H-6 (1) ET Crop of Nursery Stage

Month		Kc							ET Crop
		Cropping Order				Average			
		1st	2nd	3rd	4th	10 days	Kc	Kc/10	ETo•Kc/10
									(mm/day)
May	First	0	0	0	0	0			
	Middle	0.55	0	0	0	0.14	0.18	0.02	0.2
	Last	1.10	0.55	0	0	0.41			
June	First	1.10	1.10	0.55	0	0.69			
	Middle	0.55	1.10	1.10	0.55	0.83	0.74	0.07	0.6
	Last	0	0.55	1.10	1.10	0.69			
July	First	0	0	0.55	1.10	0.41			
	Middle	0	0	0	0.55	0.14	0.18	0.02	0.2
	Last	0	0	0	0	0			

H-7 (2) Percolation of Nursery Stage

Month		Percolation (P)						
		Cropping Order				Average		
		1st	2nd	3rd	4th	10 days	P	P/10
								(mm/day)
May	First	0	0	0	0	0		
	Middle	1	0	0	0	0.3	0.4	0
	Last	2	1	0	0	0.8		
June	First	2	2	1	0	1.3		
	Middle	1	2	2	1	1.5	1.4	0.1
	Last	0	1	2	2	1.3		
July	First	0	0	1	2	0.8		
	Middle	0	0	0	1.	0.3	0.4	0
	Last	0	0	0	0	0		

H-8 (3) Puddling Water Requirement for Nursery Stage

Month		Day	80/30x10 x day/10	Average (mm/day)
May	First	0	0	
	Middle	5	0.1	0.1
	Last	10	0.3	
June	First	10	0.3	
	Middle	5	0.1	0.1
	Last	0	0	

Note: Puddling Area = Growing Stage x 1/10

H-9 (4) Puddling Water Requirement for Growing Stage

Month		Day	80/30 x day/10	Average (mm/day)
June	First	0	0	
	Middle	10	2.7	1.8
	Last	10	2.7	
July	First	10	2.7	
	Middle	0	0	0.9
	Last	0	0	

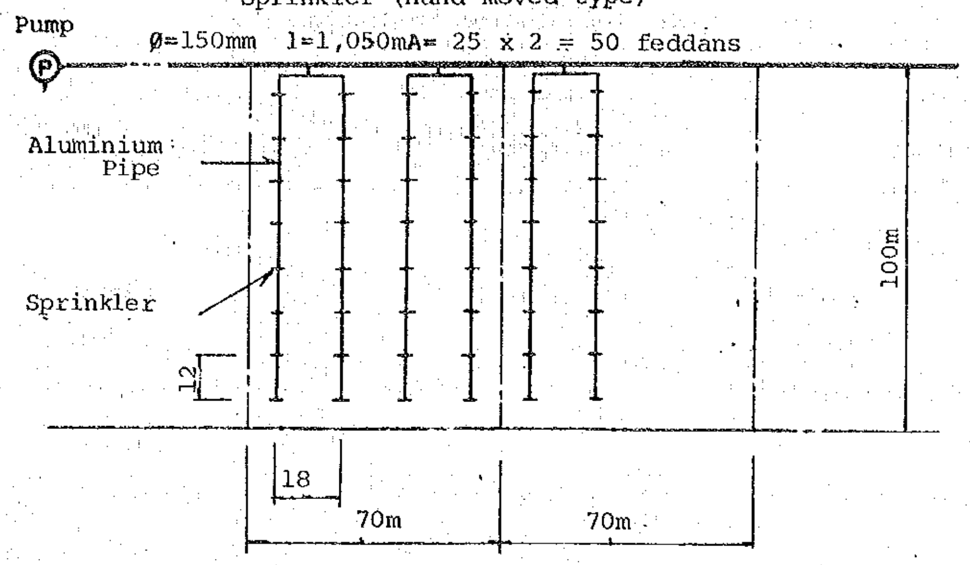
H-10 (5) Percolation of Growing Stage

Month		Cropping Order				Average	
		1st	2nd	3rd	4th	10 days	Month
June	First	0	0	0	0	0	
	Middle	1	0	0	0	0.3	0.4
	Last	2	1	0	0	0.8	
July	First	2	2	1	0	1.3	
	Middle	2	2	2	1	1.8	1.7
	Last	2	2	2	2	2.0	
Aug.	First	2	2	2	2	2.0	
	Middle	2	2	2	2	2.0	2.0
	Last	2	2	2	2	2.0	
Sep.	First	2	2	2	2	2.0	
	Middle	2	2	2	2	2.0	1.8
	Last	0	2	2	2	1.5	
Oct.	First	0	0	2	2	1.0	
	Middle	0	0	0	2	0.5	0.5
	Last	0	0	0	0	0	

H-11 Model Plan of Sprinkler and Drip Irrigation

Model Plan (1)

Sprinkler (Hand-moved type)



i) Basic data

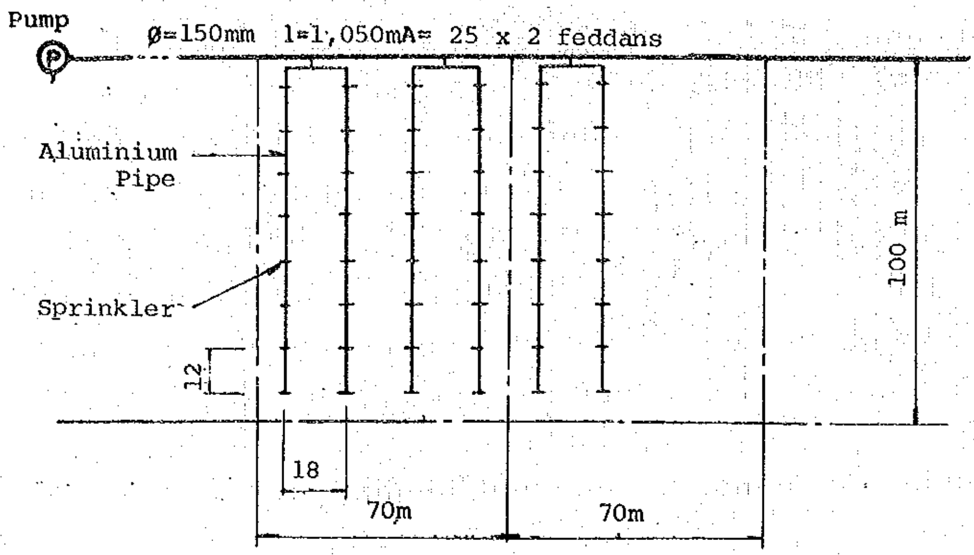
Irrigation interval (4 days on/off)		8
Amount of irrigation	(mm)	93
Irrigation hours per placement	(hr/once)	12
Movement per day	(times)	2
Irrigation area per day	(feddan)	4.2
Sprinkler interval	(m)	12 x 18
Irrigation line	(lines/time)	6
Sprinkler discharge	(l/min)	28
pressure	(kg/cm^2)	2.5
spray diameter	(m)	28
Irrigation intensity	(mm/hr)	7.8
Pump capacity	(m^3/min)	1.3

ii) Construction cost

	Volume	Unit price	Construction cost
Sprinkler-30N	96	25	2,400
Aluminum pipe ∅=70mm	1080m	5	5,400
Vinyl chloride pipe ∅=150mm	1050m	10	10,500
Pump ∅=100mm H=40m	1 set	-	5,000
Total			23,300 LE/33.3 fed.
			= 700 LE/fed.

Model Plan (2)

Sprinkler (Fixed type)



i) Basic data

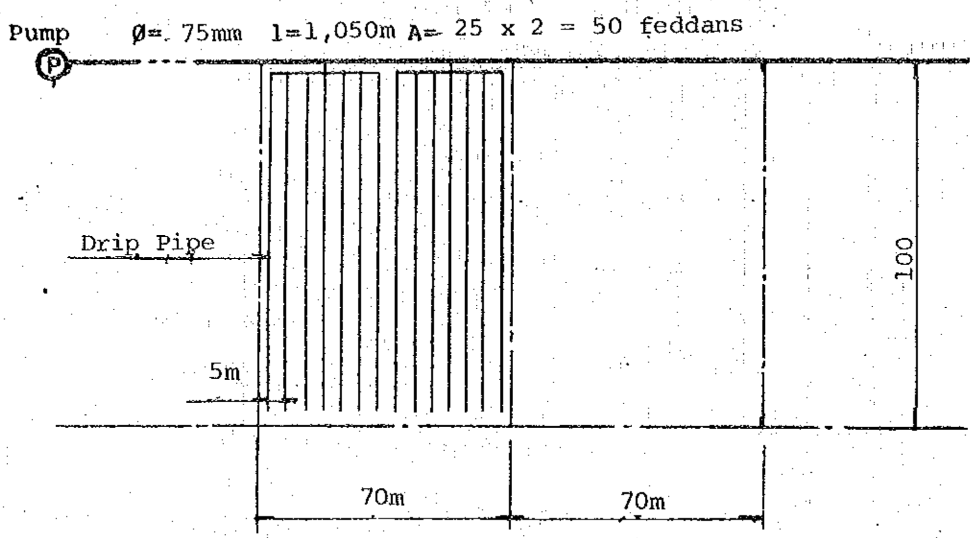
Irrigation interval (4 days on/off)		8
Amount of irrigation	(mm)	93
Irrigation hours per placement	(hr/once)	12
Movement per day	(times)	2
Irrigation area per day	(feddan)	4.2
Sprinkler interval	(m)	12 x 18
Irrigation line	(lines/time)	6
Sprinkler discharge	(l/min)	28
pressure	(kg/cm^2)	2.5
Spray diameter	(m)	28
Irrigation intensity	(mm/hr)	7.8
Pump capacity	(m^3/min)	1.3

ii) Construction cost

	Volume	Unit price	Construction cost
Sprinkler-30N	640 sets	25	16,000
Aluminium pipe ø=70mm	7200 m	5	36,000
Vinyl chloride pipe ø=150mm	1050 m	10	10,500
Pump ø=100mm H=40m	1 set	-	5,000
Total			67,500 LE/33.3 fed.
			= 2,100 LE/fed.

Model Plan (3)

Drip Type (Interval 5 metres)



i) Basic data

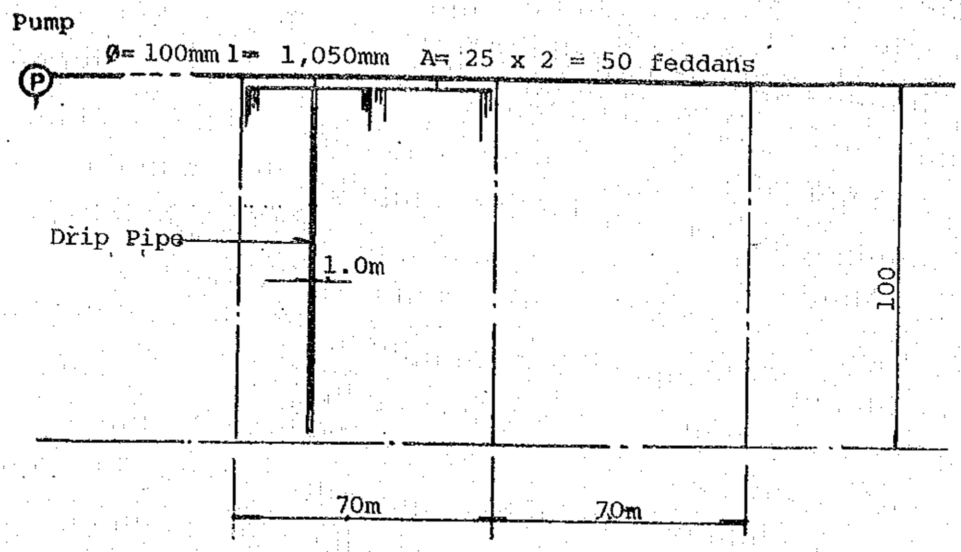
Irrigation interval (4 days on/off)		8
Amount of irrigation	(mm)	93
Irrigation hours per placement	(hr/once)	8
Movement per day	(times)	3
Irrigation area per day	(feddan)	2.1
Irrigation line	(lines)	14 x 2
Drip capacity	(l/min/100m)	11.6
Irrigation intensity	(mm/hr)	12
Pump capacity	(m^3/min)	0.34

ii) Construction cost

	Volume	Unit price	Construction cost
Drip pipe	28000 x 2m	0.7	39,200
Vinyl chloride pipe (Ø=75mm)	1050m	4.0	4,200
Pump (Ø=75 H=20m)	1 set	-	3,000
Total			46,400 LE/33.3 fed. = 1,400 LE/fed.

