THE ARAB REPUBLIC OF EGYPT

MINISTRY OF IRRIGATION

FINAL REPORT

ON

FEASIBILITY STUDY

FOR

THE SOUTH HOSAINIA VALLEY AGRICULTURAL DEVELOPMENT PROJECT

(ANNEXES)

VOLUME 5

March 1983

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JAPAN INTERNATIONAL COOPERATION AGENCY

GENERAL PLANNING MAP

LEGEND

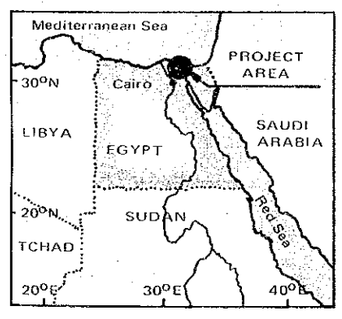
- DIVERSION FACILITY
- IRRIGATION CANAL
- DRAINAGE CANAL
- FEEDER ROAD
- VILLAGE ROAD
- SMALL VILLAGE
- SERVICE VILLAGE
- CENTRAL VILLAGE
- (P) PUMPING STATION FOR DRAINAGE
- (Py)(Pl) PUMPING STATION FOR IRRIGATION
- LIVE-STOCK CENTER

Bahr Saft drain

El Salam canal

Bahr Bagar drain

KEY MAP



SCALE

0 1 2 3 4 5 Kilometres

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ABBREVIATIONS AND GLOSSARY

ARE	:	Arab Republic of Egypt
B/C	:	Benefit Cost Ratio
CIF	:	Cost, Insurance and Freight
EIRR	:	Economic Internal Rate of Return
ET	:	Evapotranspiration
FAO	:	Food and Agriculture Organization
FC	:	Foreign Currency
FOB	:	Free on Board
FY	:	Fiscal Year (July 1st to June 30th)
IBRD	:	International Bank of Reconstruction and Development
JICA	:	Japan International Cooperation Agency
K	:	Potassium
LC	:	Local Currency
LE	:	Egyptian Pound = 1.4 US$ = 300 Japanese Yen
MOA	:	Ministry of Agriculture
MOI	:	Ministry of Irrigation
MOLR	:	Ministry of Land Reclamation
N	:	Nitrogen
O & M	:	Operation and Maintenance
P	:	Phosphorous
$, US$	:	Dollar, US$ = 0.74 LE

Units of Measurement

Length

mm	:	millimeter
cm	:	centimeter
m	:	meter
km	:	kilometer

Area

sq.cm, cm^2	:	square centimeter
sq.m, m^2	:	square meter
sq.km, km^2	:	square kilometer
MSM, $10^6 m^2$	:	million square meter

Volume

ℓ, lit	:	liter
cu.m, m^3	:	cubic meter
MCM, $10^6 m^3$	:	million cubic meter

Weight

g	:	gram
kg	:	kilogram
ton, m.t.	:	metric ton

Others

EL	:	elevation above mean sea level
MSL	:	mean sea level
FWL	:	full water level
HWL	:	high water level
LWL	:	low water level
sec	:	second
minu	:	minute
hr, hrs	:	hour or hours
min	:	minimum
max	:	maximum
%	:	percent
PPM	:	part per million
No.	:	Number
°C	:	degree centigrade
°F	:	degree fahrenheit
Cl	:	Chlorine
HP, PS	:	Horse Power
lit/sec	:	liter per second
m/s	:	meter per second

Conversion Factors

Unit	Comparison
Units of Length	
Millimeter (mm)	0.001 meter
Centimeter (cm)	0.01 meter
Meter (m)	100 cm
Kilometer (km)	1,000 meters
Units of Area	
Square centimeter (sq.cm)	0.0001 sq.m
Square meter (sq.m)	
Hectare (ha)	10,000 sq.m
Square kilometer (sq.km)	1,000,000 sq.m
Feddan	4,200 sq.m
Units of Volume	
Cubic centimer (cu.m)	0.001 cu.m
Liter (1,000 cu.m)	0.001 cu.m
Cubic meter (cu.m)	1,000 liters
Units of Weight	
Gram (g)	
Kilogram (kg)	1,000 g
Metric Ton (mt)	1,000 kg

Miscellaneous

1 cu.m per sec	=	1,000 liters per second (ℓ/s)
	=	35.3145 cu.ft per second (cfs)
	=	15,850 gallons per minute (gpm)
1 liter per second for 1 day	=	8.64 mm depth over one hectare
10 mm depth over 1 hectare	=	1.157 liters per second for 1 day
	=	3,532 cu.ft
1 horsepower (metric)	=	75 kg-m per second
	=	550 ft-lb per second
1 cu.m per day per feddan	=	0.238 mm/day = 2.38 ℓ/day/ha

F-1. EXISTING FARM LAND

F-1-1. On-Farm Facilities

Almost all the Project Area is a waste land. It can be said that no existing on-farm facilities which could be utilized in the Project or which will be obastacles in the Project implementation.

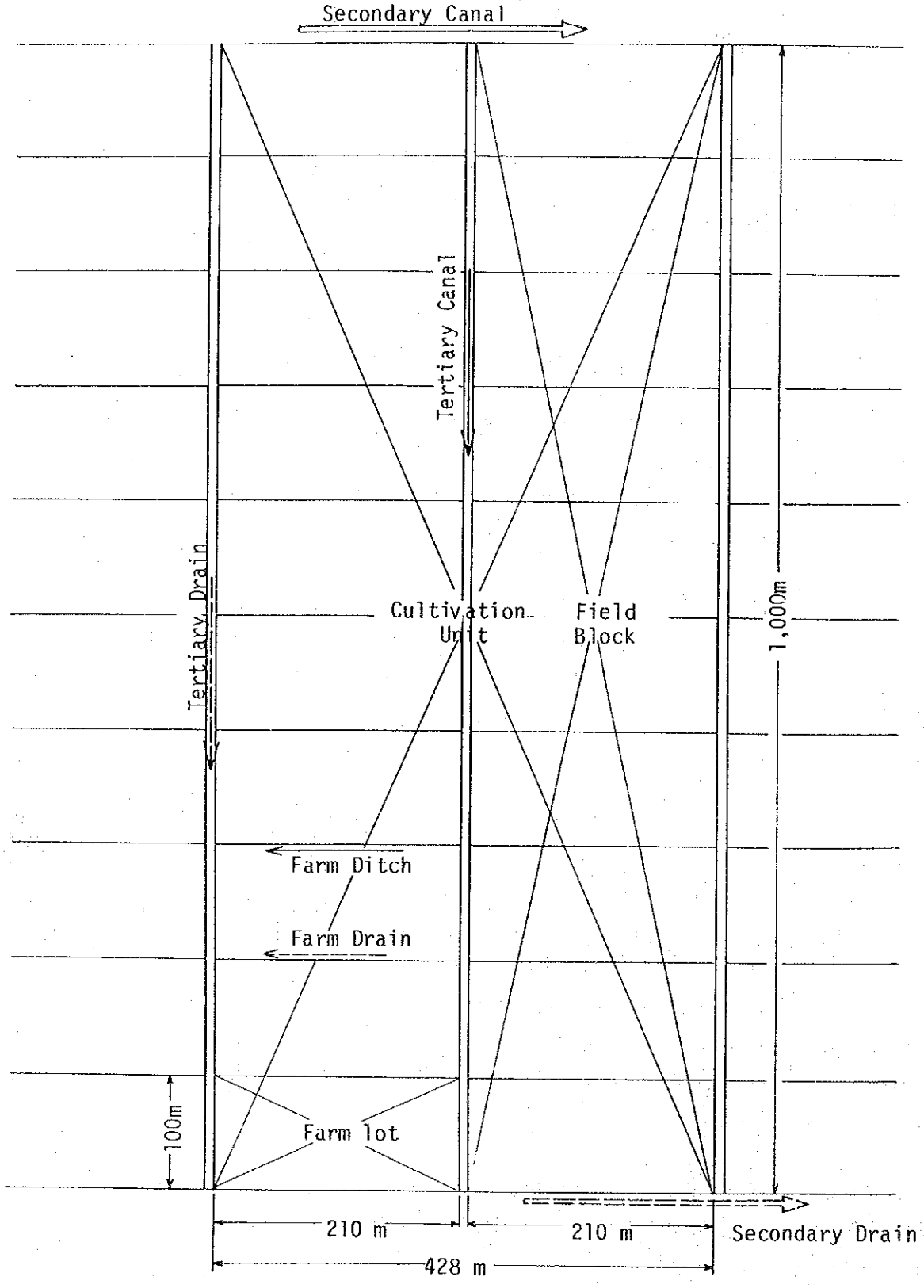
The elevation of the Project Area ranges between -0.5 m and +4.0 m above mean sea level, and the major part of the Area is lower than +2.0 m. About one-third of the Project Area is now covered by water which is influenced by the Manzala lake situated in the north of the Project Area. In general, groundwater table is high. Therefore, appropriate drainage netwroks should be planned in the Project in order to draw down the groundwater table.

