination Committee chaired by the Governor of the Ismailia Governorate should be established for smoother implementation of the Project. The membership of the Committee will consist of under secretary of various ministries, central Government such as Ministry of agriculture, Ministry of Irrigation, Ministry of Housing and Ministry of Social Affairs, and senior staff of concerned agencies. The Committee will meet periodically to decide policy matters and coordinate inter-departmental issues.

At the Project level, a Project Coordination Committee chaired by the Project Director should be established. The Committee will include representatives of the cooperative elected by the members. The arrangement will facilitate communication between the Project Office and the people in the Project area for land acquisition, alignment of irrigation canals, water management and collection of water charges. The organization charts are illustrated in Fig. V.A.1 and V.A.2.

3. Project Office

A Project Office will be established in the Project area. A fully qualified and experienced person of the rank of higher engineer at the Governorate will be appointed as full-time Project Manager.

The Project Office would be adequately staffed for efficient Project implementation. In addition to the Governorate, representatives of central government agencies concerned will be seconded to the Project Office, if necessary. These representatives will maintain technical liaison with their parent agencies. The organizational structure is the same as that adopted for implementation of other on-going irrigation projects.

Fig. V.A.1 Organization Chart of Central Coordination Committee

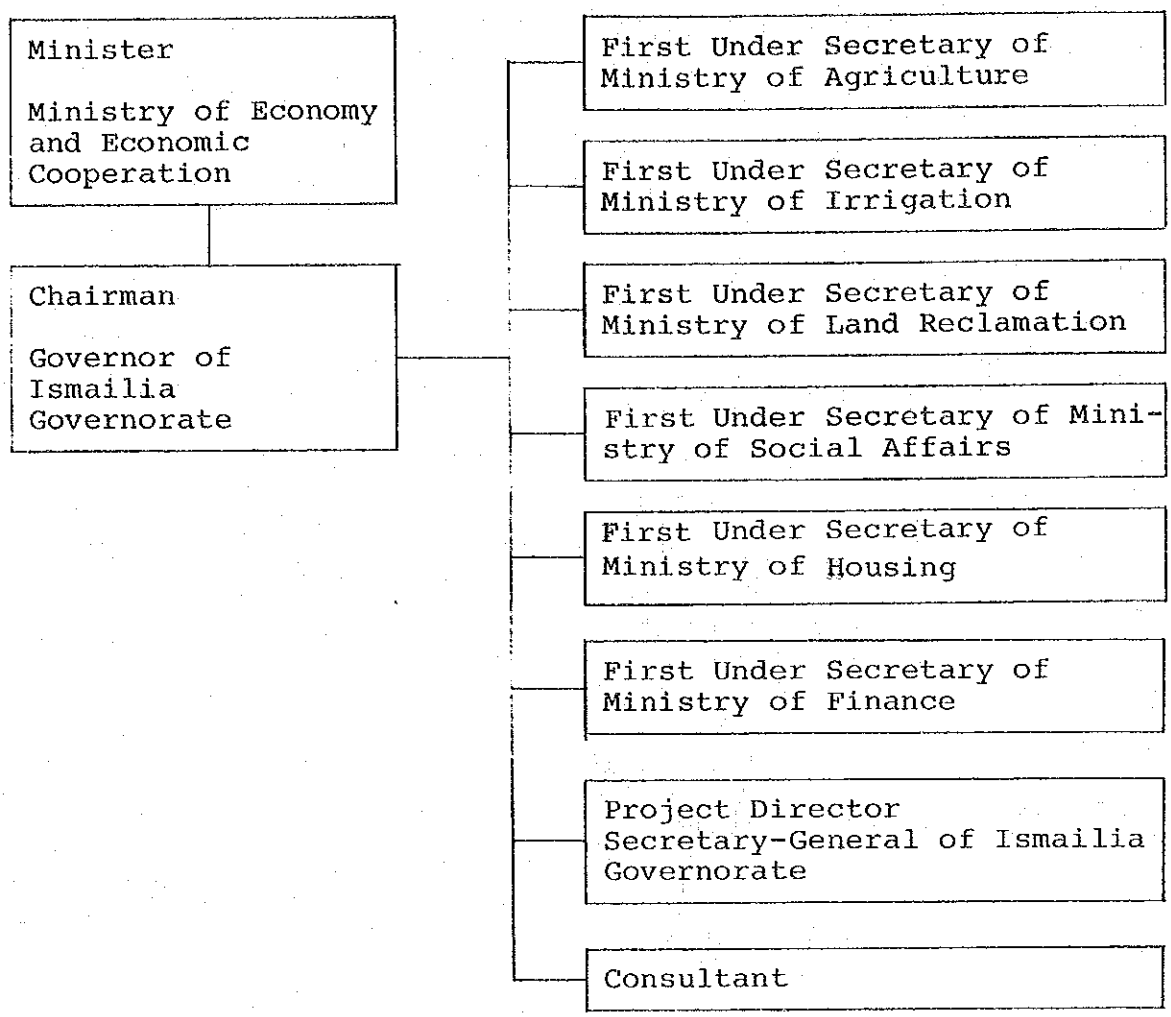
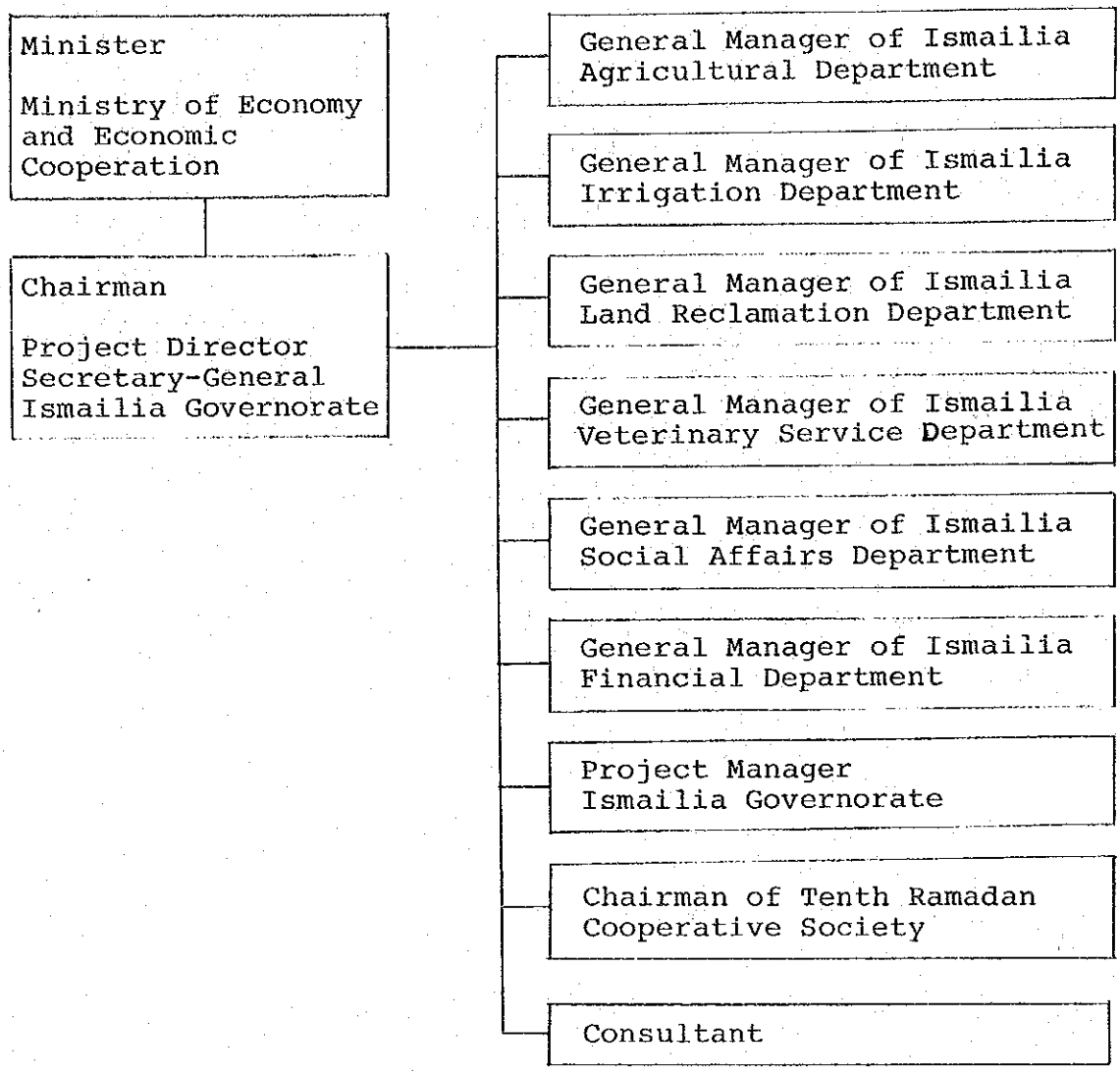