Model Plan (4)

Drip Type (Interval 1.0 metres)



i) Basic data

Irrigation interval (4 days on/off)		8
Amount of irrigation	(mm)	93
Irrigation hours per placement	(hr/once)	8
Movement per day	(times)	3
Irrigation area per day	(feddan)	2.1
Irrigation line	(lines)	70
Drip capacity	(l/min/150m)	11.6
Irrigation intensity	(mm/hr)	12
Pump capacity	(m^3/min)	0.8

ii) Construction cost

	Volume	Unit price	Construction cost
Drip pipe	140,000m	0.7	98,000
Vinyl chloride pipe (ø=100mm)	1050m	5.0	5,250
Pump (ø=100mm, H=20m)	1 set	-	5,000
Total			108,250 LE/33.3 feddan = 3,300 LE/fed.

ANNEX

I. DRAINAGE

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I. DRAINAGE

1. General

The purpose of drainage in the farmland is to remove surface water ponded by excess irrigation and groundwater or gravitational water in soil. The beneficial effects of drainage are to improve the saturation of the soil and to facilitate farm mechanization. Moreover, an important fact is that the drainage facilitates leaching salt which is harmful to plant growth. Also, the capillary rise of groundwater containing salt is restrained by lowering the groundwater table in the non-irrigation period.

In its existing condition, about 90 percent of this Project Area is the lake and swamp having a low elevation and poor drainage conditions. The soil texture is undeveloped and has such properties as poor saturation and poor permeability.
Soils of most of this area have a salinity of 8 to 32 mmhos/cm in electric conductivity. In such situation the improvement of the drainage system is considered to be an essential factor for successful agricultural development.

For the drainage improvement, construction of main drainage system to carry away the drain water to outside of the Project Area and the installation of open drains and tile drains should be carried out along with the soil improvement.

A drainage system of farmland is comprised of open drains and tile drains.

Removal of soil water by open and tile drains has some forms as shown in Fig. I-1-1.

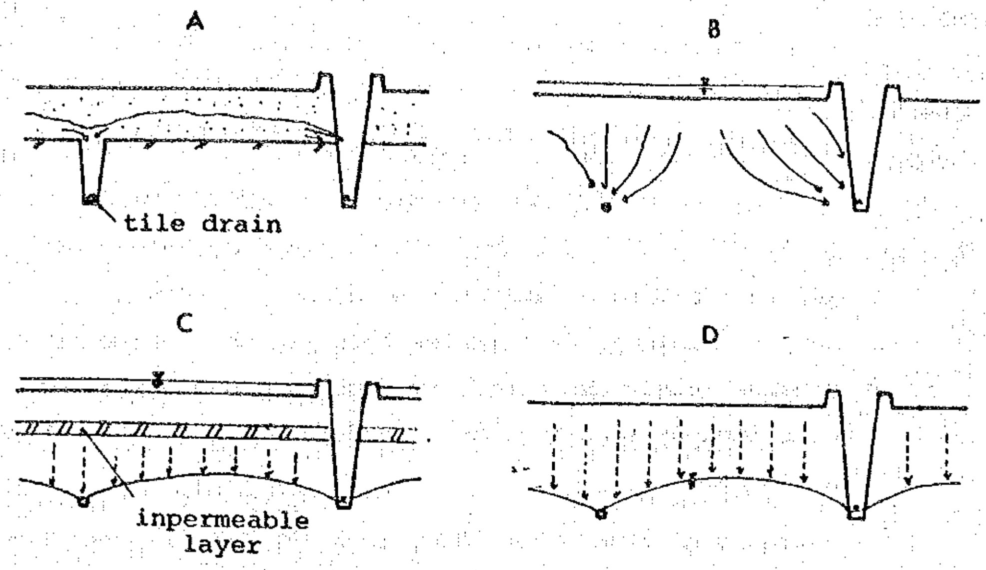


Fig. I-1-1 Drainage Mechanism

In the figure, (A) has a low permeable layer and therefore the excess soil water would flow along the surface of the layer into drains. When the layer is dried, the groundwater table would be lowered as seen in (D). This form appears in the left side area of the Baqar Drainage canal.

(B) shows that the water on the soil surface and in soils is drained into open or tile drains without forming a groundwater table. This form appears in paddy fields with homogeneous soil.

(C) has a impermeable layer above drains, and the groundwater table appears below this layer. This form is seen in the case where farmland has been used as paddy fields for a long period. This form may appear in paddy fields in the northern part of the Project Area.

(D) shows that the groundwater table is formed near drains in case the soil is homogeneous and a relatively small amount of irrigation water is applied. This form will appear in most of upland fields in this Project Area.

Since surface water and/or gravitational water in soils flow into open drains or tile drains through pore space in soil layers, farming would not be possible if soils had a low permeability making it difficult for water to move in the soils.

In sandy soils, water can move through pore spaces in the soil. On the other hand, water moves through cracks or along roots in low permeable soils. Therefore it is important to artificially provide cracks in soils, to apply organic matter and/or chemicals in making the soil aggregate in structure. Without these cares for improvement of the soil structure, the drainage effect by open and tile drain can not be expected.

In order to improve these soil structures, the following methods can be applied. (1) To provide cracks by means of repeated drying, (2) To provide aggregated structure by applying gypsum, (3) To input plants, (4) To improve by civil engineering method.

To improve the soil structure in the first stage of the project development, it is required to provide cracks and water paths in soils by such physical methods as sub-soil breaking.

Repeated drying will facilitate soil improvement and chemical improvement of soils is also expectable by the drying effect.

Most soils in this Project Area are clay-loam (CL) and silty-clay-loam (SiCL), which are not low permeable soils like heavy clay.

In general, a drainage effectiveness can no be expected in the initial stage of soil improvement if the coefficient of water conductivity be estimated at under 10^{-5} cm/s. However, from the view point of soil texture, drainage effectiveness can be obtained in this Project Area by combination of soil improvement and drainage system of farmland.

Especially, the improvement of the soil texture is important in terms of salt leaching even at the first stage of the project development.

It is expected that soils would be dried up by means of evaporation if drainage canals are constructed and the inflow of groundwater is cut off.

2. Soil Layer Improvement

Most of soils in this Project Area, except some parts of sandy soils, have poor properties, low water and air permeability. These properties restrain not only normal plant growth but the introduction of farm machinery and salt leaching.

In general, the potimum permeability coefficient suitable for paddy cultivation is said to be 10^{-4} to 10^{-5} cm/sec.

In case of upland crop cultivation, the prupose of soil improvemtnt is to obtain a proper three phase distribution of soils which is an index of the water holding capacity and air permeability.

An appropriate three phase distribution of soils for upland fields depends on the kinds of crop, the parent material of the soils, and the climate. However, the air phase should be at least more than 15 to 20 percent with pF1.5 to 2.0, and a solid phase of 30 to 50 percent is appropriate.

A permeability coefficient suitable for upland cropping is in the order of 10^{-4} cm/sec and the basic intake rate should be at least 5mm/hr for irrigation. The permeability coefficient in this area is $2 - 6 \times 10^{-4}$ cm/sec, which is not poor permeability. The basic intake rate is 5mm/hr and the air permeability is low as the air phase in the soil is 1 to 10 percent. Hence, some soil improvement practices are required in this area.

In order to improve the three phase dirstribution of soils, it is necessary to input gypsum as well as to improve soil by civil engineering method. Such improvements imply cutting-off of the capillary routes resulting in prevention of rise of groundwater containing salinity.

(1) Installation of Open Canal

Installation of open canals is the fundamental prerequisite to lower the groundwater table for water drainage in soils.

A high density of the canal installation is desirable, however, it would become constraint for mechanized farm management.

(2) Tile drainage and supplementary tile drainage

Tile drainage is installed where the groundwater table is high and/ or soils are poor by permeable so the crop growth and farm mechanization are restrained.

Tile drains should, sooner or later, replace open drains, as they would minimize unusable land and make large-sized farm mechanization possible. Tile drains would function well with a spacing of 10 to 20 m if the permeability is 10^{-3} to 10^{-5} cm/sed, and would not function well if the permeability is lower than 10^{-5} cm/sec.
In such a case, it is necessary to install tile drains with a high density and/or to combine them with supplementary tile drains. In general, supplementary tile drains would be advantageous since the high density construction of tile drains is expensive.

Supplementary tile drains are :

a) Mole drain: Mole drain is a horizonally constructed conduit having diameter of 6 to 10 cm. This drain suits to soils which can conserve the conduit.

b) Mole drain with filling: The conduit is filled with porous materials such as chaff, and suits to soils having a pore conservative property for the conduit.

c) Buried porous material: Porous materials are buried in soils. This suits to soils having pore conservativeness for permeability and cracks.

d) Sub-soil breaking: Cracks are artificially provided. This suits to soils which can conserve the cracks.

Supplementary drains are installed perpendicularly to tile drains at an interval of 0.75 to 3.0 m.

Generally, in reclaimed area, drainage water moves downwards not through pore space but through cracks in soils.
Therefore, it is considerably effective to artificially provide water-pass by the above methods at the initial stages of reclamation.

i) Mole Drain

Mole drains are constructed by pulling a bullet-shaped object through the soil.

A tractor of 60 to 80 ps is used to pull the equipment to which the bullet-shaped object is attached. (See Feg. I-2-1)

The effectiveness goes down in several years, but is effective for a long period of porous materials are filled. This method is not so effective as sub-soil breaking since fewer cracks are provided.

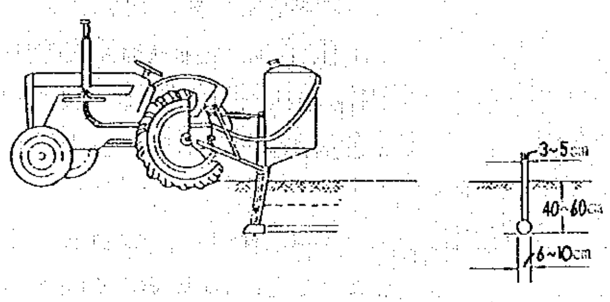


Fig. I-2-1 Mole Drain

ii) Sub-soil Breaking

Pan breaker (see Fig. I-2-2) drawn by a tractor would break the sub-soil at a depth of 40 to 60cm, for a width of about 2.25 cm per operation. This method would be very effective to improve the permeability of the soil for quite a length of time.

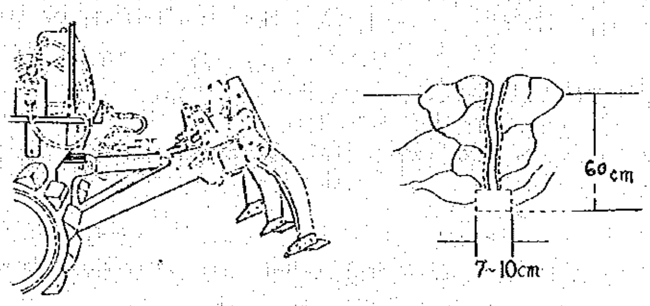


Fig. I-2-2 Sub-soil Breaking

iii) Soil Dressing

Dressing of sand grains to the thickness of about 12 cm on the heavily clayey soil would be effective when combined with under-drainage and sub-soil breaking.

(3) Improvement Plan

In this Project Area, the installation of open and tile drains with the appropriate intervals is necessary to improve the water and air permeability of soils. Along with this, supplementary tile drains and soil dressing are to be provided.

The construction costs are 400 LE/feddan for the mole drain and sub-soil breaking, and 2000 LE/feddan for the soil dressing with sand to the thickness of 10 cm. Soil dressing with sand has considerable effectiveness. However, it should be applied only for the highly profitable crops since the cost is high.