Some villages and developed lands surround the Project Area. These surrounding areas are equipped with non-lining open canals with a water surface width of 2.5 to 3.0 m. The water level of these canals is by 0.5 to 1.0 meter lower than the ground level. Weeds thickly grow in the canals, and disturb water flow to a great extent.

It is observed that one farm family owns a farm land of about 2.1 ha (5 feddans) on an average (hereinafter called "plot"). Irrigation water is lifted from tertiary canals by Sakkia at the entrance of a plot. This might be the reason why only surface irrigation is observed in the Project Area and neither sprinkler irrigation nor drip irrigation has been introduced. The salinity of soils is high to a considerable extent in surrounding farm lands, and the distance of existing field drains in plots is small with the length of about 20 m. (Refer to Fig. F-2-1)

Farm roads of about four meters wide run along tertiary canals. These farm roads are used for transportation by truck and for farm machinery, etc., but not paved.

Fig. F-2-1 Typical Layout Plan of On-farm Facilities



The Project Area is entirely a virgin soil to be newly developed. However, it might be important to formulate a plan for on-farm facilities for modernization of agriculture fully based on the traditional and present way of Egyptian agriculture.

F-1-2. Water Management

Irrigation water is lifted from tertiary canals by Sakkia, and distributed to farm plots through farm ditches as already mentioned before.

At a water inlet a concrete pipe or casting iron pipe is buried to connect a tertiary canal and Sakkia. According to the Egyptian regulations, an approval of the governmental office is required as for a diameter of the above-mentioned inlet pipe. The governmental office issues such approval taking into account the field size and water requirement of crops to be grown in the field size. This is a kind of water right given to applicants, that is, farmers.

Sakkia operated by cattle still prevails in surrounding areas of the Project Area, and engine driven small pump is the minority. The operation time of Sakkia is limited to only day time, and operation efficiency is very low. Under the circumstances, it is necessary to introduce the other type of water management system with a high operation efficiency.

F-2. ON-FARM DEVELOPMENT

F-2-1. Principle of On-Farm Development

Crops presently cultivated are paddy, cotton and maize in the summer and berseem and wheat in the winter. Only one crop should be grown in an area irrigated by one tertiary canal (hereinafter called "cultivated unit"). A three-year rotational cropping system will be carried out within this cultivation unit. (Refer to Fig. F-2-1)

Soils in the Project Area fall in the light clay that maintains irrigation water well. This kind of soils suggests that paddy cultivation will be advantageous in the Project Area. Since salt accumulation is generally high in the Project Area, leaching will be necessary for cultivation. However, if paddy cultivation is made to a full extent in the Pfoject Area, the water requirement of paddy would be higher than the designed duty of water, and El Salam canal water which is the sole water source for the Project Area will not be able to meet the water requirement. Under the circumstances, the rotational cropping is able to reduce the peak water demand.

For paddy cultivation, ground surface of each plot shall be kept nearly level. Furthermore, in order to draw down groundwater table and to increase the leaching efficiency, irrigation and drainage networks should be completely separated each other. Field drains should be located at an appropriate distance in each plot.

In selecting an irrigation method, a series of gravity irrigation system is, in general, more advantageous than lift irrigation system. Because the cost for on-farm facilities such as small but many pumping units and power supply network could be saved.

F-2-2. Land Consolidation Plan

Based on discussions made during the field survey period, the land holding of a farm household has been decided at 2.1 ha (5 feddans), and

this plot will be the minimum unit in the land consolidation.

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

Tertiary canals will be planned to go across contour lines whereas the run of long sides of farm plots will be in parallel with the contour lines. Therefore, other sides of plots will be located in parallel with the tertiary canals. If the standard length of tertiary canals is determined at one kilometer in consideration of water management and the construction cost of these facilities, the shape of a plot will be rectangular with the length of 210 m and the width of 100 m. A group of 10 farm plots (hereinafter called "field block") would be planned at a side of a tertiary canal. Therefore, a cultivated unit will be formed by two field blocks located at both sides of a tertiary canal. (Refer to Fig. F-2-1)

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

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

Plot	:	210 m x 100 m = 2.1 ha (5 feddans)
Field block	:	1,000 m x 210 m = 21 ha (50 feddans)
Cultivation unit	:	1,000 m x 428 m = 42.8 ha (102 feddans)

An irrigation area will be divided into some irrigation blocks so that irrigation water will be rotationally distributed to these irrigation blocks. The rotational irrigation system like this will continuously provide the water through irrigation canal networks, but supply irrigation water to each irrigation block with a certain interval. And this method of irrigation is usually employed where irrigation water is limited. In comparison with the continuous irrigation, a water management loss on on-farm level of the rotational irrigation system will be small. Therefore, it can be said that the rotational irrigation is to save water.