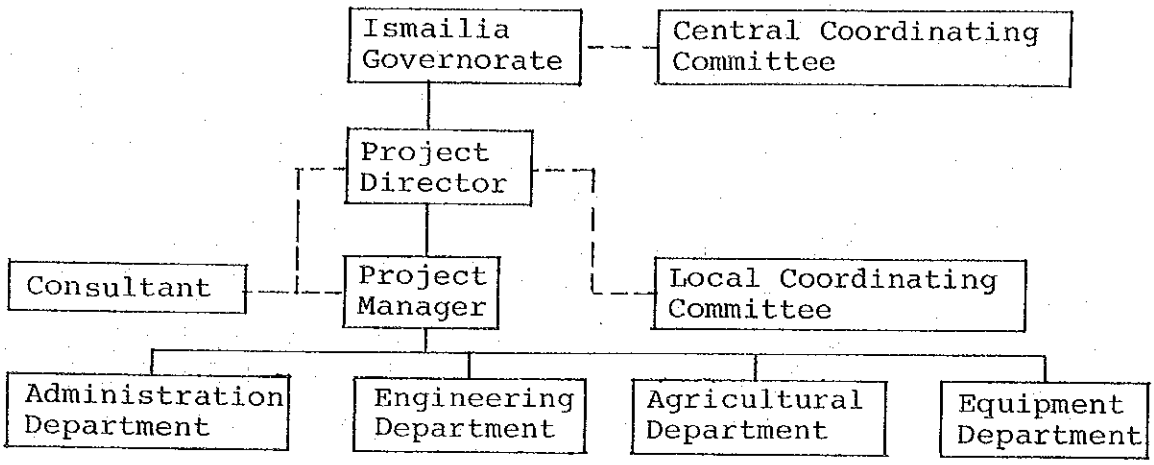
Fig. V.A.2 Organization Chart of Local Coordinating Committee



The Governorate should study carefully the success or otherwise of this structure and identify any bottlenecks or areas of possible improvement. The Project Director will have the responsibility for ensuring timely preparation of specifications, calling for and evaluation of tenders, and negotiation and execution of contracts with the assistance of the consultants. The organization chart is illustrated Fig. V.A.3 and V.A.4.

Fig. V.A.3 Organization Chart

(Construction period - 6 years)



Note: 1) The above organization will be responsible for the construction of project facilities. The project manager will be selected from among the managers in charge construction.

2) The engineering department will be responsible for surveying, designing, estimation of construction costs, supervising, and others.