Sub-soil breaking would be more effective than mole drains as the target of the improvement is to provide cracks to the sub-soil.

The sub-soil breaking as a civil engineering mean will provide cracks in soils down to a depth of 60 cm and then the capillary rise of ground-water containing salinity is prevented.

Sub-soil breaking is carried out perpendicularly to open or tile drains. The drainage effect would be facilitated by connecting the cavity of under drains.

Sub-soil breaking will be conducted at the final stage of reclamation.

3. Open Ditch and Tile Drain

(1) Water Table

The crop growth and the yield are greatly influenced by the ground-water depth, the potimal depth of which depending on the root depth of the various crop and soil texture.

Root depths of proposed crops are shown in Table I-3-1. The root depths of sorghum and some vegetables are as deep as 1.5 m to 2.0 m.

Table I-3-1 Root Depth

(Unit: m)

Crop	Depth	Crop	Depth
Berseem	0.6 - 0.9	Sugar Beet	0.7 - 1.2
Soybeen	0.6 - 1.3	Vegetables	0.3 - 0.6
Sorghum	1.0 - 2.0	(Tomatoes)	0.7 - 1.5

Date: FAO Irrigation and Drainage Paper No. 24

Soil moisture is absorbed by plant roots mostly where roots are concentrated in the soil. Generally, 50 to 70 percent of absorption occurs 30 to 50 cm from the soil surface. The groundwater depth should be deeper in clayey soils.

Fig. I-3-1 shows the relation between the crop yield and the groundwater depth in loam and clay. It can be said that there is no significant difference in the yields for most crops with a groundwater depth of 60 to 80 cm.

However, the yield of sugar beet is maximum when the groundwater depth is 110 to 150 cm, therefore it is recommended to lower the water table for this crop, which is weak against too much soil moisture.

Also, it is better to lower the groundwater depth to prevent salt rise.

However, the drainage system can not fulfil its function if the groundwater is lowered too deep. Hence, the proposed water table is set at 1.0 m depth in this project.

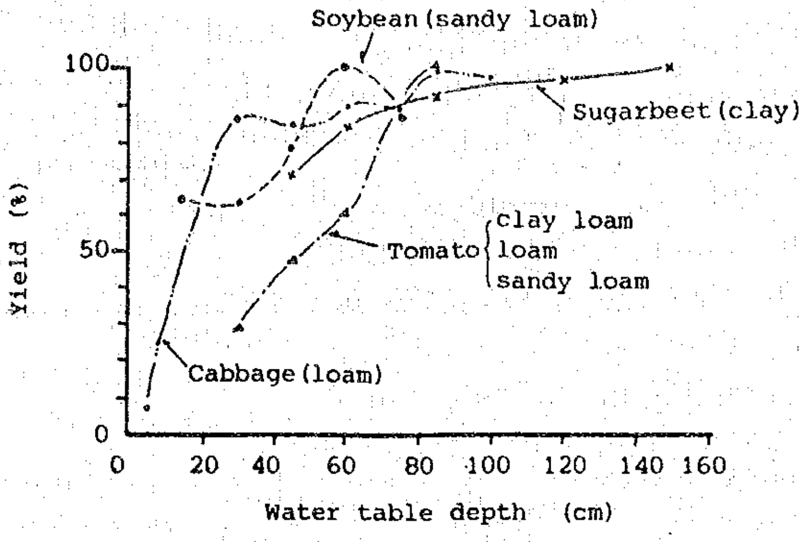


Fig. I-3-1 Yields of Crops at Varying Water Table Depth
(Data: Drainge For Agriculture)

(2) Drainage Discharge from Field

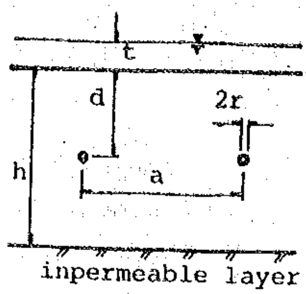
The drainage discharge from the field in case of no rainfall, varies by irrigation method.

Since paddyfields are submerged under flooded water and their soil layers are heterogenous, groundwater table can be hardly formed and the water flows down continously from the field surface into drains. In case of upland fields, irrigation water supply is very much limited compared with paddyfield so that groundwater has no chance to get replenishment and its table would come down to the neighbouhood of the drain depth. Apart from rainfall, seepage water, artesian aquifer and subsurfece percolation, the drainage discharge in the upland fields is determinable by the difference between the amount of irrigation water and crop evapotranspiration.

a) Drainage Discharge of Paddy Field

Drainage discharge from submerged paddy fields is estimated by using the following equation:

$$Q = \frac{2\pi k(t + d - r)}{\ln\left\{\left[\tan\frac{\pi(2d - r)}{4h}\right]\left[\cot\frac{\pi r}{4h}\right]\right\}}$$



where: h = 3.5 m

r = 0.03 m

d = 1.3 m

t = 0.10 m

a = 23.3

K = 4~6 x 10^{-4} cm/sec = 4~6 x 10^{-6} m/sec

Q = 7.7 x 10^{-6} ~ 1.2 x 10^{-5} m/sec

Q′ = Q x 86400/23.3

= 28.0 44.0 mm/day

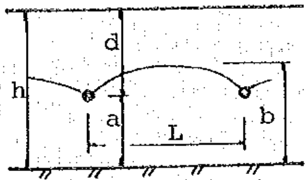
The permeability coefficient would become smaller than the above value after puddling for nursery transplanting.

In the case of paddy fields, the amount of irrigation water required depends on the drainage discharge. The drainage discharge would be controlled by tile drains if the permeability coefficient can't be lowered by puddling.
Therefore, upland field conditions are applied for paddy fields in to determining the drainage discharge.

6) Drainage Discharge from Upland Field
Evapo-transpiration of crops, in summer peak are 8.6 to 9.0 mm/day, irrigation water applied will be 11.5 to 12.0 mm/day taking the application efficiency into account. The drainage discharge is the difference of those, or about 3.0 mm/day.

(3) Spacing of Drain
In upland fields, assuming the water table is at 1.0 m, the bottom of tile drains is at 1.3 m from soil surface and the soil property is homogeneous, the spacing of drains can be calculated by the following equation:

Donnan equation (Pipe drain) :



$$L^2 = \frac{4K(b^2 - a^2)}{q}$$

where: L : drain spacing, in metres

q : drain discharge, in m|day (= 0.003 m|day)

K : hydraulic conductivity in m|day (= 4 x 10^{-4} cm|sec = 0.35 m|day)

a : distance between drain depth and barrier in metres (2.2 m)

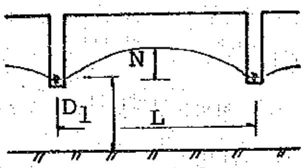
b : distance between water level and barrier in meters (2.5 m)

$L = 656^{1/2} = 25.7$ m = 26 m.

Where, h is 3.5m as deternimed by the depth to soft clay layer, which does not contain sand, sea shell, and silt. The permability coefficient (K) is 2~6 x 10^{-4} cm/sec in existing condition, and the average value is applied on the safeside, although it will be improved through development of soil layer by reclamation, drying and sub-soil breaking.

From the above the spacing of drains is calculated to be 25.7 m.

Hooghoudt Equation (Open drain):



$$N = \frac{qL^2}{8KD_1} + \frac{qL}{K} \ln\left(\frac{D_0}{u}\right)$$

where: N : distance between the water level and drains in meters (0.3 m)

q : drain dischage in m|day (0.003 m|day)

L : drain spacing in metres

K : hydraulic conductivity in m|day (= 4 x 10^{-4} cm|sec = 0.35 m|day)

D_0 : distance between drain depth and barrier in metres (2.2 m)

D_1 : $D_0 + 0.5N$ (2.35 m)

u : method perimeter in metres (0.6 m)

L = 22.1 m ≒ 22m

The spacing of drains is calculated to be 22.1 m. Using 4×10^{-4} cm/sec as a permeability coefficient, the spacing of drains are 26 m for tile drains and 22 m for open drains.
Since the permeability coefficient will increase with improvements to the soil structure, it can be said that the drainage system functions well with a spacing of 25 m.

(4) Open Ditches and Tile Drains

A significant difference exists between open ditch and tile drain. Open ditch works with certainty and the soil structure can be promptly improved starting from its immediate neighborhood.
Tile drain, on the other hand, has advantages in that the arable land can be utilized to full through mechanized farming.
Since civil engineering means are used for improvement of the given soil properties, the drainage system will work sufficiently well by providing tile drains only immediately after reclamation work is over. However, in view of attaining satisfactory results from the primary leaching, open ditch will be dug in the initial stage to be replaced by tile drain after 3-year crop rotation of rice and berseem.

(5) Design of Drainage Ditchs and Tile Drains

Tertiary drain, farm drain (open ditch) or tile drain are provided in farm blocks. The acreage of field lot is 1.7 feddan, 100 x 70 m, and open ditches are located on both sides of the field for assured drainage.

i) Drainage discharge of tile drain

$q = 0.003 \times 100 \times 23/86400 = 0.08\ell/\text{sec}$

Tile Drain: Diameter 60 mm, Slope 1/500, Depth 1.3 m

ii) Drainage discharge of farm drain

$q = 0.003 \times 100 \times 23/86400 = 0.08\ell/\text{sec}$

Depth of drain 1.3 m

In case tile drains are installed deeper than 1.0 m, enveloping materials such as sand, straw, and chaff will be used to ensure the drainage function. Straw will be used as it is readily available. as it is readily available.

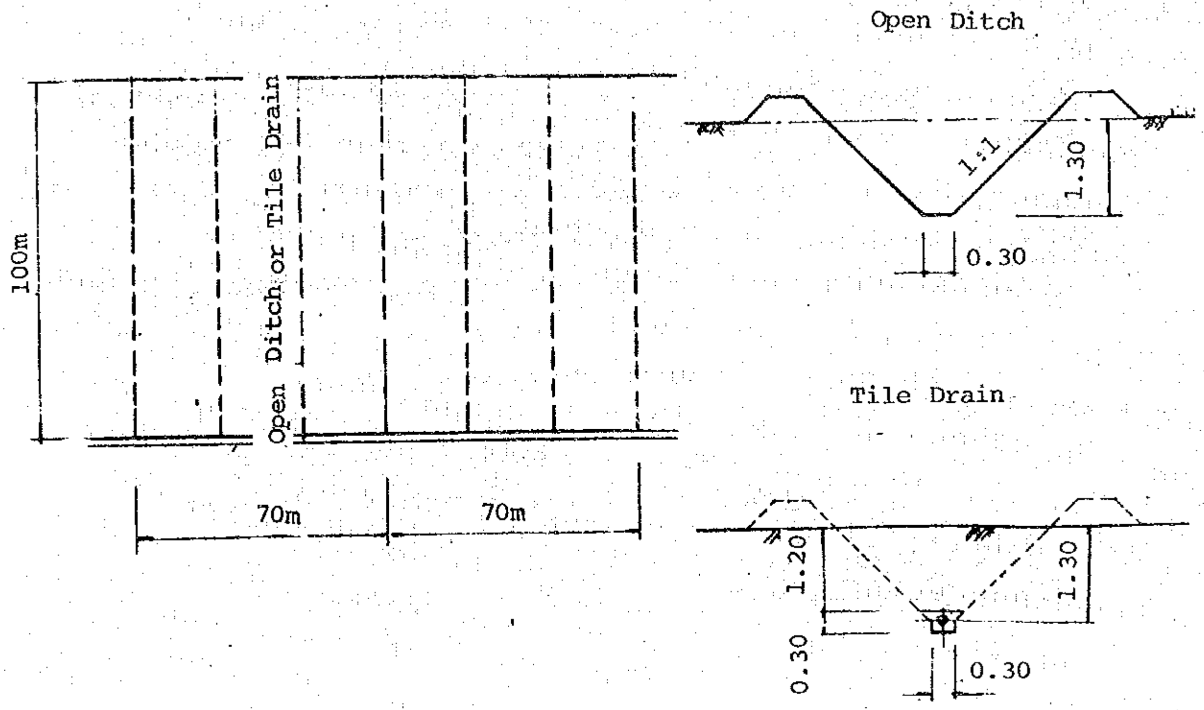


Fig. I-3-2 Spacing of Drain and Typical Section

4. Leaching

Leaching would be broadly divided into the primary leaching immediately after reclamation and the supplementary leaching during and after trial cropping.