F-2-3. Water Management and On-Farm Facilities

1) Irrigation principle of paddy cultivation

i) Maximum Gross Water Requirement

The maximum net water requirement for paddy cultivation, which is computed based on climatic data and crop coefficient, is 12.4 mm/day (on June). The application loss 25% is assumed on a field. Therefore, the gross water requirement is calculated as follows:

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

ii) Rotational irrigation and irrigation hours

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

iii) Designed discharge of farm ditch

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

$$\frac{16.5 \text{ mm/day} \times 10 \times 5 \text{ days}}{86{,}400} = 9.6 \text{ litres/sec/ha}$$

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

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

iv) Water application from farm ditches

Each farm plot will be divided into 10 sections by field drains. Therefore, 1.57 litre/sec of discharge should be applied to each section. (Refer to Fig. F-2-17)

Synthetic rubber siphons could be used to supply water from farm ditches to fields. The difference of water level between the farm ditch and the paddy field would be about 8 cm. In this case, flow through a 50 mm diameter siphon would be 1.6 litre/sec approximately (Fig. F-2-2). Siphons with a length of about 1.3 m would be required.

v) Designed discharge of a tertiary canal

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

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

vi) Irrigation canal system for paddy cultivation

The irrigation canal system for paddy cultivation is shown in Fig. F-2-3.

Fig. F-2-2 Discharge Curve of Small Syphons

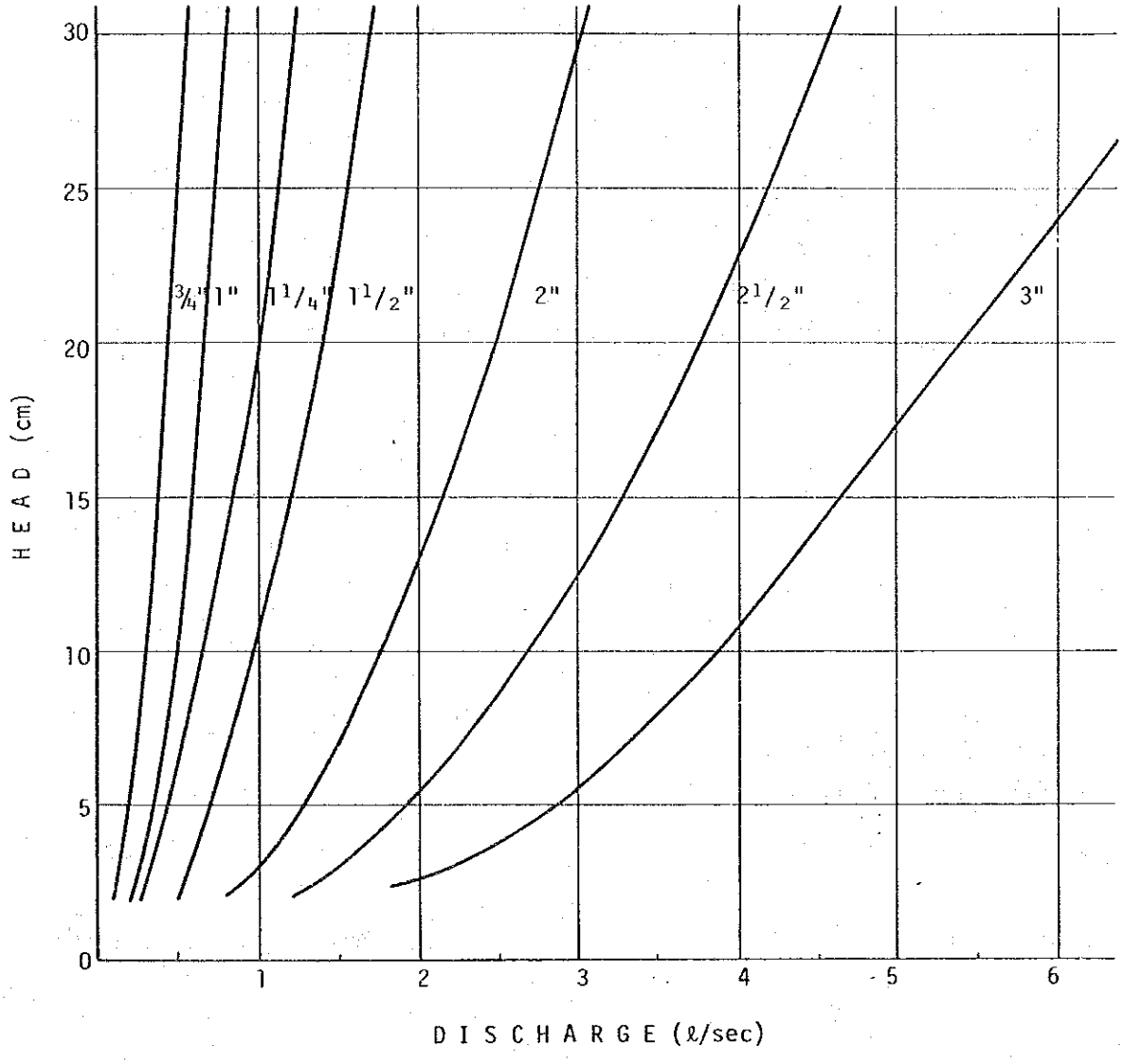
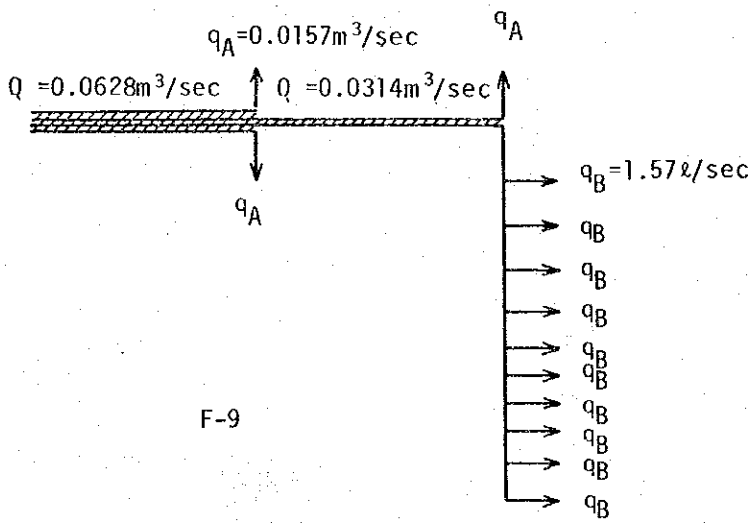


Fig. F-2-3 Diagram of Irrigation Water



2) Application of furrow irrigation

As mentioned previously, four summer crops and two winter crops will be grown in the Area under the three-year rotational cropping system. In this section, how to irrigate cotton by using on-farm facilities which are mainly designed for paddy cultivation will be explained.

i) Amount of water for an irrigation

a) Name of crop : Cotton
Effective depth of root zone : 100 cm

b) Amount of water in root zone

Soil texture	:	Heavy texture
Field capacity	:	280 mm
Depletion of moisture content for optimum growth	:	98 mm (35%)
Available moisture	:	182 mm (65%)

c) Net amount of water for an irrigation

At peak period and under five days irrigation interval, the net amount of water is calculated as follows;

$$9.7 \text{ mm/day} \times 5 \text{ days} = 48.5 \text{ mm}$$

The figure of 48.5 mm is about 27 percent of the available moisture (182 mm), which means 73 percent of available moisture is always supplemented.