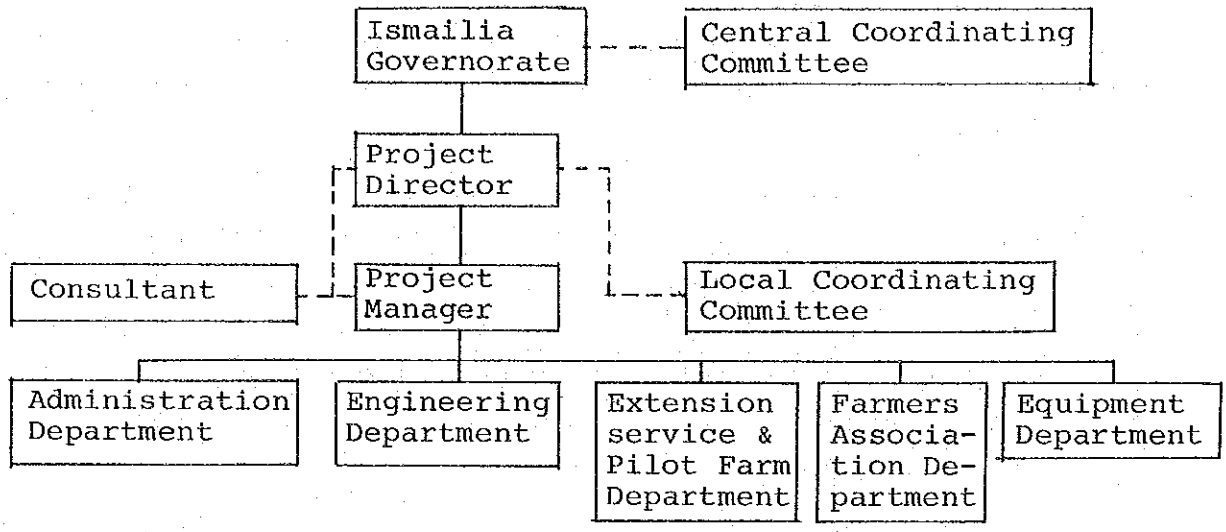
3) The agricultural department will be responsible for the operation of the pilot farm, training of farmers, settlement, management of farmers' association and others.

4) The equipment department will be responsible for the management and maintenance of equipment.

5) The administration department will be responsible for personnel, accounting, management and procurement of assets and office supplies.

Fig. V.A.4 Organization Chart

(Agricultural development period -7 years)



Note: 1) The above organization will be responsible for the implementation of the agricultural development project. An agriculturalist will be appointed as project manager.

2) The engineering department will be responsible for the operation and maintenance of irrigation systems and other small-scale engineering works.

3) The extension service and Pilot farm development will be responsible for the operation of pilot farm and provision of extension services.

4) The farmers' association department will be responsible for organizing and supervising farmers' association.

5) The administration department will be responsible for general management and collection of water charges.

6) Immediately after the agricultural development period, the activities will be taken over to the established farmers' association (Tenth of Ramadan Cooperative).

B. IMPLEMENTATION SCHEDULE

The construction schedule is mainly divided into the preparatory work period and the actual construction period. According to some experiences on development projects by foreign loans, preparatory works usually require at least 25 months even when they progress under a most desirable circumstances.

The preparatory woeks have to take the following steps; the review of F/S, the detailed design including surveying, preparation of tender documents based on the detailed design, tendering, evaluation of tenders and negotiation of contracts. Every step requires a fixed time for adjustments and approvals between the lender and the borrower, and for internal procedures of both sides.

The actual construction in this Project is standardized as a four-year plan, considering the scale of the construction, mutual relations among the works, and periods of ordering, fabrication and transportation for the materials, and referring to some experiences of past development projects as well.

The schedule of the main construction items is shown in the Table V.B.1. In the schedule it is planned that the agricultural production begins in the fifth year with 6,000 feddan which is one third of 18,000 feddan, then extends to another one third in the sixth year and enters in full swing from the seventh year.

Since the minimum estimated period is given for the above mentioned preparatory works, it is very difficult to make the period shorter with the regular procedures. However, it may be possible to shorten the period of the actual construction, when the construction conditions including the contractors are extremely blessed. Actually, it is usual that there occurs some changes of the conditios affecting the construction schedule. Therefore, the standard period of the actual construction must be taken in the F/S, and it is proper to endeavour to shorten the period by means of a good supervision in the construction period.

Table V.B.1 CONSTRUCTION SCHEDULE OF THE PROJECT

Work Item	Month / Quantity	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
		12	24	36	48	60	72
1. D/D							
2. Tendering							
3. Preparatory works	(Employer)						
4. Preparatory works	(Employee)						
5. Reclamation	21,524 Feddans						
6. Road	160,850 m						
7. Main pump station							
-1 Housing	450 m^2						
-2 Intake							
-3 Facilities	ø800 x 6 sets						
8. Main pipeline	26,300 m						
9. Secondary pipeline	112,400 m						
10. Irrigation facilities							
-1 Farm pond	10 place x 11,700 m^3						
-2 Booster pump st.	10 place						
a. Housing	10 x 200 m^2						
b. Facilities	10 x ø350 x 3 sets						
11. On-farm facilities	900 sets						
12. Wells	30 wells						
13. Supporting services	11 buildings 9,350 m^2						
14. Settlement	5 buildings 5,900 m^2 Water supply 41,000 m						

C. ANNUAL OPERATION AND MAINTENANCE COST

The major maintenance and operation items of the Project and the corresponding costs are shown in Table V.C.1.

Table V.C.1 Annual Operation and Maintenance Cost (L.E.)

Item	Cost
1. Main pump station	230,328
2. Booster pump station	504,251
3. Well pump station	66,614
4. Main and secondary pipeline	150,404
5. Roads	18,460
6. Supporting services	1,790
7. Project facilities	773
8. Personnel expenses and overhead	42,380
Total	1,015,000

1. Main Pump Station

Annual operation and maintenance cost of the main pump station is for fuel expenses, repair, parts, and personnel expenditure. Oil expenses are for A-heavy oil consumption during annual operation hours of the diesel engine generators.

2. Booster Pump Station

Annual operation and maintenance cost of the booster pump stations are the same as the main pump station.

3. Well Pump Station

Well pumps are operated continuously 24 hours/day for 2-months during the maximum water requirement period in June and July.