(1) Primary Leaching

a) Method

The values of "Electrical Conductivity" (EC) which show density of salt content in soils have been measured at various points all over the Project area and it was found that the points showing EC of 8 to 16 mmhos/cm are distributed over most of the area but the points showing EC of more than 32 mmhos/cm are very few.

Table I-4-1 EC Distribution Area Ratio

EC	Depth	
	0 - 30 cm	30 - 60 cm
4 - 8 mmhos/cm	11%	16%
8 - 16	58	52
16 - 32	30	30
32 - 64	1	2

The allowable EC values for field crops such as sorghum, soybeans and sugar beet are less than 4.0 to 7.0 mmhos/cm, and less than 1.5 to 3.0 mmhos/cm for most of vegetables. The above table shows that leaching is sine-qua-non for agricultural production in the reclaimed land.

Yet it is necessary to keep in mind that the effictiveness and the period of leaching depend on such factors as the soil type and salt varieties: sandy soil is easier to leach than clayey soil and sulphate is more difficult to dissolve than chloride. It will also depend on the salt contained in leaching water and the level of the existing groundwater table.

Primary leaching will be preceded by construction of drainage facilities, application of gypsum, and subsoil breaking.

Leaching is basically done by flooding the ground surface with deep water for a considerable period of time, say, 300 mm-deep water being kept for about 40 days in the western region of USA or 7,240 m^3/ha (724 mm) water for about 40 days under "Al Hassan Project" in Saudi Arabia by Braunschweig University of West Germany; in the latter case, very high original EC value was brought down to 4.0 mmhos/cm.

The leaching method generally applied in Egypt is that 150 - 200 mm deep water is kept on farm surface for initial 30 days, for the next 30 days the water is left to infiltrate into the ground without supplying any supplementary water, and then the farm soil will be dried during the final 30 days.

By applying the same method as has been adopted in other parts of Egypt, the following sequence of preliminary work phases is believed necessary to raise leaching efficiency:

Drainage of Closed Water - Surface Drying - Levelling - Construction of Open-ditches - Application of Gypsum - Subsoil Breaking - LEACHING

b) Ground Infiltration Volume for Leaching

Initial leaching water requirements are calculated by the following formula cited from FAO Irrigation and Drainage Paper NO. 7:

$$Y = N_1 \times N_2 \times N_3 \times 400 \times \pm 100$$

where Y : depth of leaching water (mm)

N_1: textural coefficient (0.5 to 2.0)

N_2: water table coefficient (1 to 3)

N_3: groundwater salinity coefficient (1 to 3)

X : percent mean salt content in a depth of 2 meters.

$X = 0.07\ EC \cdot Mo \cdot dB$

where EC : electrical conductivity of the soil (14 mmhos/cm)

Mo : moisture ratio (0.9)

dB : apparent specific gravity (1.1)

N_1 value is estimated at 1.5, an intermediate value, because soil texture available in the project area is of non-clayey type despite of the less developed structure. N_2 value is estimated at 2.0, which is someshat larger, because of high groundwater table which may not be lowered immediately after land reclamation due to the peculiar soil structure. N_3 value is estimated at 1.0 on the assumption that salt content in the groundwater is more or less the same as in the soils (the weighted avarage of EC values all over the project area is measured at 14 mmhos/cm). Therefore, the leaching water volume for infiltration will be 1,200 mm as follows:

$$X = 0.07 \times 14 \times 0.9 \times 1.1 = 1.0\ \%$$

$$Y = 1.5 \times 2.0 \times 1.0 \times 400 \times 1.0 \pm 100$$

$$= 1200 \pm 100\ mm$$

c) Leaching Days

When 10 to 20 cm deep water is kept on the ground surface at any time, the drainage value is calculated by the following formula:

$$Q = \frac{2\pi k(t+d-r)}{\ln\left\{\left[\tan\frac{\pi(2d-r)}{4h}\right]\cdot\left[\cot\frac{\pi r}{4h}\right]\right\}}$$

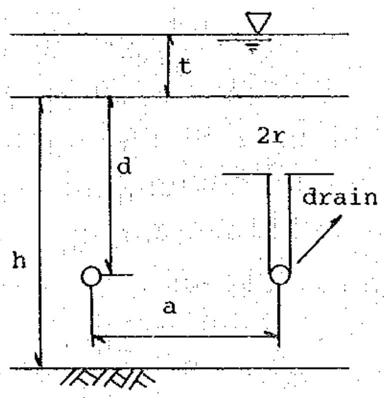
where: h = 3.5 m

d = 1.3 m

t = 0.1 m

r = 0.025 m

a = 23 m



k = Water permeability coefficient
(the average value in the present condition, 4×10^{-4} cm/sec = 4×10^{-6} m/sec, was applied.)

Q = drainage volume per the distance of drains(m^3/sec)

$$Q = \frac{2\pi x 4x10^{-6} x (0.1+1.3-0.03)}{\ln\left\{\left[\tan\frac{\pi x(2x1.3-0.03}{4x3.5}\right] x \left[\cot\frac{\pi x 0.03}{4x3.5}\right]\right\}}$$

$= 7.7 \times 10^{-6}$ m^3/sec.

for unit area: $7.7 \times 10^{-6} \times 86400/23.3 = 0.028$ m/day
= 28 mm/day

The standard days required for leaching will be 43 days as follows:

1200 / 28 = 43 days

d) Leaching Water Requirement

The leaching water requirement is determined upon consideration of evaporation from the surface of bashin water during the leaching period, and the efficiency based on infiltration volume. The leaching is to be efficted during the period starting from October and ending in March when evaporation is not much. The mean evaporation rate over this period is expected to be 4.4 mm/day, and the irrigation efficiency is estimated at 0.9 which is equivalent to conveyance efficiency since little water loss is expected in continous supply of additional water Therefore, the leaching water requirement will be 1,544 mm or 3,981 m^3/feddan for 43 days (90 m^3/day/feddam) as follows:

$$\frac{1,200 + 43 \times 4.4}{0.9} = 1,544 \text{ mm}$$

$1,544 \times 4,200 \times 0.60 = 3,891$ m^3/feddan
= 90 m^3/day/feddan

where : unusable land percentage in the first stage is 60%

Primary leaching will be completed in 2 years. The leaching method would be that any given area will be divided into 4 equal portions, 2 of them to be leached in the first year and the remaining 2 in the second year.

e) Effictiveness of Leaching

After the execution of the primary leaching, EC value is expected to be lowered from 8-16 mmhos/cm (the weighted avarage being 14 mmhos/cm) to 6 mmhos/cm or so. This value of 6 mmhos/cm is still too high for vegetables and other field crops. To solve this problem without carrying out additional leaching by flooding, alternate cultivation of paddy rice and berseem continously for 3 years is suggested after the primary leaching is over. Continous cultivation of paddy rice would practically mean water infiltration of about 500 mm, thus help bringing down EC value to the level unharmful for almost all the crops recommended under the cropping patterns. Even after 3-year continous cultivation of paddy rice combined with berseem, high yield may not be expected if not attended by careful improvement of soil structure and good maintenance of drainage system.

(2) Supplementary Leaching

Supplementary leaching will be effected after the farmers will start following the proposed cropping patterns. It is meant to dissolve and wash away salt to be unavoidably accumulated in the soils due to two reasons: one is due to the salt content in the irrigation water itself, and the other is due to the rise of salt contatined in the groundwater through capillary action. Even though percolation of salty groundwater may be cut off to a certain extent by constructing drains and subsurface soil breaking, accumulation of salt in the soils through irrigation by use of water which contains 900 ppm salt must be dealt with squarely.
Supplementary leaching will be effected by supplying 120% irrigation water several times during each cropping season.
Apart from the supplementary leaching explained in the above, accumulation of salt in the soils can be prevented or at least minimized by adhering to the following instruction:

i) To carefully practice water management so that no excessive irrigation water be supplied to the field;

ii) To quickly drain excessive water from the field;

iii) To reduce evaporation from the soil surface with mulching;

iv) To give efforts to improve soil structure in view of lowering the groundwater table, stopping its capillary action , and improving drainage efficiency;

v) To increase leaching effectiveness by growing paddy rice in rotation.

Sprinkler or drip irrigation is effective in eliminating excessive supply of irrigation water and thus, may be extremely useful in reducing salt accumulation which is most undersirable for cultivation of high-valued crops. Pipeline water distribution method would also be desirable in the future, since open canal system unavoidably helps raising salt content of irrigation water through evaporation from canal water surface in its conveyance and raising of groundwater table in the neighborhood of the canals by seepage through the canal bottoms.

5. Drainage Requirements in the Project Area

Drainage requirements for the main and secondary drainage canals and pump are determined by using the following equation.

$$W = (W_1 + W_2 + W_3 + W_4) - (W_5 + W_6)$$

where : W_1 : irrigation water requirement

W_2 : rainfall

W_3 : seepage water from El Salam Canal and dyke

W_4 : artesian aquifer

W_5 : crop evapo-transpiration

W_6 : subsurface percolation

i) irrigation water requirement (W_1)

Peak irrigation water requirement is 44.6 m^3/day/feddan.

ii) amount of rainfall (W_2)

The annual rainfall is 68 mm in rainy season from October to April. Monthly rainfall is 16 mm in January. However, the drainage discharge except the effective rainfall is as follows.

(Unit:mm/day)

Month	J	F	M	A	M	J	J	A	S	O	N	D
W_2	0.7	0.7	0.3	0.3	0	0	0	0	0	0.3	0.3	0.7

iii) seepage water (W_3)

Seepage water from El Salam Canal is 0.02 m^3/day/feddan, which is negligible due to its small amount.

iv) artesian aquirfer (W_4)

Artesian aquirfer could not be seen through the field survey, and hence this is considered negligible.

v) crop evapo-transpiration (W_5)

As shown in Table I-5-2 crop evapo-transpiration is 25.6 m^3/day/feddan in summer peak, or 4,436 m^3/year/feddan.

vi) subsurface percolation (W_6)

Subsurface percolation is negligible, since the Project Area is surrounded by canals and Lake Manzala, and the elevation of canals is higher than that of the field.

From the above, the drainage discharge from the Project Area is 21.3 m^3/day/feddan, or 3,681 m^3/year/feddan.

The monthly discharges are shown below.

Table I-5-1 Monthly Drainage Discharge

(Unit: M^3/day/feddan)

Month	J	F	M	A	M	J	J	A	S	O	N	D	Total
Project Water Re.	20.0	25.2	21.9	8.2	9.2	28.2	44.6	41.6	23.6	11.8	15.4	17.0	8,117
Consumptive Use	11.5	14.4	12.8	5.2	5.2	13.8	25.6	20.3	12.4	6.0	8.8	9.8	4,436
Drainage Discharge	8.5	10.8	9.1	3.0	4.0	14.4	19.0	21.3	11.2	5.8	6.6	7.2	3,681*

(* : M^3/year/feddan)

Drainage discharge is 21.3 ≒ 22m^3/day/feddan.

However, the allowance of 25% (standard rate in Egypt) is added to this value for fear of occurring a mistake on water management.