ii) The time needed to fill the effective depth of soil with irrigation water

a) Cumulative depth infiltration curve

$$D = 3.7\ T^{0.37} \quad \text{----------} \quad (1)$$

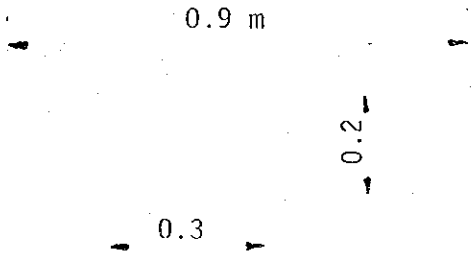
Where, D : cumulative depth infiltered (mm), 48.5
T : time (min)

From the equation (1),

$$T = (D/3.7)^{2.70} = 1{,}048 \text{ min} = 17.5 \text{ hrs} \text{ -------- } (2)$$

iii) Dimension of furrow

Furrow will be 0.9 meter spacing, 0.2 meter height and 0.3 meter wide, and the distance of two furrows will be 90 cm as illustrated below.



iv) Timet to wet furrow

a) Discharge of a furrow

Discharge of siphon: approx. 1.6 litre/sec
When a siphon would be located against ten furrows, discharge of a furrow would be approx. 0.16 litre/sec.

b) Empirical approximation equation

The relationship between discharge in a furrow and flow velocity of water is approximately shown as follows:

$$qt = 0.5\ hbl + itbl \text{ ---------- } (3)$$

Where, q: discharge of a furrow (cu.m/sec)
b: width of flow (cm)
h: water depth at inlet (cm)
t: time to wet furrow (sec)

i: average intake rate in time t (cm/sec)

l: furrow length (cm)

From equation (3),

$$t = (0.5\ hbl) / (q - ibl) \quad \text{----------} \quad (4)$$

c) Time of advance

By appling water depth h = 5 cm, width of flow b = 25 cm, furrow length l = 100 m = 10,000 cm, discharge q = 0.16 litre/sec = 160 cu.cm/sec, average intake rate i = 10.9 mm/hr = 3.02 x 10^{-4} cm/sec to the equation (4), the time of advance t is,

$$t = 7{,}396 \text{ sec} \doteqdot 2.05 \text{ hrs.}$$

The advance ratio (AR), which is the ratio of the time to wet furrow against the time of infiltration is,

$$AR = 2.05 / 17.5 \doteqdot 1 / 8.5$$

and from Fig. F-2-4, the percolation loss to deeper layers against the average depth of infiltered water is approx. 2.5 percent.

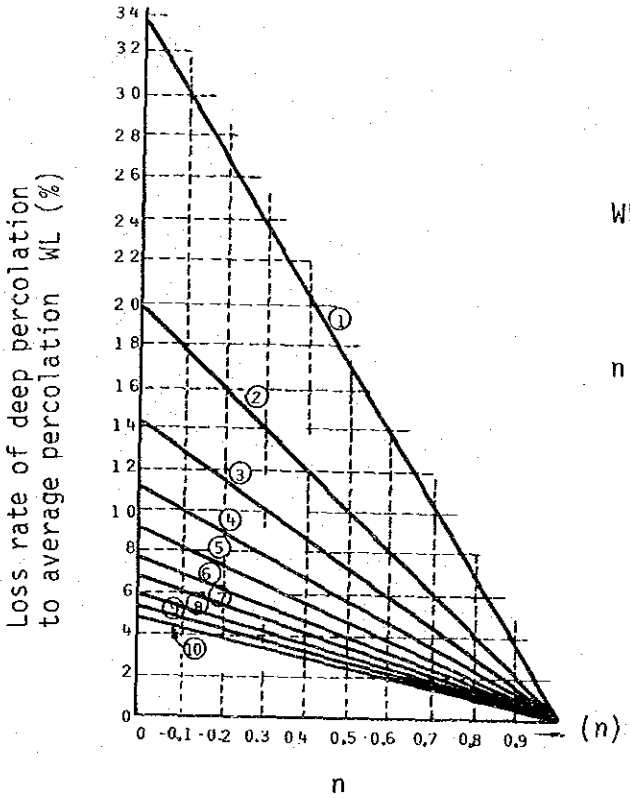
v) Irrigation time

The gross water requirement of a furrow, with 75 percent of application efficiency is,

$$(48.5 \text{ mm} \times 90 \text{ cm} \times 100 \text{ m}) / 0.75 = 5.82 \text{ cu.m}$$

The discharge of a furrow is 0.16 litre/sec. Therefore, a furrow irrigation time will be 10.1 hours. When irrigating, a plot will be divided into two portions. The upper stream portion of a farm ditch is irrigated at first and then the lower stream portion. The total irrigation time would be approx. 21 hrs a day.

Fig. F-2-4 Relationship of WL. and n



WL; Ratio of losses on the Deep layer for average amount percolation

n; $D = \frac{K}{60(n+1)} T^{n-1}$

Time required for soaking root zones

① method to discharge water from inlets to field terminaly for T hours in furrow irrigation.

② Similar to ① , method to discharge water from inlets to field terminals for T hours in furrow irrigation ③, ④ and on, similar to the ① and ② .

3) Application of border irrigation

In this section, how to irrigate maize or berseem by using on-farm facilities which are planned for paddy cultivation is explained.

i) Amount of water in root zone

a) Name of crop : maize or berseem
Effective depth of root zone : 100 cm

b) Amount of water in root zone

Soil texture	:	heavy texture
Field capacity	:	280 mm
Depletion of moisture content for optimum growth	:	98 mm
Available moisture	:	182 mm

c) Net amount of water for an irrigation

The net amount of water for an irrigation under five days irrigation interval at peak period is calculated as follows,

$$8.2 \text{ mm/day} \times 5 \text{ days} = 41 \text{ mm}$$

The above figure is 23 percent of the available moisture. It means that 77 percent of available moisture is always supplemented.

ii) The time needed to fill the effective depth of soil with water

a) Cumulative depth infiltration curve

$$D = 3.7\ T^{0.37} \quad \text{---------- (1)}$$

Where, D: cumulative depth infiltered (41 mm)
T: time (min)

From equation (1),

$$T = (D / 3.7)^{2.70} \quad \text{---------- (2)}$$

b) Time of infiltration

$$T = (41 / 3.7)^{2.70} = 661 \text{ min}$$

iii) Size of border strip

The intake rate of the soil, slope, width and length of the border strip, depth of application, height of the border ridges, and erosion are all considered in determining the size of border strip to use.