Oil parts, repair and personnel expenditures are the same as the main pump station.

4. Main and Secondary Pipeline

Repair and parts costs of the pipeline are set at an annual rate of 2.5% of the total material expenses. The pipeline system is 265 km long. A daily patrol is required by motorcycle which requires personnel expenditure and motorcycle purchase expenses.

5. Roads

Maintenance cost of trunk roads (L = 30 km), pavement and branch roads (L = 130.85 km) is 1% of the construction cost. Farm roads are maintained by the farmers.

6. Supporting Services

Bulk coolers and cold storages for use as agricultural facilities are maintained at a cost of 5% of purchase prices.

7. Project Facilities

A sum equal to 5% of the construction costs of office, work shops, accomodations and others are expended for maintenance costs.

8. Personnel Expenses and Overhead

Personnel expenses and wages are for management of the cooperative.

D. CONSULTING SERVICES

An experienced foreign agency is to be in charge of the implementation work of the Project to assist the Ismailia Governorate, which is responsible for the implementation of the Project, and other related organizations. The consultant works have been estimated as 119 man/months for the detailed design and 246 man/months for construction supervision.

The following highly qualified experts and engineers will be employed.

- Team Leader
- Agronomist
- Farm Management Expert
- Economist
- Soil Scientist
- Geologist
- Irrigation Engineer
- Farm Consolidation Engineer
- Surveyor
- Design Engineer
- Agricultural Machinery Engineer
- Documents Preparation Clerk
- O/M Engineer

The consultant shall carry out the work following the guidelines concerning consulting services compiled by the Government and internationally accepted by financing organizations such as the World Bank.

The foreign consultant shall carry out the works jointly with a local consultant. The local consultant will be employed by the Governorate before the arrival of the foreign consultant to carry out investigations and preliminary designs. The foreign consultant will have 18 man/month support from the local consultant for preparing the work schedule, the detailed design and the contract documents, and 123 man/month support of the local engineers during construction supervision including agricultural development. The foreign consultant

shall cooperate with the officers of the Governorate to effectively carry out the Project.

Although Ismailia Governorate has already carried out irrigation projects, the experience of the Governorate concerning large-scaled pump stations, sprinkler irrigation systems, water management and social organization is not sufficient. Therefore, Ismailia Governorate plans to send to a developed country about three engineers who are directly concerned with the Project's implementation for training of from 1 to 4 months who have superior techniques in construction, water management and agricultural development.

E. COST ESTIMATE

The investment cost of the Project is estimated to be LE69,357,000 consisting of the foreign currency portion: LE51,550,000 and the local currency portion: LE17,807,000. This estimate is based upon the following conditions:

(1) Prices used for the cost estimate are as of March, 1982 for both foreign and local costs.

(2) The conversion rate from local currency to foreign currency is LE.0.8 = US$1.00 and LE.1.00 = ¥303.

(3) Physical contingencies of the cost estimate are set at 20% for the local currency portion (civil works), and 10% for the foreign currency portion.

(4) Price contingencies applied in the estimate are 15% per year for the local currency portion and 7% per year for the foreign currency portion.

The break-down of the cost estimate and budget schedule are as shown in Tables V.E.1, V.E.2 and V.E.3.

Table V.E.1 Investment Cost

(LE)

Item	Local Currency Portion	Foreign Currency Portion	Total
1. Facilities & Materials	-	32,633,000 (6,315,000)	32,633,000 (6,315,000)
2. Earth work	7,295,000	-	7,295,000
3. Wages	720,000	-	720,000
4. Consulting Services	389,000	3,052,000	3,441,000
5. Physical Contingency	1,681,000	3,569,000	5,250,000
6. Price Escalation	7,722,000	12,296,000	20,018,000
Grand Total	17,807,000	51,550,000	69,357,000

Table V.E.2 INVESTMENT COST OF THE PROJECT

(LE)

Work Item	F/C	L/C	Total
1. Preparatory Work	-	10,000	10,000
2. Main Pump Station	2,434,000	95,000	2,529,000
3. Main & Secondary P.L.	11,887,000	910,000	12,797,000
4. Intake Works	26 ,000	80,000	106,000
5. Booster Pump Station	5,946,000	404,000	6,350,000
6. Farm Pond	-	1,250,000	1,250,000
7. Wells	1,697,000	173,000	1,870,000
8. Reclamation	-	250,000	250,000
9. On-farm Facilities	10,087,000	385,000	10,472,000
10. Roads	-	1,850,000	1,850,000
11. Supporting Services	556,000	482,000	1,038,000
12. Settlement	-	1,174,000	1,174,000
Sub-Total	32,633,000	7,063,000	39,696,000
13. Project Facilities	-	232,000	232,000
14. Administration Cost	-	720,000	720,000
15. Consulting Services	3,052,000	389,000	3,441,000
Sub-Total	35,685,000	8,404,000	44,089,000
16. Physical Contingency	3,569,000	1,681,000	5,250,000
Total	39,254,000	10,085,000	49,339,000
17. Price Escalation	12,296,000	7,722,000	20,018,000
Grand total	51,550,000	17,807,000	69,357,000

Table V.E.3 BUDGET SCHEDULE OF THE PROJECT

(Unit: LE10^3)