So, unit drainage discharge is 27.5 m^3/day/feddan.

$$q = \frac{27.5 \times 1000}{86,400} = 0.3183 \ m^3/sec/feddan$$

Table I-5-2 Consumptive Use

Crop Type	Crop	Area	Ration	Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
No.1	Rice	27,951	0.254					0.05	0.36 0.15	1.96 0.05	2.16	1.85	0.41		
	Berseem	27,951	0.254	0.91	1.14	1.04	0.10						0.69	1.09	0.94
	Soybeen	27,951	0.254				0.10	0.89	2.06	2.18	0.74				
	Sugar Beet	27,951	0.254	0.86	1.19	1.24	0.86	0.20				0.08	0.30	0.53	0.66
	Sorghum	27,951	0.254						0.56	1.68	1.91	1.07	0.05		
	Vegetable (W)	27,951	0.254	0.91	1.02	0.66	0.13						0.08	0.43	0.71
No.2	Rice	8,715	0.079					0.02	0.11 0.05	0.61 0.02	0.67	0.58	0.13		
	Berseem	8,715	0.079	0.28	0.36	0.32	0.03						0.21	0.34	0.29
	Soybeen	8,715	0.079				0.03	0.28	0.64	0.68	0.23				
	Sugar Beet	8,715	0.079	0.27	0.37	0.39	0.27	0.06				0.02	0.09	0.17	0.21
	Vegerable (W)	8,715	0.079	0.28	0.32	0.21	0.04						0.02	0.13	0.22
	Sorghum	4,358	0.040						0.09	0.26	0.30	0.17			
	Vegetable (S)	4,358	0.040					0.05	0.20	0.36	0.22	0.01			
Total (mm/day) (a)				3.5	4.4	3.9	1.6	1.6	4.2	7.8	6.2	3.8	2.0	2.7	3.0
(m^3/day/faddan) (a x 4200 x 0.78)				11.5	14.4	12.8	5.2	5.2	13.8	25.6	20.3	12.4	6.6	8.8	9.8
(Project Water Re.)-(Consumptive Use) (m^3/day/feddan)				8.5	10.8	9.1	3.0	4.0	14.4	19.0	21.3 ≑$22m^3$	11.2	5.8	6.6	7.2

6. Consideration of the Absolute Rainfall Record

(1) Surface Run-off

The absolute rainfall record of 47.7 mm/day is explained for the drainage plan as follows.

Run-off can be estimated by suing empirical methods.

The equation suggested by USDA (FAO. I/D Paper - No. 25) is as follow:

Run-off equation:

The equation used for surface run-off is:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

Q = run-off over the drainage area (mm)

P = Precipitation over the drainage area (mm)

S = potential water retention by the soil over the drainage area at time of start of rainfall (mm)

S values are expressed in the relation CN = 1,000/(10 + S).

Based on the above equation, the surface run-off was estimated.

The following classes are adopted from viewpoint of the physical condition of the project area.

i) Runn-off potentiality

Class-C ..... Shallow soils of medium to heavy texture with below average infiltration rates.

ii) Antecedent moisture condition

Dry-I ...... In Growing Season, less than 35mm precipitation druing 5 days before the day in question.

iii) Vegetable covers and conservation treatment

Winter season, Berseem, Sugar beet, vegetables are caltivated. Land use is straight raw and without any conservation treatment.

Therefore, CN will amount to 88 for medium moisture condition and 75 for dry condition.

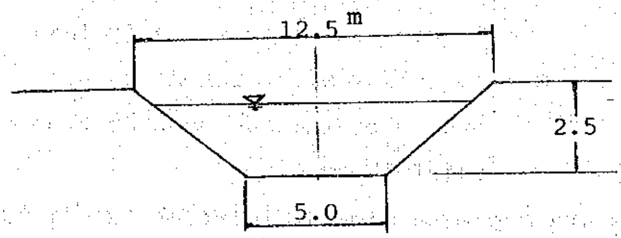
The depth of surface run-off flow will be 8.6 mm.

(2) Pump Capacity

The peak drainage discharge has been estimated at 27.5 m^3/fed/day which is 6.5mm in depth so that the pump capacity designed.

(3) Storage Capacity of Main Drainage Canals

The cross sectional design of main drainage canal is as follows;



and the total length of the canal is estimated at 103,100 m long.

Now, the area of crosssection can be calculated as below:

$$A = \frac{(12.5 + 5.0)\ 2.5}{2} = 21.88\ m^2$$

Therefore, the total storeage capacity of the main drainage canals is,

$$V = A \times l = 21.88\ m^3 \times 109{,}400m$$
$$= 2{,}393{,}672\ m^3$$
$$= 21.8\ m^3/fed$$
$$= 5.2\ mm$$

(4) Conclusion

The probable run-off water of 8.6 mm based on the absolate precipitation record of 48 mm/day can be disposed with the drainage & storage capacity of 11.7 mm including 6.5 mm of the pumping capacity and 5.2 mm of the drainage canal storage capacity.

Note). The USDA, SCS (1969) has developed a procedure using charts and tables for estimating volume and peak rates of run-off. Apart from rainfall characteristics, important factors influencing rainfall run-off are the run-off potentiality of the area; the antecedent moisture condition; the degree of vegetal cover; conservation practices followed. The peak flow rates are also strongly dependent on slope of the land and area of the watershed. The method includes the following steps:

Processing of rainfall data:

by processing records of the daily values of total rainfall, probability values at any frequency, for any given period, are obtained for the project concerned;

Run-off potentiality:

the soils are to be grouped into one of the four hydrological classes on the basis of their run-off potentiality which is closely scheduled to their infiltration rates.

Class A (low run-off potential): deep sandy soils;

B: shallow sandy soils and medium texture soils with above average infiltration rates;

C: shallow soils of medium to heavy texture with below average infiltration rates;

D: (high run-off potential) clay and shallow soils with hardpan, high groundwater table, etc.

Antecedent moisture condition:

the moisture condition is selected from precipitation during the 5 days (or more) preceding the day in question; there are 3 classes, as follows:

Precipitation during 5 days before the day in question (mm)		Condition
Growing season	Dormant season	
Less than 35	Less than 12.5	Dry - I
35.0 to 52.5	12.5 to 27.5	Average - II
Greater than 52.5	Greater than 27.5	Wet - III

ANNEX

J. LAND RECLAMATION

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J. LAND RECLAMATION

1. Project Component

1-1 Project Area

The total project area is 110,000 feddan and its land use is as follows,

Land Use

Proposed Land-Use (Feddan)

Land-Use	N-Hussinia	S-Port Said	Total (Ratio)
Total Project Area	69,000	41,000	110,000
Structure Lot	4,300	3,600	6,900
Housing Lot	1,950	1,350	3,300
Agro-Industry Lot	250	200	450
Others	200	150	350
Farm Road Lot	680	4,000	10,800
Sub Total	13,500	8,300	21,800
Land Holder	55,500	32,700	88,200 (80%)
On-Farm Facility Lot	1,500	900	2,400
Farm Land Acreage	54,000	31,800	85,800 (78%)

1-2 Boundary of the Project Area

The project area is surrounded by the following boundaries.

A) Eastern boundary

Along the eastern boundary of the project area, national highway No. 44 leads to Port Said City from Ismailia City which is located to the south around 30 km. from the project area.

Port Said City is situated on the west bank of the Suez Canal entrance from the Mediterranean Sea.

A transmission line with a voltage of 66 kv. runs along the national highway No. 44 on the west side. A 150 m wide belt zone along the transmission line should be made for the operation and maintenance of the transmission line.

The eastern boundary of the project area is therefore delineated along national highway No. 44 with a 150 m. wide belt zone between the project area and the transmission line.

B) Southern Boundary

El Salam Canal is currently under construction from west to east along the southern side of the project area and construction is expected to be completed within two more years up to the western side of the Suez Canal. The toe line of the left side embankment of the El Salam Canal is the southern boundary of the project area.

C) Western boundary

Southern half of the western side of the project area is connected with the upstream of the above mentioned El Salam Canal.

The outside toe line of the left side embankment of the Canal is the western boundary of the project area in the same as the southern boundary. Northern half of the western part of the project area is cut by the Hadous Drain. The outside toe of the right side embankment of the Hadous Drain is, therefore, also the western boundary of the project area.

D) Northern boundary

Construction of the Tidal dyke for the North Hussinia Project area was commenced in September 1983 by the Ministry of Irrigation with a planned construction period of 18 months. Outside toe line of the tidal dyke embankment is the northern boundary of the project area.

Construction of the tidal dyke for the South Port Said area was completed in 1979 under administration of the Ministry of Irrigation. Accordingly, the tidal dyke is also the northern boundary of the project area.

E) Northeastern boundary

As mentioned before, Port Said City is located in the northeastern part of the project area. Under the Master Plan Study of Port Said City Urban Development Programme extension boundary of the City is decided. The southeastern extension boundary of the City is adopted as northeastern boundary of the project area.

1-3 Major Components

The Project is a national large scale lake reclamation project with the following construction works and facilities as its major components.

(1) Construction works

Pumping Stations for Drainage	2	Sites
Main Canal	106.2	km
Secondary Canal	264.7	km
Canal for Housing	47.6	km
Intake Barrage for Main Canal	6	Sites
" " Secondary Canal	86	Sites
Main Drain	109.4	km
Secondary Drain	218.4	km
Bridge for Canal or Drain	88	Sites
Land Reclamation	85,800	Feddan
Tidal Dyke	80	km

(2) Pilot Farm

Acreage for Farm	400	Feddan
" Facilities	100	"
(Machinery; Tractor with Attachment)		

(3) Agro-Industry

Sugar Beet Processing Factory	1
Vegetable Processing Factory	1
Milk Processing Factory	1
Slaughter House	1

(4) Settlement

Number of Village	52
Household	19,800
Population	99,000

2. Land Reclamation Plan

2-1 Division of the Project Area

The total Project Area is estimated at 110,000 feddan based on 1/20,000 topographical map. The Baqar Drain and Bastir Drain run from south to north in the middle part of the Project Area. Both of the drains are planned to be connected to each other in near future. Thus, the whole Project area will be divided by the new Baqar Drain into two areas, i.e, the South Port Said area in the eastern side of the drain (41,000 feddan) and the North Hussinia area in the western side (69,000 feddan).

(1) South Port Said Area

A major branch of the Bastir Drain runs from east to west in the South Port Said waste area. Therefore, it was suggested during the early stage of the study that the South Port Said area can be divided into two blocks, i.e. south block and north block with the existing Bastir Drain as a dividing line. Each of them was visualized as an independent block, having separate irrigation network and drainage canal system with a drainage pumping station. However, through a more carefule study druing the second stage, it was found that the tidal dyke to enclose the South Port Said area had been already constructed by the Ministry of Irrigation, leaving some channels to carry the lake water between inside and outside of the Project Area. Hence, one package plan has been formulated for developing the entire South Port Said area. This would imply a great economization in construction cost because construction of a full-length dyke along the Bastir Drain can be eliminated and one drainage pumping station would surfice to remove excessive water from the whole area instead of two separate pumping stations as originally planned. A major branch of the Bastir Drain will be used as an internal main canal, and one drainage pumping station will be constructed at the western-most end of the internal main drain to discharge excessive water to the new Baqar Drain. Furthermore, other construction works can be executed without large changes in costs from the original plan, if one package construction is excuted.

(2) North Hussinia Area

During the first stage of the study, it was suggested that the North Hussinia area should be divided into two blocks by constructing tidal dike along the existing branch canal of the Baqar drain which passes through the middle of the North Hussinia project area. However, construction of the tidal dike for this area was commenced in September 1983 by the Ministry of Irrigation. Under the condition, it is not necessary to construct additional tidal dike along the existing branch canal of the Baqar Drain. Consequently, one package development scheme of the North Hussinia Area is definitely more economical than the two block development scheme for the same reason as in the South Port Said area.

(3) Conclusion

From the former discussions, it is recommended that the two block development scheme, i.e. the South Port Said area and the North Hussinia area be selected instead of the four block development scheme which was suggested during the first stage of the study. However, phasing of construction implementation in development of the Project Area should be systematically considered. The phasing of the construction will be explained in later chapter of this report.

2-2 Construction Phasing

After taking into consideration the topographical conditions of the Project Area, the existing major irrigation and drainage canals such as the El Salam Canal and the Baqar Drainage Canal, and the on-going civil works which are being carried out by the Egyptian Government in and around the Project Area, the total Project Area can be divided into two blocks viz.the North Hussinia Block and the South Port Said Block. However, for development of the project, when lay-out of the proposed irrigation and drainage system is arranged and determined

in the Project Area based on the topography of the area, the whole Project Area can also be divided into 9 construction units.
In other words, if irrigation canal system is provided as one area including 9 units, 4 for the South Port Said and 5 for North Hussinia block, which were defined by the drainage canal systems based on the topography, dewatering and construction of road network and on-farm facilities in the unit area can be carried out independently regardless of the progress of construction in the other units. Agricultural production and benefit of the unit area can be obtained earlier than for the other unit area.
For the procurement of construction equipment and availability of construction funds or recruitments of the labor force around the Project Area, it is not necessary to commence construction in the whole Project Area similtaneously. Construction can be executed on a unit area basis one by in a sequence of nine units by considering the accessibility to the unit area and ease of transporting the construction equipment and materials to the job site in the unit area.