Figures F-2-5 and F-2-6 show the relationships of these factors, based on empirical data from many projects.

a) Unit border strip on slope of 0.5 percent

From Fig. F-2-5, the depth of water required to fill the root zone is 41 mm, and the basic intake rate is 2.0 mm/hr, therefore, the unit discharge for a border strip is 0.037 litre/sec.

b) Unit discharge for a border strip on practical slopes

Plots would be sloped at 0.1 percent, so the slope coefficient is 1.35 (Refer to Fig. F-2-6).

$$0.037 \times 1.35 = 0.0499 \text{ litre/sec}$$

c) Border strip

Width and length of a border strip is 18 m and 100 m, respectively. Therefore, discharge of border strip is computed as follows,

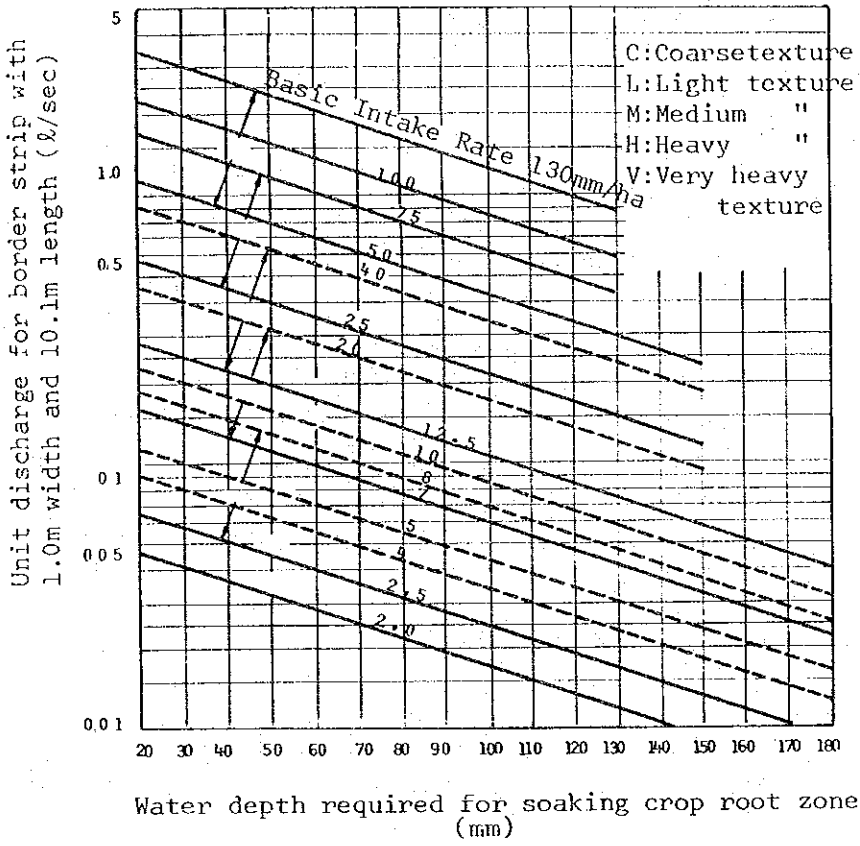
$$0.0499 \times 18 \times 100/10 = 8.98 \text{ litres/sec}$$

iv) Irrigation time

The similar siphons as used in irrigation of paddy will be used for border strips. Water depth at an inlet of border strips is at 20 cm. The difference of water level between a farm ditch and an inlet of border strip is 11 cm and the discharge through a siphon will be 1.84 litre/sec based on Fig. F-2-2.

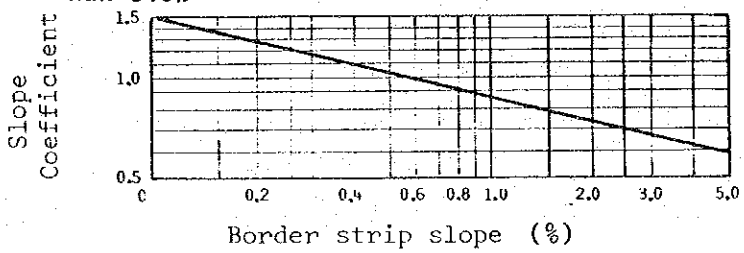
The necessary number of siphons for a border strip (18 m x 100 m) is,

Fig. F-2-5 Estimation Curve for Unit Flow in 0.5% Sloping Lands



Note: For those lands sloping with those other than 0.5%, unit flow can be obtained by multiplying the unit flow derived from this diagram by the coefficient obtained Fig. F-2-6.

Fig. F-2-6 Coefficient to Be Adopted for Adjusting Unit Flow Derived from Fig. F-2-5 for Lands Sloping with Other than 0.5%



$$8.98 / 1.84 = 4.9 \fallingdotseq 5 \text{ siphons}$$

However, against 15.7 litres/sec of the designed discharge of a farm ditch, the required discharge is 18.4 litres/sec when ten siphons are used at same time. It is technically possible to increase this discharge only for border irrigation, but it is more practical to limit that discharge of a farm ditch within 15.7 litres/sec to prevent the confusion on water management. Therefore, the number of siphons per border strip will be four and and the required discharge of a farm ditch will be 14.7 litres/sec.

In case the application efficiency of 75 percent, irrigation time to apply 41 mm of depth of water is as follows,

$$\frac{41 \text{ mm} \times 18 \text{ m} \times 100 \text{ m}}{0.75 \times 1.84 \text{ ℓ/sec} \times 4} = 13{,}370 \text{ sec} \fallingdotseq 3.7 \text{ hr}$$

Two border strips are used for irrigation simultaneously. Therefore, during the peak water demand period, five times of irrigation are permitted in a day. The daily working hours is about 20 hrs.

$$3.7 \text{ hrs} \times 5 \times 1.1 = 19.3 \text{ hrs.}$$

4) Drainage

i) Permeability

The permeability of soil is calculated as follows (Fig. F-2-7):

$$K = QL / A.\ h1$$

Where, K : permeability
Q : flow of water
A : gross soil cross-sectional area
h1: loss of hydraulic head
L : flow length