WORK ITEM	TOTAL			1ST YEAR		2ND YEAR		3RD YEAR		4TH YEAR		5TH YEAR		6TH YEAR	
	L/C	F/C	TOTAL	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C
1. Preparatory Work	10	-	10	-	-	10	-	-	-	-	-	-	-	-	-
2. Main Pump Station	95	2,434	2,529	-	-	-	-	76	487	19	1,947	-	-	-	-
3. Main & Secondary Pipelines	910	11,887	12,797	-	-	-	-	174	8,354	385	1,325	175	1,325	176	883
4. Intake Works	80	26	106	-	-	-	-	-	-	80	26	-	-	-	-
5. Booster Pump Station	404	5,946	6,350	-	-	-	-	182	1,189	222	2,378	-	2,379	-	-
6. Farm Pond	1,250	-	1,250	-	-	-	-	475	-	625	-	150	-	-	-
7. Wells	173	1,697	1,870	-	-	-	-	43	339	57	679	57	679	16	-
8. Reclamation	250	-	250	-	-	-	-	225	-	25	-	-	-	-	-
9. On-farm Facilities	385	10,087	10,472	-	-	-	-	-	2,017	131	2,723	127	2,723	127	2,624
10. Roads	1,850	-	1,850	-	-	-	-	703	-	925	-	222	-	-	-
11. Supporting Services	482	556	1,038	-	-	-	-	121	111	159	445	159	-	43	-
12. Settlement	1,174	-	1,174	-	-	-	-	235	-	317	-	317	-	305	-
Sub-Total	7,063	32,633	39,696	-	-	10	-	2,234	12,497	2,945	9,523	1,207	7,106	667	3,507
13. Project Facilities	232	-	232	-	-	232	-	-	-	-	-	-	-	-	-
14. Administration Cost	720	-	720	-	-	144	-	144	-	144	-	144	-	144	-
15. Consulting Services	389	3,052	3,441	50	1,007	-	-	66	458	74	671	101	580	98	336
Sub-Total	8,404	35,685	44,089	50	1,007	386	-	2,444	12,955	3,163	10,194	1,452	7,686	909	3,843
16. Physical Contingency	1,681	3,569	5,250	10	101	77	-	489	1,296	633	1,019	290	769	182	384
Total	10,085	39,254	49,339	60	1,108	463	-	2,933	14,251	3,796	11,213	1,742	8,455	1,091	4,227
17. Price Contingency	7,722	12,296	20,018	9	78	149	-	1,528	3,206	2,843	3,487	1,761	3,407	1,432	2,118
Grand Total	17,807	51,550	69,357	69	1,186	612	-	4,461	17,457	6,639	14,700	3,503	11,862	2,523	6,345

VI ECONOMIC JUSTIFICATION AND FINANCIAL ANALYSIS

VI ECONOMIC JUSTIFICATION AND FINANCIAL ANALYSIS

A. ECONOMIC JUSTIFICATION

1. General

The proposed Project aims to increase crop and livestock production, create more employment opportunities and improve living conditions through provision of irrigation facilities, farmers' organization and others. The investment in the Project area is justifiable in terms of the net value added to the national and regional economy, the benefits to farm families and other socio-economic benefits.

2. Economic Costs and Benefits

The economic costs of the Project area are estimated at LE 44,404,000 at March 1982 prices which include the total investment cost net of allowance for taxes, duties, price escalation and others. Operation and maintenance costs (LE 1,015,000 per year from 1992/93 and onwards) including replacement costs of pump plants for every years during the estimated project life (50 years) are calculated separately.

The major tangible benefits to evolve from the Project will be a substantial increase in upland crop production and livestock rearing, and the resulting income and employment opportunities for some 900 farm families and labourers concerned. The economic benefits attributable to the Project are mainly in the form of incremental agricultural production including livestock rearing less incremental costs, both of which are calculated on the basis of economic value from the viewpoint of the national and regional economy.

The increase in agricultural production will be mainly due to: (i) increase in the cropping intensity from zero without the Project to 145 per cent (actually 200 per cent) with the Project at full development; (ii) increase in higher annual average yields of potatoes, tomatoes (winter),

watermelon, cucumber, sesame and fruits (citrus), resulting in respective increases in production per year of potatoes (21,330 tons), tomatoes (winter) (15,120 tons), watermelon (34,290 tons), cucumber (19,440 tons), sesame (450 tons) and fruits (citrus) (59,400 tons) when the Project area fully develops in 1997/98; (iii) increase in higher annual production of milk, meat, chicken and eggs at full development stage. The Project will, when fully developed, generate incremental net benefits of LE 12,812,486 per year. The annual agricultural benefits are in Table VI.A.1.

3. Economic Internal Rate of Return (EIRR)

On the basis of the economic costs and the direct tangible economic benefits from upland crop production and livestock rearing as mentioned above, the economic internal rate of return (EIRR) for the Project is calculated at 14.6 per cent which is considered satisfactory. Table VI-A-2 shows the calculation.

The EIRR is calculated on the basic assumptions of: (i) projected prices of LE 80/ton for potatoes, LE 110/ton for tomatoes (winter), LE 80/ton for watermelon, LE 105/ton for cucumber, LE 370/ton for sesame and LE 130/ton for fruits (citrus) in due consideration of export; (ii) average yields of 7.9 tons per crop per feddan for potatoes, 5.6 tons per crop per feddan for tomatoes (winter), 12.7 tons per crop per feddan for watermelon, 7.2 tons per crop per feddan for cucumber, 0.5 ton per crop per feddan for sesame and 6.6 tons per crop per feddan for fruits (citrus); (iii) a large increase in livestock production; (iv) an agricultural development period of seven years after completion of the Project; (v) a Project economic life of 50 years; and (vi) a cropping intensity of 145 per cent (actually 200 per cent).

4. Sensitivity Test

Sensitivity tests of the EIRR for the Project are calculated for the following cases: (i) a 15 per cent reduction of unit prices of upland crops; (ii) taking into account Construction Costs of Tolonbaht Canal, and (iii) a two-year progress in Project completion.

Results of th sensitivity tests are as shown below, and considered feasible.

	Assumptions	EIRR (%)
(i)	A 10 per cent reduction of unit prices of upland crops	11.9
(ii)	Taking into account construction costs of Tolonbaht Canal	13.3
(iii)	A two-year progress Project completion	15.0

5. Other Socio-Economic Impact

In addition of the increase of agricultural production, the Project will have significant socio-economic impact on employment, income distribution and cthers.

5.1 Employment Opportunities

The farmers in the Project area will benefit directly from an increase in employment opportunities in agriculture, transportation and marketing after completion of the Project, and even during the construction period.