In this case, attention should be paid to the construction of the major drainage pumping stations planned to be installed for the North Hu-sinia and the South Port Said Blocks. This is because, from whichever unit of North Hussinia or South Port Said Area the reclamation work should be commenced, the first job to be taken up ought to be the provision of the drainage pumping station serving for the unit concerned.

2-3 Tidal Dyke

(1) Designed Water Surface Elevation of the Manzala Lake

a) A difference in elevation between Water Surface Elevation of the Manzala Lake and the Mean Sea Level of the Mediterranean Sea Hydraulic head or slope of water surface is necessary for the Manzala Lake to drain lake water into the Mediterranean Sea. Considering that the slop of the El Salam Canal is designed by the Ministry of Irrigation at to be 4 cm per 1 km in length of the Cana the hydraulic slope from the Manzala Lake to the Mediterranean Sea will be more flat; 3 cm per 1 km of the slope is considered to be reasonable. The average distance between the Manzala Lake area located near the Project Area and the Mediterranean Sea is estimated about 10 km. Thus, the water surface elevation must be 30 cm higher than the mean sea level of the Mediterranean Sea, which is ± 0.0 m in elevation.

b) Swelling of the Lake Water Surface due to Fluctuation of Atmosphere Pressure (Seiche Phenomenon)

The swelling of the Lake water surface caused by the fluctuation of the atmosphere pressure is calculated by the following equation.

$$Hp = 0.99\ \Delta p \text{ cm}$$

Δp in the equation is deviation from normal atmosphere pressure or 1.010 mili bar. The mean annual atmosphere recorded in Port Said City shows 1,013.7 mb, which is adopted as the normal atmosphere pressure for the Project Area. The minimum of monthly average atmosphere in Port Said City is 1,007.7 mb in July. However, 1,000 mb is taken for the minimum pressure for safety. (See Table J-2-1). Therefore,

$$Hp = 0.99 \times (1{,}013.7 - 1{,}000.0) = 13.7 \text{ cm}$$

c) Swelling of the Lake Water Surface due to Up-rush by Wind

Swelling of the Lake water surface due to up-rush caused by wind is estimated by the following formula.

$$Y = k \cdot f \cdot (V \cos\theta)^2 / h \text{ cm}$$

where,

k:	wind pressure coefficient	0.16×10^{-2} in Tokyo Bay
F:	fetch of wind	12 km
V:	wind velocity	10 m/sec
θ:	angle between wind direction and normal line of coast line. Take 90° for the maximum, accordingly, cosθ = 1	
h:	average Lake water depth along wind fetch	0.57 m

$$Y = 0.16 \times 10^{-2} \times 12 \times (10 \times 1)/0.57 = 3.37 \text{ cm}$$

d) Designed Water Surface Elevation of the Manzala Lake

$$MSL. \pm 0.00 + 30 + 13.7 + 3.37 = 47.07 \text{ cm}$$

Say 50.0 cm.

e) Data for Reference

i) In cource of making the topographical map of the Project Area, the JICA field survey party measured the lake water surface elevations at several points of the southern part of the Manzala Lake, and concluded that the lake water surface was +0.27 to +0.37 m.

ii) According to the Manzala Lake Study, final report Vol. I, paragraph 4.5.3-page 14-11, April 1982, it is described that a study of data obtained at nearby Port Said (Golder Associates, 1979) suggested that lake level rarely fluctuated more than ±0.2 m from the mean.

(2) Wave Height Caused by Wind

There are various formulae to predict the wave height caused by wind. Among them, Bretschneider's method is applied for estimating wave height because the Manzala Lake area related to the Project Area is shallow in water depth, 0.57 m in depth. (See Fig. J-2-1 .However, in calculation of wave height of the Manzala Lake, a maximum depth of the Lake of 1.5 m is taken for safety.

$$gF/U^2 = 9.8 \times 12,000/10^2 = 1,176$$

where,

g:	Gravity	9.8 m/sec
F:	Fetch	12 km or 12,000 m
U:	Wind velocity	10 m/sec

$$gh/U^2 = 9.8 \times 1.5/10^2 = 0.147$$

where,

h: Maximum depth of water area

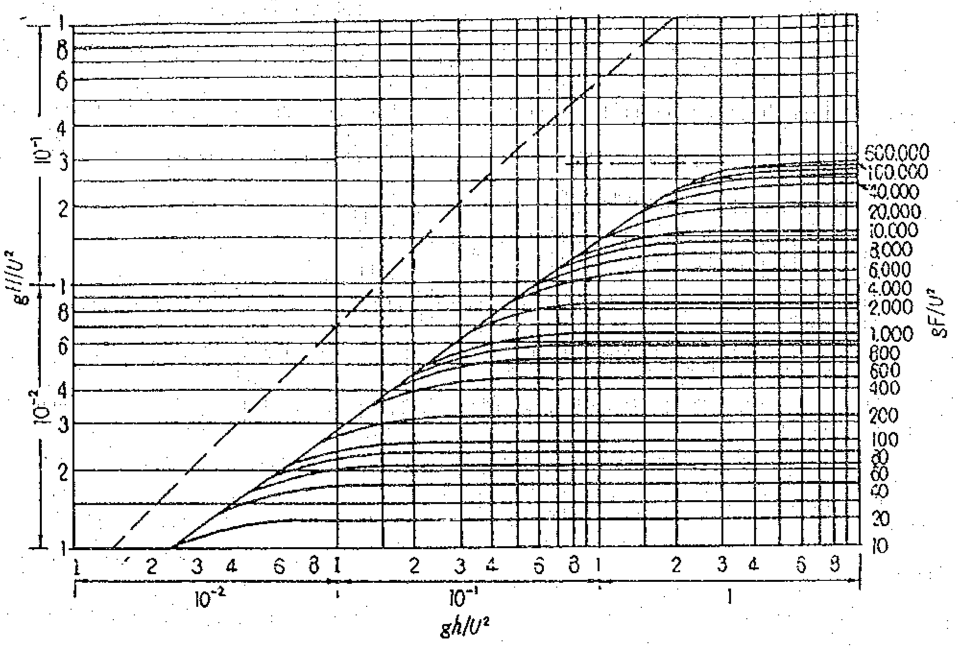

Fig. J-2-1 CHART OF RELATIONSHIP BETWEEN WAVE HEIGHT, WATER DEPTH, WIND VELOCITY AND FETCH DISTANCE IN CASE OF CONSTANT SHALLOW WATER AREA

H: EFFECTIVE WAVE HEIGHT
U: WIND VELOCITY
F: FETCH
h: WATER DEPTH

NOTE: APPLICABLE IN CASE OF FRICTION COEFFICIENT f=0.01

From the attached chart, the following figure is obtained.

$$gH/U^2 = 0.038$$

Therefore, the predicted wave height H is calculated as follows;

$$H = 0.038 \times 10^2/9.8 = 0.39 \text{ m} \quad \text{say } 0.50 \text{ m}$$

For reference data, the Manzala Lake Study suggested 0.75 m of the wave height. However, the detailed calculation method was not shown.

(3) Free Board of the Tidal Dyke

0.50 m of free board for the new tidal dike is considered to be reasonable, because fluctuation of atmosphere pressure and wind speed are quite mild in the recorded meteorological and hydrological data.

(4) Designed Crest Elevation of the Tidal Dike

By the former discussed view, the crest elevation of the tidal dyke is designed as follows;

- Water surface elevation of the Manzala Lake	+0.50 m
- Wave height caused by wind	0.50 m
- Free board	0.50 m
- Crest elevation of the tidal dyke	+1.50 m

(5) Anticipated Subsidence of the Dyke Foundation

According to the soil explorations carried out in the Project Area, the foundation conditions of the new tidal dyke are as on the attached chart. When taking 1.50 m as the maximum depth of the Manzala Lake along the tidal dike, the maximum height of the tidal dike is estimated as 3.0 m above the lake bottom. Final subsidence of foundation caused by consolidation is obtained by the following formula;

$$S = Cc \frac{1}{1 + e_o} H \log \frac{P + \Delta P}{P}$$

where,

S: Subsidence cm

Cc: Compression index

e_o: Void ratio

P: Effective stress

ΔP: Additional weight

	Wet density *1)	Cc *2)	eo *3)
Embankment	1.4 ton/m^3	--	--
Soft clay	1.4	0.86	1.9
Stiff clay	1.55	0.60	1.6

*1) Table 4-3 Manzala Lake Study Vol. I, April 1982

*2) Page 4-8 ditto

*3) Fig. 4-7 ditto

a) Anticipated Subsidence of Soft Clay Layer in Thickness of 3 m

$$S_1 = 0.86 \times \frac{1}{1 + 1.9} \times 3.0 \times \log \frac{0.6 + 4.2}{0.6}$$

$$= 0.86 \times 0.344 \times 3.0 \times \log 8$$

$$= 0.887 \times 0.4231 = 0.80 \text{ m}$$

b) Anticipated Subsidence of Stiff Clay Layer in Thickness of 7 m

$$S_2 = 0.6 \times \frac{1}{1 + 1.6} \times 7.0 \times \log \frac{3.125 + 4.2}{3.125}$$

$$= 0.6 \times 0.384 \times 7.0 \times \log 2.344$$

$$= 1.613 \times 0.369 = 0.59 \text{ m}$$

c) Total Subsidence

$$S = S_1 + S_2 = 0.80 + 0.59 = 1.39 \text{ m}$$

However, it is considered that about 60 percent of the total subsidence will be completed during the construction period of embankment. Therefore, extra banking for the embankment after completion of the dyke is as following:

1.39 m x 0.4 = 0.558 m say 50 cm

Crest elevation of the new tidal dike is +2.0 m when construction of embankment is completed.

(6) Width of Embankment for the Tidal Dyke

The width between both toes of the embankment should be more than 15 times of the water head against the tidal dyke In other words, width of the tidal dyke should be more than 30 m (= 2 m of water depth in maximum x 15).

2-4 Intrusion Water from Outside of the Project Area

(1) Predicted Intrusion Water Amount

Intrusion water to the Project Area from outside will be mainly caused by seepage water through the embankment and foundation of the tidal and surrounding dykes the seepage water through the embankment and foundation of the dykes can be estimated by the following formula;

$$q = K \frac{H_2^2 - H_1^2}{2L} \quad m^3/sec/m$$

where,

k: Coefficient of water conductivity cm/sec
The results of the field permeability test in the Project Area carried out by the F/S team show that the coefficient of water conductivity of foundation is in the range of 10^{-3} to 10^{-4} cm/sec. Among them, 10^{-3} cm/sec or 10^{-5} m/sec is adopted for safety.

H_2: Water head between elevation of water surface outside and elevation of water surface inside
Elevation of the Manzala Lake water surface: +0.50 m
Elevation of drainage canal water surface: -5.00 m
Therefore, H_2 is 5.50 m.

H_1: Water depth of the drainage canal or 1.20 m

L: Length of phreatic line through embankment
According to a "Rule of Thumb" in engineering design prevailing in the Egyptian country, the length of the phreatic line should be more than 15 times of water head difference. Water head difference in this case is 6.70 m. Consequently, the length of the phreatic line is about 100 m.

$$q = 4 \times 10^{-5} \times \frac{5.5^2 - 2.5^2}{2 \times 100} = 4.8 \times 10^{-6} m^3/sec/m$$

Seepage water amount per kilometer is estimated at 4.8 x 10^{-6} m^3/sec/ m

Total length of the dykes surrounding the Project Area is 80 km including the following

Lake Manzala	40 km
FL Salam Canal	34
Both sides of Baqar Drain	40
Suez Canal	14
Total	128 km

Total amount of seepage water into the Project Area is about 5,000 m^3/day

$4.8 \times 10^{-6} m^3/sec/m \times 128km = 0.61 m^3/sec$

or 52,704 m^3/day, (0.48m^3/day/feddan)

The total amount of seepage water intruded into the Project Area through embankment and foundation of the surrounding dykes is not estimated to be great, considering the length of the dyke and the vast area of the project and compared to the possible amount of the drainage canal which will be estimated at approximately 22 m^3/sec, more or less.