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

Fig. F-2-7 Sketch of Permeability Test

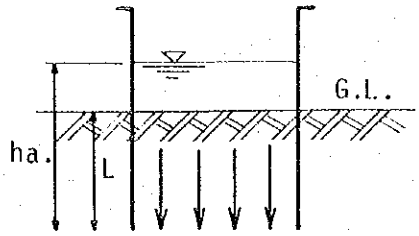


Fig. F-2-8 Diagram of Drainage Model

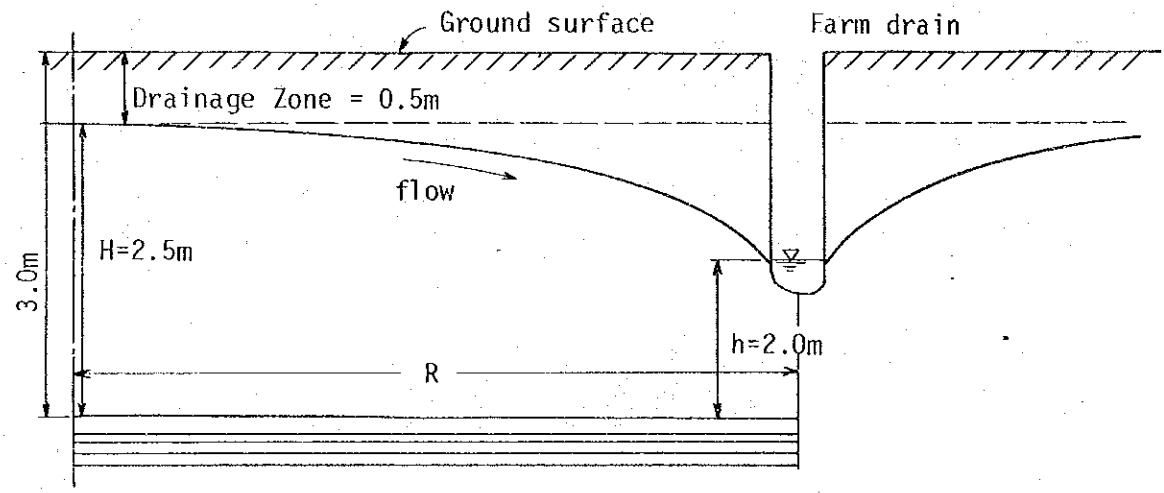
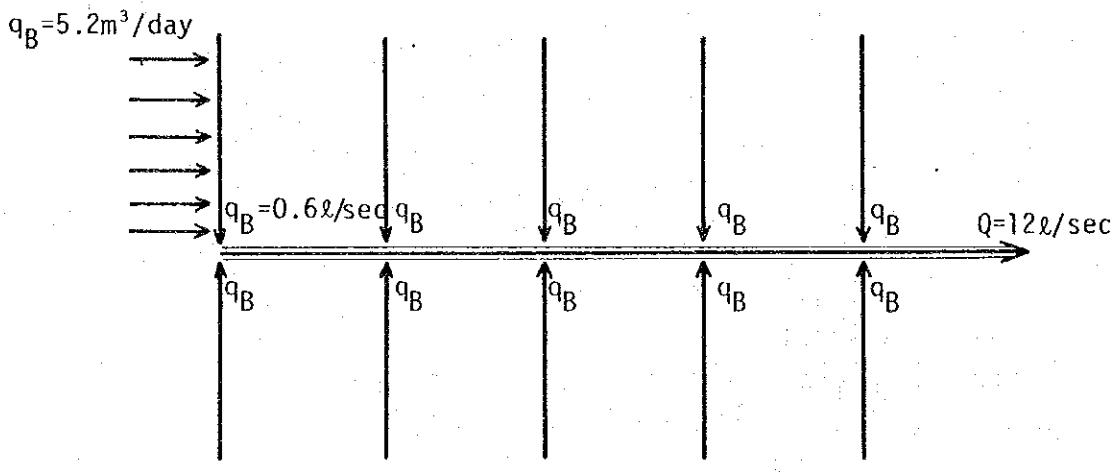


Fig. F-2-9 Diagram of Drainage Water



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

ii) Drainage discharge

The proposed drainage module is 0.35 litre/sec/ha (= 0.15 litre/sec/feddan)

iii) Spacing of field drains (type A)

The Project Area is entirely covered by clayey soil and the thickness of this surface layer is considered as three meters.

In order to determine the spacing of field drains (type A), the following model (See Fig. F-2-8) is assumed.

On this model, the spacing is determined as follows:

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

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

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

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

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

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

and with taking safety, the spacing is 20 m.

iv) Drainage canal system

Drainage canal system from field drains (type A) to tertiary drain is shown in Fig. F-2-9.

F-2-4. Plan for On-Farm Facilities

1) Irrigation Canals

i) Typical cross-section of farm ditches

With the design discharge of Q = 0.0157 cu.m/sec, roughness coefficient in the Manning's formula n = 0.025, side slope (1: y) on farm ditches y = 1, designed hydraulic gradient $I = 1.2 \times 10^{-4}$. The most effective cross-section will have the depth h = 0.27 m, width of water B = 0.76 m, width of canal bed b = 0.22 m, width of ditch 0.96 m when the freeboard is 0.10 m. The velocity V is 0.115 m/sec.

However, the minimum width of canal bed is 0.3 m in consideration of construction exercise. Under the circumstances, the above figures are modified to the depth of water h = 0.26 m, width of water B = 0.82 m, width of canal bed b = 0.30 m, width of ditch is 1.0 m when the freeboard is 0.09 m (Fig. F-2-10).

ii) Typical cross-section of tertiary canals

With the designed discharge Q = 0.0628 cu.m/sec, roughness coefficient of the Manning's formula n = 0.025, side slope (1: y) of tertiary canals y = 1.5, designed hydraulic gradient $I = 1.2 \times 10^{-4}$, the most effective cross-section will have the depth h = 0.43 m, width of water B = 1.55 m, width of canal bed b = 0.26 m, width of canal is 2.45 m when the freeboard is 0.30 m. And velocity V is 0.157 m/sec.

Due to the same reason mentioned before on farm ditches, these figures are modified to the depth of water h = 0.43 m, width of water B = 1.60 m, width of canal bed b = 0.30 m, width of canal is 2.50 m when the freeboard is 0.30 m. And velocity V is 0.155 m/sec (Fig. F-2-11).

Fig. F-2-10 Typical Cross Section of Farm Ditch, Field Drain (type B)