Increased agricultural production in the Project area will result from the introduction of selected profitable upland crops and more intensive land use, which will make possible the double cropping of some 18,000 feddans, almost all of the entire cultivated area after project development.

Farm labour requirements in the Project area at full development will reach about 4,000 persons per year, of which 2,000 persons will be provided as permanent labourers. While some of the farm labour requirements will come from the farmers who are also land owners, landless labourers and/or under-employed labourers will benefit significantly as permanent or temporary labourers by the creation of jobs.

Employment opportunities in marketing and transport will increase significantly in parallel with the upland crop production, particularly when the market volume will exceed about 100,000 tons per year at full development of the Project.

For the construction of the Project, labour requirements of 90 man-days are estimated. It will provide significant employment opportunities during the early stage of construction.

5.2 Income Distribution

Without the Project, the rural income situation would not be improved. With the Project, farm income will be greatly increased. As agricultural production and income increase with the Project, farmers' demand and purchasing power for industrial goods for living items and farm inputs will increase accordingly.

In parallel with the increase of income, farmers' living conditions would be substantially improved. Homes could be further enlarged, and more and better goods will be available at the farmers' level also.

Table VI-A-1 Income[1/] with and without the Project

(Unit: LE)

No.	Year	(Present) Income	(Without p) Income (A)	Income from Crops (B)	Income from Livestock (C)	(With Project) Total (D)=(B)+(C)	Difference (E)=(D)-(A)
1	1983/84	0	0				
2	1984/85	0	0				
3	1985/86	0	0				
4	1986/87	0	0				
5	1987/88	0	0	647,610		647,610	647,610
6	1988/89	0	0	1,343,191	775,860	2,119,151	2,119,151
7	1989/90	0	0	2,110,729	1,887,797	3,998,526	3,998,526
8	1990/91	0	0	2,302,613	3,009,211	5,311,824	5,311,824
9	1991/92	0	0	3,046,165	3,537,912	6,584,077	6,584,077
10	1992/93	0	0	4,029,573	3,871,595	7,901,168	7,901,168
11	1993/94	0	0	5,108,924	4,300,957	9,409,881	9,409,881
12	1994/95	0	0	5,756,534	4,720,846	10,477,380	10,477,380
13	1995/96	0	0	6,160,230	5,147,499	11,307,729	11,307,729
14	1996/97	0	0	6,739,941	5,468,996	12,208,937	12,208,937
15	1997/98	0	0	7,051,755	5,616,819	12,668,574	12,668,574
16	1998/99	0	0	7,195,667	5,616,819	12,812,486	12,812,486
↓	↓	↓	↓	↓	↓	↓	↓
50	2032/33	0	0	7,195,667	5,616,819	12,812,486	12,812,486

1/ Incomes here represent value net from production costs

Table VI-A-2 Summary of Economic Benefits and Costs of the Project[1/] (EIRR)

(Unit: LE '000)

No.	Year	Benefits	Investment Costs	C&M Costs	Total Costs	Net Flow (Incremental Costs)	Present Worth Discounted at 14%	Present Worth Discounted at 16%
1	1983/84		1,152		1,152	-1,152	-1,011	-993
2	1984/85		296		296	-296	-228	-220
3	1985/86		15,815		15,815	-15,815	-10,675	-10,132
4	1986/87		13,176		13,176	-13,176	-7,801	-7,277
5	1987/88	648	9,269	338	9,607	-8,959	-4,653	-4,265
6	1988/89	2,119	4,696	677	5,373	-3,254	-1,482	-1,336
7	1989/90	3,999		1,015	1,015	2,984	1,194	1,056
8	1990/91	5,312		1,015	1,015	4,297	1,508	1,311
9	1991/92	6,584		1,015	1,015	5,569	1,715	1,465
10	1992/93	7,901		1,015	1,015	6,886	1,859	1,563
11	1993/94	9,410		1,015	1,015	8,395	1,990	1,637
12	1994/95	10,477		1,015	1,015	9,462	1,968	1,590
13	1995/96	11,308		1,015	1,015	10,293	1,873	1,492
14	1996/97	12,209		1,015	1,015	11,194	1,791	1,399
15	1997/98	12,669		1,015	1,015	11,654	1,632	1,259
16	1998/99	12,813		1,015	1,015	11,798	1,451	1,097
↓	↓	↓		↓	↓	↓	↓	↓
50	2032/33	12,813		1,015	1,015	11,798	17	7
	Total	531,091	44,404	45,675	90,079	441,012	1,384	-3,544

$$EIRR = 14 + 2\left(\frac{1,384}{1,384 + 3,544}\right) = 14.6\%$$

1/: All in constant prices in 1982

B. FINANCIAL ANALYSIS

1. Revenue and Expenditure of Typical Farm Budget

The financial analysis of the Project is made from the farmers' viewpoint. In order to estimate the farm budget under the future with project conditions, the analysis is made on 20-feddan-unit with compound farm system. Typical farm budget is shown in Table VI-B-1.

After the irrigation development, the annual gross return in farm production by farmers is expected to increase in acreage, in unit yield of various crops and in amount of livestock products year by year. The return will be at its maximum starting from the seventh year and onwards after irrigation development is completed. Annual gross return from crop production and livestock rearing in and after the seventh year of irrigation development applying intensive farming systems is estimated at LE 22,274.2 per farm household on an average.

On respective farms, advanced farming practices will be introduced for profitable farm management. Accordingly, the funds necessary for the performance of such farm activities will necessarily be more when compared to those for primitive methods. The farming expenditure increases with the advanced farming and is at a maximum in and after the seventh year.

Capacity to pay which is calculated by deducting labor costs from actual net return can be estimated at LE 11,933.7 on an average. From the capacity to pay, the farmer must pay the annual O&M costs (in a narrow sense) is estimated at LE 1,151.8 per farm household. Therefore, about LE 10,781.9 of the net profit will be reserved even after payment of O&M costs.