(2) Possibility of Encountering Artesian Saline Ground Water
A possibility of encountering artesian ground water having salinity might be appears in the low land area which is currently under lake water after completion of reclamation. Normally, such artesian ground water is caused by confined aquifers connected with high head water sources. The

Manzala Lake water outside of the Project Area is one of the high head water sources. However, as mentioned before, the seepage water amount through the embankment and foundation of the dykes intruded into the project area is estimated at around 5,000 m^3/day which means very little amount of water as a source of artesian ground water. The seepage water from Manzala Lake is caught by the main drainage canals which are excavated between the enclosure dikes and the reclaimed land.

Another water source for the artesian ground water in the reclaimed land will be under ground water from outside of the southern boundary of the project. This ground water can be drained by networks of on-farm drainage systems such as open drains and tiledrains which are designed to keep the ground water level at least 100 cm below the ground surface level.

There is a very little possibility that some fissures exist in the hard clay layers underlying the top soil layer. Artesian ground water through these fissures will be connected with the Manzala Lake water or under ground water sources located in the outside area of the Project Area. However, a survey of such possible fissures has not been carried out under the study for the time being. If such artesian saline ground water comes out after reclamation, then appropriate counter-measure should be taken to eliminate it.

Table J-2-1 Monthly Average Atmospheric Pressure at Port Said City Recorded Period from 1941 to 1960 (Pressure in milli bar, Corrected to Mean Sea Level (MSL))

January	1,017.4 mb
February	1,017.0
March	1,015.2
April	1,014.1
May	1,012.9
June	1,011.1
July	1,007.7
August	1,008.3
September	1,012.2
October	1,015.1
November	1,016.4
December	1,017.5
Total	12,164.9
Average	1,013.7

ANNEX

K. LAND DISPOSAL

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K. LAND DISPOSAL

1. Land Disposal Plan

1-1 Existing Land Disposal System

Land disposal in the land reclamation projects in Egypt is carried out by the two systems, of distribution by the Government and selling by auction. The distribution system is classified into small holders and large holders. Farm land of 1 to 8 feddan has been conventionally distributed to small holders including landless farmers and retired soldiers who intend to settle in the project area. Large holders are composed of agricultural secondary school diplomats and university graduates who obtain 10 to 30 feddan of farm land. The relative proportion of the distribution system and auction system in allocating the land is reported to be 40 percent for distribution and 60 percent for auction. The maximum land acreage obtained through auction is limited up to 400 feddan of the reclaimed land.

The land holding system as mentioned above aims to develop many successful family farms. In addition to two systems, there are large state farms, land reclamation cooperative farms and company farms. The managing agency of these farms is classified by government, cooperative and company. According to the Five Year Development Plan, 1980/84, the target percentage of the farm area managed by government (including farm land disposed through distribution system), land reclamation cooperatives and companies is 48, 49 and 3, respectively.

- State Farm

According to information given by the General Department of Plants Production, GARPAD, the Egyptian Government has been managing 13 state farms as of now. Reportedly, the area of these state farms ranges from 15,000 to 50,000 feddan, which is divided into several production units. Under the Ismailia Agriculture Development scheme, 11,000 feddan of farm land has been reclaimed by the Government out of 19,000 feddan of arable land since 1978.

The Sharkia Governorate Authority developed the cattle fattening farm in 1976. At present 3,000 feddan of arable land have been reclaimed into farm land out of total land of 13,000 feddan.

- Land Reclamation Cooperative Farms

  Land reclamation cooperative has been organized in order to achieve the following objects.

  i) to mobilize private capital,
  ii) to give employment opportunities to landless farmers, and
  iii) to train farmers employed by the cooperative for their better farm management.

  Seventy-five (75) percent of the farm land reclaimed by the cooperative is sold to the member, and 25 percent of reclaimed farm land is sold to small farmers.

- Company Farm

  The representative company farm is the Salkia Pilot Agricultural Project which was constructed and has been managed by the Arab Contractor Company in Ismailia Governorate since 1978.

  The existing land holding system as mentioned above can be summarized as follows:

	Managing Agency	Land Disposal System	Conventional Size of Farm (feddan)
(1)	Government	∘ Distribution	1. Small holder 1 to 8 2. Large holder 10 to 30
		∘ Auction selling	max. 400
		∘ State farm	
(2)	Land Reclamation Cooperative	∘ Land reclamation cooperative farm (Auction)	Land area to be sold to membership, 5 to 20
(3)	Company	∘ Company farm	

1-2 Selection of the Land Disposal System

Since the company farm is not emphasized in the Five Year Development Plan, company farms are not included in land disposal study of this project. Farms managed by the Government and the Land Reclamation Cooperative will be recommended. The main reason to take the Land Reclamation Cooperative is to mobilize the private capital.

Among land disposal systems by the Government, distribution and auction selling is desirable. Because, one of the major aims of North Hussinia Valley and South Port Said Project is to create employment opportunities as much as possible, and in order to achieve this aim, the reclaimed land under the Project shall be disposed to landless farmers, retired soldiers and the rural and urban unemployed, who have enough knowledge about farm management. Consequently, the farmers who obtain farm land by distribution system shall be mainly small holders.

According to the results of the soil survey and the land classification, the marginal arable land or the low class arable land is not found in the Project Area. The whole Project Area, therefore, is in a position to be distributed among small holders, it will be possible for the farmers to earn a reasonable farm income through their agricultural activities in the newly disposed farm land.

1-3 Land Disposal for the Cooperatives

In order to accelerate mobilization of private investment, various ways and means have been examined. One idea is to cover the local currency portion of social infrastructure component which is included in the total project cost. The social infrastructure component involves electric power, water supply and public service facilities, etc. The reclaimed area to be disposed to the private sector and its per-feddan price may be determined by taking this concept into consideration and the revenue therefrom may be put in the national budget for reallocation towards this project's purposes.

Total area of 110,000 feddan to be reclaimed under the project may therefore be disposed to the Government and the Land Reclamation Cooperatives. The alternative land disposal patterns based on different Government: Land Reclamation Cooperative of 9:1, 8:2, 7:3 and 6:4 are studied (Table K-1-1).

As a result of such study, it is proposed that 30 percent of the total reclaimed land will be given to the cooperatives and 70 percent of the total area will be put under the government administration.

Eighty (80) percent of the area under the government administration will be distributed to the small holders and 20 percent will be sold by auction.

Table K-1-1 Allocation of Land and Land Value Sold to Land Reclamation Cooperative

G.:Coop.	Government (feddan)	Land Reclamation Cooperatives (feddan)	Land Value Sold to Land Reclamation Cooperatives		Infra. (10^6 LE)
			Unit (LE)	Total (10^6 LE)	
10:0	110,000	0	0	0	66.0
9:1	99,000	11,000	2,090	23.0	66.0
8:2	88,000	22,000	2,090	46.0	66.0
7:3	77,000	33,000	2,090	69.0	66.0
6:4	66,000	44,000	2,090	92.0	66.0

Notes:
1. The land price is tentatively estimated at 2,090 LE per feddan. The price includes 90 LE for interest of the loan.
2. Social infrastructure cost per feddan 1,000 LE
   Local currency 1,000 x 0.6 = 600 LE/feddan
   Total cost of local currency
   600 x 110,000 feddan = 66.0×10^6 LE

2. Farm Size

The optimum size of land disposal for one management unit should be decided in consideration of the following requirements;

(1) The settlers shall earn an income sufficient to cover the rising living standard in future, and to pay the amortization of the loan for land and buildings, etc.

(2) The settlers shall obtain an average income which is not less than that enjoyed by the farmers in the neighboring districts of the Project Area.

(3) A family labor availability of small holder is at least 40 - 50 mandays per month. Based on the proposed cropping patterns and farm mechanization plan, the required labor of small holders was studied and the result is shown in Table K-2-1.

(4) Farm land from four to six feddan is conventionally distributed among the small holders, and 10 to 20 feddan among the graduated settlers.

(5) The estimated farm budget by farm sizes is shown in Table K-2-2.

Thus, farm land would be distributed to settlers in the following manner:

- Small Holder

Labor demand will reach its peak in May when it exceeds the total available family labor (1.5 persons x 30 days/month = 45 mandays/month), hence the farm size of the small holder should be less than 6 feddan (labor days of the small holder estimated on the basis of the proposed cropping patterns and mechanization plan are shown in Table K-2-1). On the other hand, from farm budget analysis point-of-view as shown in Table K-2-2, the farm size of a small holder must not be less than 5 feddan; if land size is less than 5 feddan, the small holder's economic standing will remain low even after completing repayment of annual amortization for cost of reclaimed land and settler's house.

- Large Holder

The farm budget obtainable from 10 feddan of farmland is not enough for the large holder. Taking into consideration the results of farm budget analysis and in reference to the present distribution of land ownership in Egypt (see Table K-2-3), farm size for the large holder is desired to be over 15 feddan. Appropriate size of farmland for distribution among the large holders would be as follows:

- Agricultural secondary school diplomates ..... 15 feddan
- University graduates .... 20 feddan

Large holders' labor days estimated on the basis of the proposed cropping patterns and mechanization plan are shown in Table K-2-4.

3. Allocation of Land Small Holder and Large Holder

3-1 Socio-Economic Considerations

An alternative study on small and large land holdings was carried out giving consideration to the socio-economic conditions as follows;

a) According to the rural development plan, the land acreage to be distributed to one village is as follows;

   Gross Area .... 110,000 feddan
   Number of Villages 51
   Gross Area per Village .... 110,000 ÷ 51 = 2,157 feddan
   Acreage to be Distributed of Sold .. 2,157 x 0.80 ≑ 1,730 feddan

b) Alternative plans of Cases A, B and C for land disposal per village are carried out as follows;

Condition of Alternatives	Case A	Case B	Case C
	1,730	1,730	1,730
Small Holder (%)	80	70	60
Large Holder (%)	20	30	40

Under the above conditions the number of settlers is calculated and shown as below;

	Distribution Land (feddan)		
	Case A	Case B	Case C
Small Holders	1,380	1,210	1,040
Large Holder	350	520	690
of which 15 feddan (60%)	210	310	410
20 feddan (40%)	140	210	280

	Number of Settlers		
Small Holders	276 (93%)	242 (88%)	208 (84%)
Large Holder			
of which 15 feddan	14 (5%)	21 (8%)	27 (11%)
20 feddan	7 (2%)	11 (4%)	14 (5%)
Total	297(100%)	274(100%)	249(100%)

The net farm income and credit of household's land and house is estimated as follows:

	Case A	Case B	Case C
Net Farm Income per Household (L.E)			
5 feddan	1,572	1,572	1,572
15 feddan	6,108	6,108	6,108
20 feddan	8,100	8,100	8,100

	Case A	Case B	Case C
Total Net Farm Income per One Satellite Village (L E)			
5 feddan	433,872	380,424	326,976
15 feddan	85,512	128,268	164,916
20 feddan	56,700	89,100	113,400
Total	576,084	597,792	605,292

Total Credit of Household's Land and House (1,000 L E)			
5 feddan	3,450	3,025	2,600
15 feddan	532	798	1,026
20 feddan	336	528	672
Total	4,318	4,351	4,298

c) Alternative plan for land disposal for whole Project Area

	Case A	Case B	Case C
i) Number of Households	15,147	13,974	12,699
(%)	(100)	(92)	(84)
ii) Number of Population	77,735	69,870	63,495
(%)	(100)	(92)	(84)
iii) Net Farm Income (Million L E)	29.9	36.0	31.4
(%)	(100)	(111)	(118)
iv) Credit (Million L E)	220	222	219
(%)	(100)	(101)	(100)

The land disposal rate to small and large holders shall be decided to create employment opportunities as much as possible and to realize the highest net farm income. As a result of above-mentioned study, Case A is possible to create numerous settlers in this project. The net farm income is estimated by deducting the living cost, annual amortization, and annual charge from the farm gross income. The net income will be spent in upgrading the living standard, savings, and additional input for better production. The increase in the net farm income results in the stabilization of farm management in the Project Area, and in prevention of the giving up of farming by settlers. The necessary credits would consist of LE 2,000 for land per feddan, LE 2,500 for small land holder's house, and LE 8,000 for large land holder's house. The total credit amounts in Case A, Case B, and Case C are not much different.