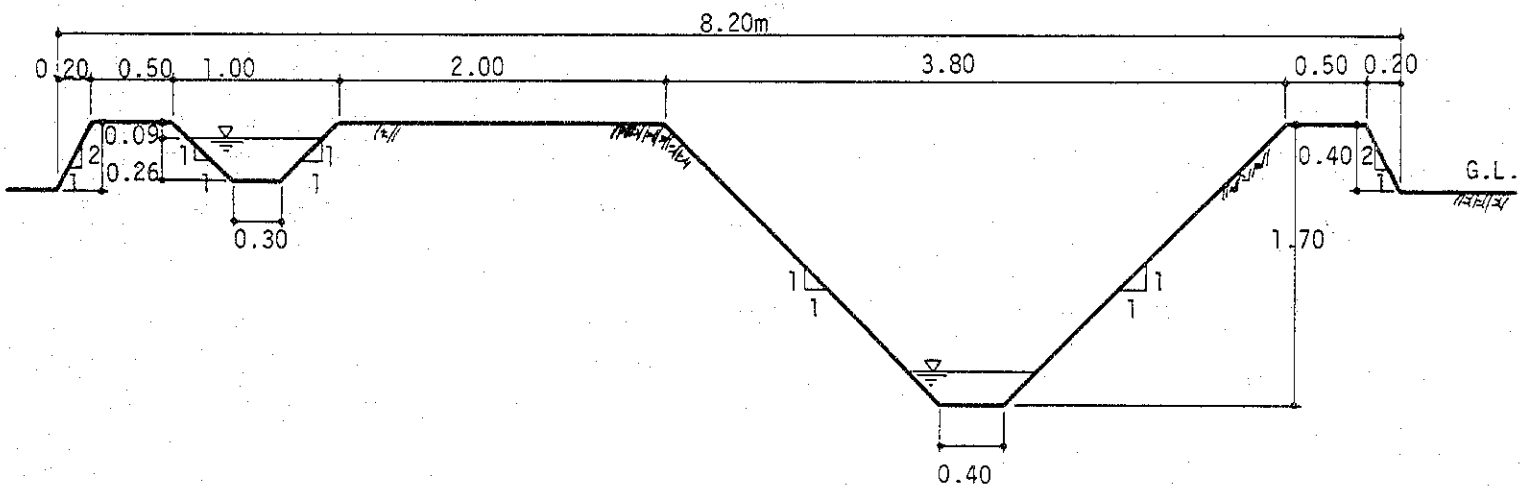
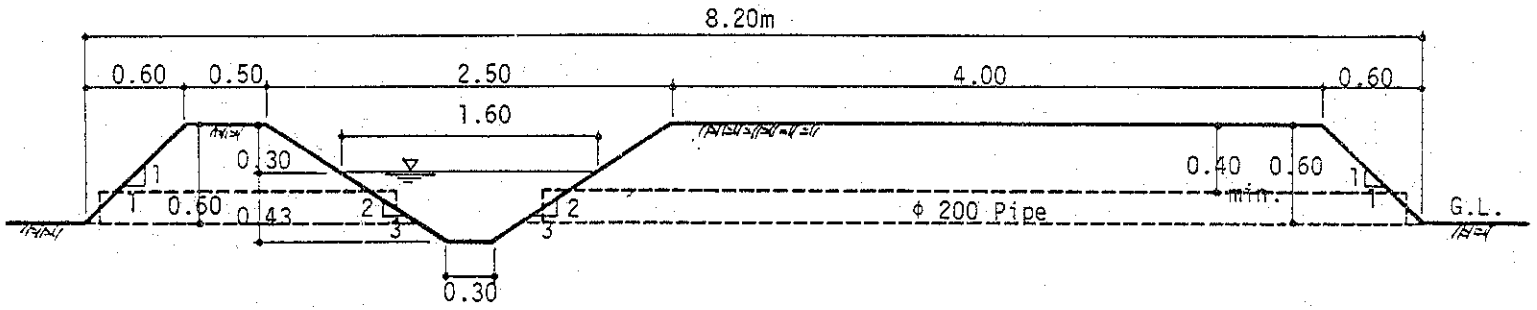


Fig. F-2-11 Typical Cross Section of Tertiary Canal



iii) Structure of canals

Canals will be trapezoid in their cross-section and non-lining open ones.

iv) Turn-out and check

A turn-out is constructed at the beginning point of a tertiary canal. The facility will play an important role on the water management of on-farm levels. The discharge of the tertiary canal is controlled by this facility with a retangular weir without contraction. It is easy to control the discharge of the canal by measuring the depth of water flowing over the weir. The discharge of the canal is calculated as follows,

$$Q = C\ B\ h^{1.5}$$

$$C = 1.785 + \left(\frac{0.00295}{h} + \frac{0.237h}{D} \right)(1 + \varepsilon)$$

Where, Q : discharge
B : length of weir crest
h : depth of water flowing over weir
C : coefficient of discharge
D : height of weir
ε : height adjustment factor (when D = 1 m, $\varepsilon \leqq 0$)

In order to measure about 60 litres/sec of discharge by a 0.90 m wide weir, the sluice gate will be adjusted to keep the depth of over flow (h) at 0.11 m. (Refer to Fig. F-2-12)

A check structures to divide irrigation water from a tertiary canal to a farm ditch. The check structures with a stop log are located on the canal to distribute water to farm plots as even as possible. (Fig. F-2-13)

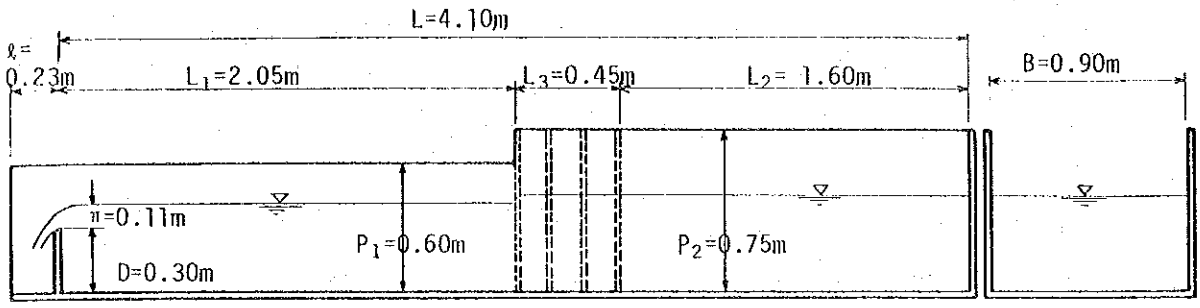
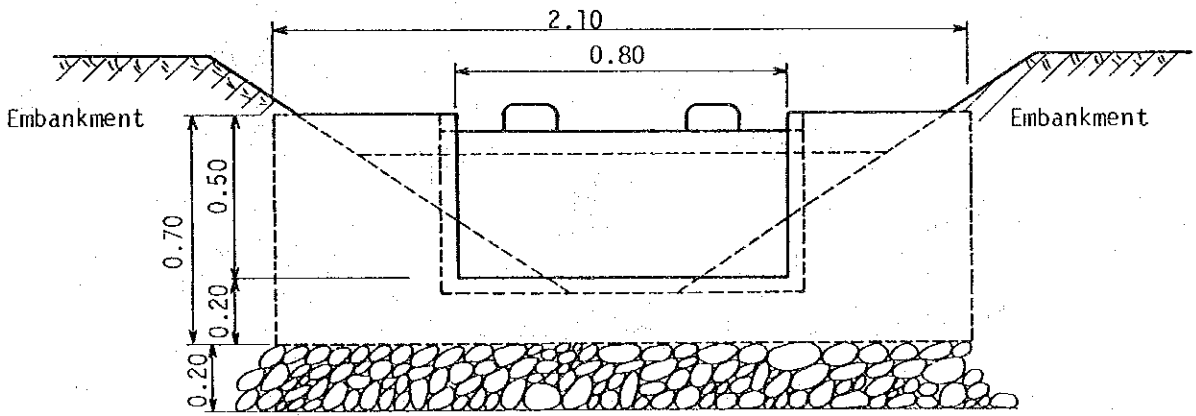
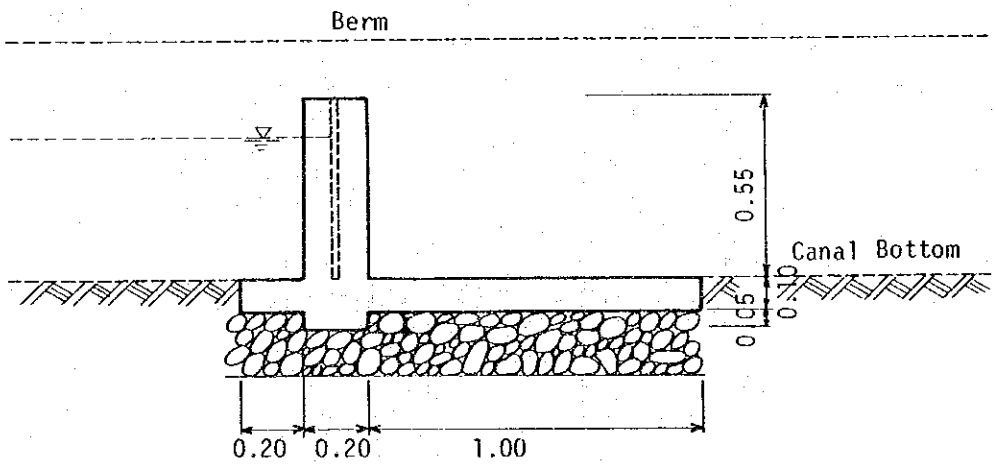