2. Repayment of Construction Cost

The project cost will be made available through loan

arrangements by the Ismailia Governorate under the assistance and cooperation of the Ministry of Economy and Economic Cooperation. The foreign currency portion is to be raised by a proposed loan from some international lending agencies, and the local currency portion should be of the governorate security.

The loan must be repaid either by public funds or by project beneficiaries. To meet the repayment obligation satisfactorily, first of all, a policy for the Project should be established by the Governorate in the most feasible way.

Trial accounts of the balance between loans and their repayment have been carried out under the assumption that the loan conditions of the foreign currency portion (LE 51,550,000) are 3.5% annual rate of interest and 10 years unredeemable, borrowed from international lending agencies, the repayment period is 30 years including the unredeemable period, the loan conditions of the local currency portion (LE 17,807,000) are 3% annual rate of interest and 3 years unredeemable, borrowed from the Land Reclamation Fund of the Egyptian Agricultural Development Credit Bank and the repayment period is 10 years including the unredeemable period.

The results of the trial accounts mentioned above are shown in Table VI.B.2. At a glance, it is quite apparent that the funds for repayment are lacking during the construction stage, since the income from agriculture production is not realized at the time. However, annual surplus reaches about LE 6,000 per farm in the 15th year, 10 years after agricultural production starts.

For the smooth repayment of loans, it is deemed necessary to take the following counter-measures on farm level: i) farm management guidance to facilitate for quick turnover of the capital, and ii) establishment of an appropriate mutual-aid type credit system.

Table VI-B-1 Typical Farm Budget of 20 Feddan Unit Farm in and after the Seventh Year of Project Completion

(in case of compound farm system)

Crop	Cropped acreage	Unit Yield	Unit Price	Gross Value	Production Cost	Net Value
	(Feddan)	(ton/feddan)	(LE/ton)	(LE/Unit farm)	(LE/Unit farm)	(LE/Unit farm)
Crop						
Winter						
Berseem	3.0	20				
Potatoes	3.0	7.9	77	1,824.9	1,189.5	635.4
Tomatoes	3.0	5.6	105	1,764.0	1,189.2	574.8
Summer						
Sorghum	2.0	20				
Sesame	1.0	0.5	370	185.0	116.7	68.3
Cucumber	3.0	7.2	98	2,116.8	1,421.7	695.1
Watermelon	3.0	12.7	78	2,971.8	2,082.9	888.9
Perennial						
Alfalfa	0.5	40				
Napier Grass	0.5	73				
Fruits (citrus)	10.0	6.6	120	7,920.0	3,056.0	4,864.0
Sub-total				6,782.5		7,726.5
Cost of labour						804.1
Total						6,922.5

Livestock	Unit Production	Gross Value	Net Value
	(kg or dozen)	(LE/Unit farm)	(LE/Unit farm)
Dairy Cattle			
Milk	16,110 kg	4,027.5	1,611.0
Meat	296.6 kg	682.2	682.2
Chicken			
Chicken	1,170 kg	702.0	702.0
Eggs	12,000 dozen	10,080.0	2,016.0
Total		15,491.7	5,011.2
Grand total		22,274.2	11,933.7

Table VI.B.2 Repayment Progarm

(Unit: LE '000)