3-2 Balance of Labor in the Project Area

Based on the balance of labor in the Project Area, the proportion of land disposal between small holder and large holder can be determined on the assumption that, large holder farmer will need to employ additional labor due to the labor shortage problem in their farm management, particularly at the time of peak labor demand during planting and harvesting seasons.

In order to supply additional labor, it is recommended to use the surplus labor of small holders.

The proposed cropping patterns call for about 6.4 million labor days in a year. The total number of family labor per day is calculated at about 21,300 persons on the assumption that they work 300 days per year (Table K-3-1).

The labor balance study between small and large holders was carried out in the proportion of 9:1, 8:2, 7:3, and 6:4, assuming family labor at 1.5 persons in average.

As shown in Table K-3-2 which presents the result of the labor balance study, the optimum proportion will be 80 percent of small holders and 20 percent of large holder.

However, the total labor man-days in May will be 0.8 million man-days. The necessary labor man-days in May would be 36 days which can be obtained by dividing 0.8 million man-days by the total family labor of 32,757 persons. 36 man-days mean 11 days' addition on normal labor force per month of 25 days. The eleven (11) days' shortage of labor requirement may be covered by 3.5 hours overtime for 25 days (Table K-3-3).

4. Major Items of Determined Land Disposal Plan

After various studies were carried out as above-mentioned, major items of determined land disposal plan are present in Table K-4-1.

Furthermore, the number of small holder and large holder is summarized as below.

	Government	Land Reclamation Cooperatives	Total
Small Holder	7,902	4,498	12,400
Large Holder	1,334	239	1,573
Total	9,236	4,737	13,973

Table K-2-1 Labor of Small Holders

(Unit: Man-days)

Farm Size (feddan)	Items	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
3.0	Agriculture	7.3	3.9	10.7	17.6	8.3	15.2	7.9	9.8	8.8	8.8	2.9	20.6	121.9
	Livestock	7.0	6.2	7.0	6.7	7.0	6.7	7.0	7.0	6.7	7.0	6.7	7.0	81.8
	Total	14.3	10.1	17.7	24.4	15.2	22.0	14.8	16.7	15.5	15.8	9.7	27.5	203.8
4.0	Agriculture	9.8	5.2	14.3	23.5	11.0	20.3	10.5	13.0	11.8	11.8	3.9	27.4	162.6
	Livestock	9.3	8.3	9.3	9.0	9.3	9.0	9.3	9.3	9.0	9.3	9.0	9.3	109.1
	Total	19.0	13.5	23.6	32.5	20.3	29.3	19.8	22.3	20.7	21.0	12.9	36.7	271.7
5.0	Agriculture	12.0	6.4	17.6	29.6	38.4	24.8	14.4	15.6	11.2	12.8	4.8	33.6	221.2
	Livestock	11.5	10.4	11.5	11.3	11.5	11.3	11.5	11.5	11.3	11.5	11.3	11.5	136.1
	Total	23.5	16.8	19.1	40.9	49.9	36.1	25.9	27.1	22.5	24.3	16.1	45.1	357.3
6.0	Agriculture	14.6	7.8	21.5	35.3	16.6	30.5	15.7	19.6	17.6	17.6	5.9	41.2	243.8
	Livestock	13.9	12.5	13.9	13.4	13.9	13.4	13.9	13.9	13.4	13.9	13.4	13.9	163.7
	Total	28.6	20.3	35.4	48.7	30.5	43.9	29.6	33.5	31.1	31.6	19.3	55.1	407.5
7.0	Agriculture	17.1	9.1	25.1	41.2	19.3	35.6	18.3	22.8	20.6	20.6	6.9	48.0	284.5
	Livestock	16.2	14.6	16.2	15.7	16.2	15.7	16.2	16.2	15.7	16.2	15.7	16.2	191.0
	Total	33.3	23.7	41.3	56.9	35.7	51.2	34.6	39.1	36.3	36.8	22.5	64.3	475.4

Table K-2-2 Analysis of Farm Budget
- Farm Size

Livestock (Small Holders) 1/

(Unit: LE)

Item \ Area (feddan)	3.0	4.0	5.0	6.0	7.0
Total Inflow	4,137	5,530	6,923	8,316	9,709
Total Outflow	3,472	4,412	5,351	6,290	7,230
Balance	(-)665	(-)1,118	1,572	2,076	2,479

Livestock (Large Hoders) 1/

(Unit: LE)

Item \ Area (feddan)	10	15	20	30	40
Total Inflow	13,888	20,852	27,775	41,692	55,597
Total Outflow	10,048	14,744	19,675	29,135	38,662
Balance	3,840	6,108	8,100	12,557	16,935

1/ : Livestock recommended for breeding among the settling farmers consist of both dairy cattle and beef cattle; for the convenience of inflow/outflow calculations, livestock is represented by beef cattle.

Table K-2-3 Distribution of Land Ownerships in Egypt(1)

Bracket	Land Owners 000.	Area Owned feddan 000.	Percentage: Land Owners (%)	Percentage: Area Owned (%)
Less than 5 feddan	3,223	2,834	95	51.3
5 feddan	93	609	2.7	11
10 feddan	44	569	1.3	10.3
20 feddan	23	663	0.7	12
50 feddan	7	482	0.2	8.7
100 feddan(2)	3,391	5,530	100	100
Total	3,391	5,530	100	100

Notes: (1) State lands, desert prairie and that under distribution are not included.

(2) Includes Organizations, Companies and Individuals.

Table K-2-4 Labor of Large Holders

(Unit: Man-days)

Farm Size (feddan)	Items	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
10	Agriculture	24.5	13.1	35.9	59.4	35.9	29.3	16.3	32.7	26.1	26.1	6.5	63.6	369.3
	Livestock	23.1	21.0	23.1	22.4	23.1	34.3	23.1	23.1	22.4	23.1	22.4	23.1	272.1
	Total	47.5	51.8	59.0	81.8	59.0	51.7	39.4	55.7	48.5	49.2	28.9	86.7	641.4
15	Agriculture	36.0	19.2	52.8	88.8	76.8	45.6	28.8	48.0	28.8	33.6	9.6	93.6	561.6
	Livestock	34.5	31.1	34.5	33.3	34.5	33.3	34.5	34.5	33.3	34.5	33.3	34.5	405.8
	Total	70.5	50.3	87.3	122.1	111.3	78.9	63.3	82.5	62.1	68.1	42.9	128.1	967.4
20	Agriculture	48.0	25.6	70.4	118.4	102.4	60.8	38.4	64.0	38.4	44.8	12.8	124.8	748.8
	Livestock	45.9	41.5	45.9	44.5	45.9	44.5	45.9	45.9	44.5	45.9	44.5	45.9	540.8
	Total	93.9	67.1	116.3	162.9	148.3	105.3	84.3	109.9	82.9	70.7	57.3	170.7	1,289.6
30	Agriculture	73.4	39.2	107.8	178.2	107.6	87.8	49.0	98.0	78.4	78.4	19.4	190.8	1,108.0
	Livestock	69.2	63.0	69.2	67.2	69.2	67.2	69.2	69.2	67.2	69.2	67.2	69.2	816.2
	Total	142.6	102.2	177.0	245.4	176.8	155.0	118.2	167.2	145.6	147.6	86.6	260.0	1,924.2
40	Agriculture	97.8	52.2	143.6	235.4	143.4	117.1	65.3	130.6	104.6	104.5	25.9	254.4	1,477.3
	Livestock	92.3	84.0	92.3	89.6	92.3	89.6	92.3	92.3	89.6	92.3	89.6	92.3	1,088.3
	Total	190.1	136.2	235.9	327.2	235.7	206.7	157.6	222.9	194.2	196.8	115.5	346.7	2,565.6

Table K-3-1 Requirement of Family Labor

A. Requirement of Labor for Cropping

Crop	Cropped Area (feddan)	Labor Days per feddan	Total Labor Days (1000 days)	Remarks
Rice	28,600	23.8	681	(25.5 x 0.8 + 0.2)
Soybeans	28,600	16.0	458	
Sorghum	25,200	11.0	277	
Berseem	28,600	7.0	200	
Sugarbeat	28,600	12.6	360	(13.5 x 0.8 + 9 x 0.2)
Veg. (winter)	28,600	63.9	1,828	(65.6 x 0.8 + 57.0 x 0.2)
Veg. (summer)	3,400	62.1	211	
Animal Breeding	85,800	27.8	2,385	
Total			6,400	

B. Workable days per year per family ....300 days

C. Requirement of family labor.............6,400,000 ÷ 300 = 21,333 persons

Table K-3-2 Comparison of Labor Balance (Annual Labor)

A.	Gross Area ..... 110,000 feddan		Farm Land Area ..... 88,200 feddan			
B.	Proportion Allocated (%)					
	Small holders	100	90	80	70	60
	Large holders	0	10	20	30	40
C.	Acreage Allocated (feddan)					
	Small holders	88,220	79,380	70,560	61,740	62,920
	Large holders	0	8,820	17,640	26,460	35,280
D.	No. of Settler (farmers)					
	Small: 5 feddan	17,640	15,876	14,112	12,348	10,584
	Large: 15 feddan	0	352	706	1,058	1,411
	20 feddan	0	176	353	529	706
	Total	17,640	16,404	15,171	13,935	12,701
E.	No. of Family Labor - Persons (1.5) persons per farm)					
	Total	26,460	24,606	22,757	20,903	19,052
F.	Requirement of Family Labor	21,333	21,333	21,333	21,333	21,333
G.	Balance	5,127	3,273	1,424	-430	-2,281

Table K-3-3 Comparison of Labor Balance (Peak in May)

A. Gross Area ..... 110,000 feddan	Cultivation Area ..... 85,800 feddan				
B. Proportion Allocated (%)					
Small holder	100	90	80	70	60
Large holder	0	10	20	30	40
C. Acreage Allocated (feddan)					
Small holder	85,800	77,200	68,640	60,060	51,480
Large holder	0	8,580	17,160	25,740	34,320
D. Labor Days in May					
Small (10.2 labor/fed.)	875,160	787,644	700,128	612,612	525,096
Large (7.5 labor/fed.)	0	64,350	128,700	193,060	257,400
Total	875,960	851,994	828,828	805,672	782,496
E. Requirement of Family Labor per Month (25 days)	35,006	88,040	33,153	32,227	31,300
F. No. of Family Labor	26,460	24,606	22,757	20,903	19,052
G. Necessary Labor Days per Month (D÷F)	33	35	36	39	41
H. Normal Labor Days	25	25	25	25	25
I. Overtime per Labor (Day)	8	10	11	14	16

Table K-4-1 Major Items of Determined Land Disposal

	Government		Land Reclamation Cooperative		Total
1. Proportion of Allocation	70%		30 %		
2. Gross Land (fed.)	77,000		33,000		
	Distribution	Auction	Membership	Small Holder	Total
3. Allocation (%)	80	20	75	25	
4. Gross Land (fed.)	61,600	15,400	24,750	8,250	
5. Farm Land (fed.)	49,390	12,350	19,840	6,620	88,200
6. Small Holder (%)	80	-	80	-	
6-1 5 fed.	39,510	-	15,870	6,620	62,000
6-2 No. of Settler	7,902	-	3,174	1,324	12,400
7. Large Holder (%)	20	100	20	-	
7-1 15 fed.	5,930	7,410	2,380	-	15,720
20 fed.	3,950	4,940	1,590	-	10,480
7-2 No. of Settler					
15 fed.	395	494	159	-	1,048
20 fed.	198	247	80	-	525
8. Total No. of Settler	8,495	741	3,413	1,324	1,573
	9,236		4,737		
9. Grand Total No. of Settler		13,973			

ANNEX

L. STRUCTURE DESIGN

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