No.	Year	Capacity to Pay	O&M Costs	Net Profits	Foreign Loan	Cumulative Foreign Loan	Repayment of Foreign Loan	Cumulative Installment	Balance of Foreign Loan	(3.5%) Interest Payment	Annual Surplus	Accumulated Surplus	Local Loan	Cumulative Local Loan	Repayment of Local Loan	Balance of Local Loan	(3%) Interest Payment	Annual Surplus	Accumulated Surplus
1	1983/84			-	1,186	1,186			1,186	42	-42	-42	69	69		69	2	-44	-44
2	1984/85			-	0	1,186			1,186	42	-42	-84	612	681		681	20	-62	-106
3	1985/86			-	17,457	18,643			18,643	653	-653	-737	4,461	5,142		5,142	154	-807	-913
4	1986/87			-	14,700	33,343			33,343	1,167	-1,167	-1,904	6,639	11,781	10	11,771	353	-1,530	-2,443
5	1987/88	561	346	215	11,862	45,205			45,205	1,582	-1,367	-3,271	3,503	15,284	98	15,176	455	-1,920	-4,363
6	1988/89	1,763	691	1,072	6,345	51,550			51,550	1,804	-732	-4,003	2,523	17,807	736	16,963	509	-1,977	-6,340
7	1989/90	3,420	1,037	2,383					51,550	1,804	579	-3,424			1,685	15,278	458	-1,564	-7,904
8	1990/91	4,488	1,037	3,451					51,550	1,804	1,647	-1,777			2,186	13,092	393	-932	-8,836
9	1991/92	5,588	1,037	4,551					51,550	1,804	2,747	970			2,547	10,545	316	-116	-8,952
10	1992/93	6,624	1,037	5,587					51,550	1,804	3,783	4,753			2,546	7,999	240	997	-7,955
11	1993/94	7,889	1,037	6,852			2,578	2,578	48,972	1,714	2,560	7,313			2,533	5,466	164	-137	-8,092
12	1994/95	8,803	1,037	7,766			2,578	5,156	46,394	1,624	3,564	10,877			2,444	3,022	91	1,029	-7,063
13	1995/96	9,574	1,037	8,537			2,578	7,734	43,816	1,534	4,425	15,302			1,807	1,215	36	2,582	-4,481
14	1996/97	10,241	1,037	9,204			2,578	10,312	41,238	1,443	5,183	20,485			858	357	11	4,314	-167
15	1997/98	10,616	1,037	9,579			2,578	12,890	38,660	1,353	5,648	26,133			357	0	0	5,291	5,124
16	1998/99	10,740	1,037	9,703			2,578	15,468	36,082	1,263	5,862	31,995						5,862	10,986
17	1999/00	10,740	1,037	9,703			2,578	18,046	33,504	1,173	5,952	37,947						5,952	16,938
18	2000/01	10,740	1,037	9,703			2,578	20,624	30,926	1,082	6,043	43,990						6,043	22,981
19	2001/02	10,740	1,037	9,703			2,578	23,202	28,348	992	6,133	50,123						6,133	29,115
20	2002/03	10,740	1,037	9,703			2,578	25,780	25,770	902	6,223	56,346						6,223	35,338
21	2003/04	10,740	1,037	9,703			2,578	28,358	23,192	812	6,313	62,659						6,313	41,651
22	2004/05	10,740	1,037	9,703			2,578	30,936	20,614	722	6,403	69,062						6,403	48,054
23	2005/06	10,740	1,037	9,703			2,578	33,514	18,036	631	6,494	75,556						6,494	54,548
24	2006/07	10,740	1,037	9,703			2,578	36,092	15,458	541	6,584	82,140						6,584	61,132
25	2007/08	10,740	1,037	9,703			2,578	38,670	12,880	451	6,674	88,814						6,674	67,806
26	2008/09	10,740	1,037	9,703			2,578	41,248	10,302	361	6,764	95,578						6,764	74,570
27	2009/10	10,740	1,027	9,703			2,578	43,826	7,724	270	6,855	102,433						6,855	81,425
28	2010/11	10,740	1,037	9,703			2,578	46,404	5,146	180	6,945	109,378						6,945	88,370
29	2011/12	10,740	1,037	9,703			2,578	48,982	2,568	90	7,035	116,413						7,035	95,405
30	2012/13	10,740	1,037	9,703			2,568	51,550	0	0	7,135	123,548						7,135	102,540
31	2013/14	10,740	1,037	9,703							9,703	133,251						9,703	112,243
32	2014/15	10,740	1,037	9,703							9,703	142,954						9,703	121,946
33	2015/16	10,740	1,037	9,703							9,703	152,657						9,703	131,649
34	2016/17	10,740	1,037	9,703							9,703	162,360						9,703	141,352
35	2017/18	10,740	1,037	9,703							9,703	172,063						9,703	151,055
36	2018/19	10,740	1,037	9,703							9,703	181,766						9,703	160,758
37	2019/20	10,740	1,037	9,703							9,703	191,469						9,703	170,461
38	2020/21	10,740	1,037	9,703							9,703	201,172						9,703	180,164
39	2021/22	10,740	1,037	9,703							9,703	210,875						9,703	189,867
40	2022/23	10,740	1,037	9,703							9,703	220,578						9,703	199,570
41	2023/24	10,740	1,037	9,703							9,703	230,281						9,703	209,271
↓	↓	↓	↓	↓							↓	↓						↓	↓
50	2032/33	10,740	1,037	9,703							9,703	317,608						9,703	296,599
	Total	445,467	46,665	398,802			51,550			29,644	317,608				17,807		3,202	296,599	

VII RECOMMENDATIONS

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(1) The Tenth of Ramadan Project, an agricultural development scheme based on desert irrigation, is technically feasible and economically viable. It can bring about many-sided socio-economic benefits such as the provision of employment opportunities and the generation of ample spill-over effects in favour of the areas extending around it. Being aligned to the national food policy and aimed at a model for desert development by the hand of the land reclamation cooperative societies, it is expected to make due contributions on behalf of the planning and executing agencies of the State in chalking out appropriate policy-measures towards structural re-organization of agriculture in the country through its modernization, and also on behalf of the cooperative leaders at both national and Governorate levels in establishing new guidelines for revitalization of the agricultural cooperative movement which has been sunk in stagnation. It is, therefore, very much hoped for that full consideration be given to expedite its implementation. Likewise, support and encouragement by the Central Government are hoped for not only for the whole work of the Project, but also for the construction of Tolonbaht Canal and Salhya Canal as its mother stream, since this construction is the premise of the Project.

(2) Agricultural processing industry which plays an important role in achieving a stabilized supply of farm products in large quantities and in enhancement of the added value are expected to be positively taken up by the existing State Company as well as the private concerns which are enterring anew into this field of enterprise, rather than by this Project itself. The Governorate of Ismailia is looking forward to an increasingly important phase of its own development and, from such a comprehensive standpoint, the private companies may need to be given more chances and opportunities to expand their share in agricultural products

processing, including invitations to foreign capital interested in agro-based industries to start their own venture in the Free Zone.

(3) As the premise in this plan, the water requirements per feddan per day was determined to be 28.1 cubic meters in the peak month and 5,900 cubic meters per annum. The Ismailia Governorate, which has already recognized this requirement figure, should make strenuous efforts to secure this in its negotioations with the central Government. Since, water is the most valuable, finite resource in Egypt, it will be necessary to study a much more modern method of water utilization within the framework of the pilot plan with the assistance of the national institutes in the overall implementation of this Project. Also, it is necessary to ensure timely completion of construction or expansion of the canals which will provide the Project with irrigation water and, therefore, are premises of the feasibility of the Project.

(4) This Project requires quite a number of qualified engineers and technicians all through its implementation period. Overseas training and education is recommended on behalf of the personnel directly engaged in the Project work for obtaining not only technical know-how modern agricultural production but also the understanding of the agricultural cooperative operation and management meeting the requirements of the day, and the engineering techniques called for in reclamation and development of desert-land. The knowledge, experience and information absorbed from the Project personnel of the developed countries will also prove beneficial to similar undertakings in the other parts of the country.

(5) In conclusion, a special mention will probably need to be made on the plan which is proposed for operation of the Project funds. The repayment conditions taken into consideration, however, it is presumed that a more or less tight situation will have to be experienced in the initial period of its development. To tide over such a stringent situation, it is necessary to put into effect: i) steady progress of the construction work through the most effective and economical ways and means; ii) farm-management guidance to facilitate for quick turnover of the capital; iii) establishment and operation of an appropriate mutual-aid type credit system among the membership, and iv) credit-repayment measures taken by the Governorate which assumes an overall responsibility for the Project implementation.