Fig. F-2-12 Profile of Check Structure

Fig. F-2-13 Cross Section of Check Structure





2) Drainage Canals

The major propose of drainage canals in the Project Area is to draw down groundwater tables. Therefore, even the field drain (type A) must be constructed at least one meter depth below the ground level. (Fig. F-2-14, 15)

All drainage canals will be constructed as open canal without lining.

3) Farm Road

Farm roads along tertiary canals are four meters width and unpaved. And farm roads of two meter width are constructed for passing of light farm machinery for farming.

4) Material for construction of farm roads and ridges

Volume of excavation and embankment to construct on-farm facilities is shown in Table F-2-1. It shows that the volume of excavation for constructing drainage canals is sufficient to construct farm roads, irrigation canals and ridges.

5) Farm land utilization

A farm plot of 2.1 ha (5 feddans) is utilized as follows:

i) Gross area: 210 m x 10 m = 21,000 sq.m.

ii) Right of way

a) Farm ditch, farm road (2 m), field drain (type B):

8.20 x 210 m = 1,722 sq.m

b) Field drain (type A)

3.15 m x 85 m x 10 = 2,678 sq.m

Total (a + b): 4,400 sq.m

iii) Net cultivable area:

21,000 - 4,400 = 16,600 sq.m

Fig. F-2-14 Typical Cross Section of Field Drain (Type A)

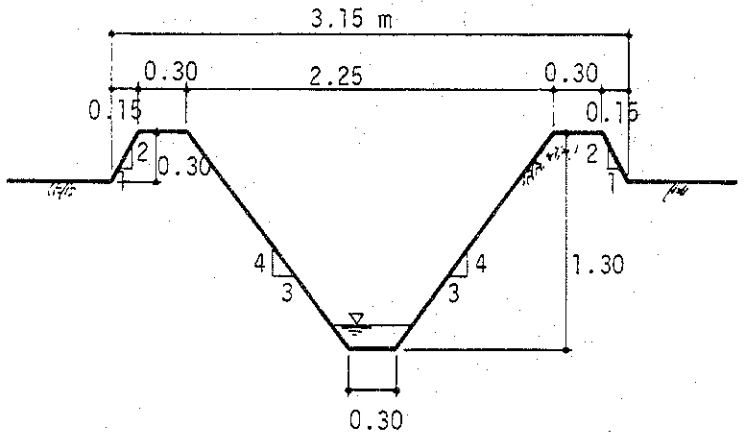


Fig. F-2-15 Typical Cross Section of Tertiary Drain

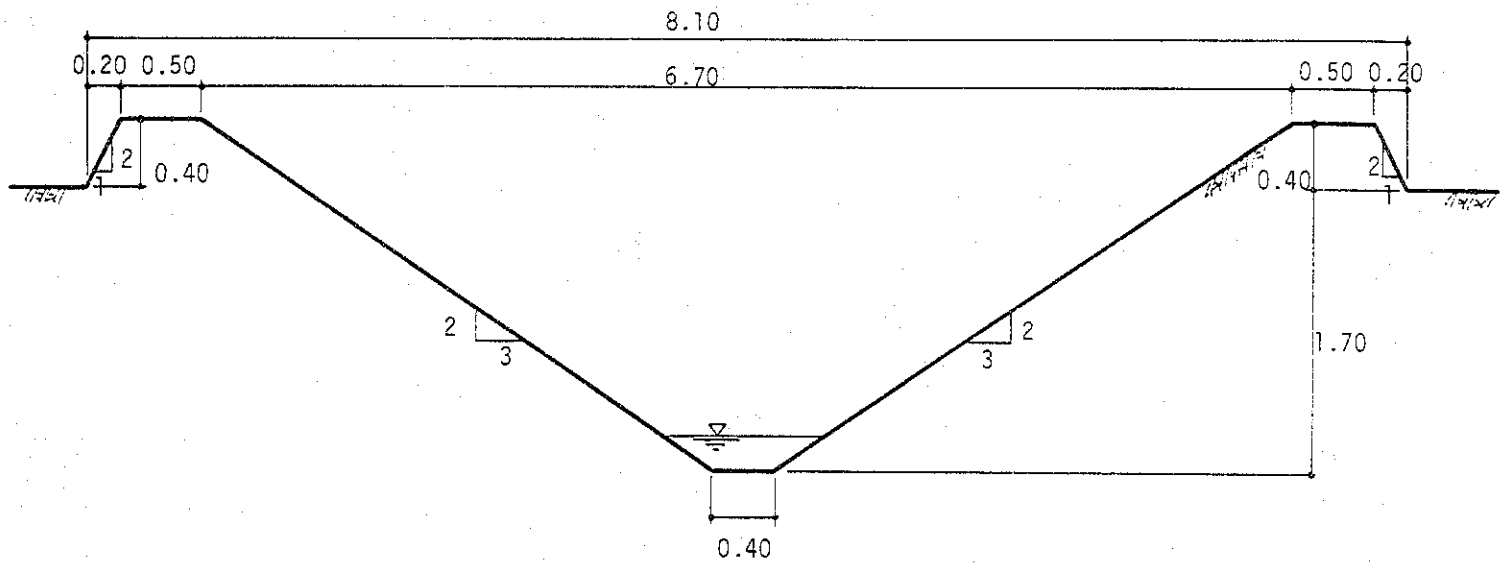


Table F-2-1 Balance of Embankment and Excavation

(per 2.1 ha = 5 feddan section)

Item	sectional length (m)	volume of excavation per meter (cu.m)	volume of embankment per meter (cu.m)	balance per meter (cu.m) excvtn.	balance per meter (cu.m) embkmt.	sectional balance (cu.m) excvtn.	sectional balance (cu.m) embkmt.
1. Tert.canal & Tert. road	100/2	0.6	3.6	-	3.0	-	150
2 Farm ditch, Farm road, Farm drain (B)	210	2.2	1.6	0.6	-	126	-
3. Field drain (type A) (1)	85 x 10	1.1	0.3	0.8	-	(680)	-
4 Tertiary drain	100/2	5.0	0.7	4.3	-	215	-
Total						381	150

Note (1) : field drain (type A) would be constructed after completion of land preparation work.

iv) Wet Cultivable Area

$$\frac{16,600}{21,000} \times 100 = 79\%$$

v) Increase of right of way near boundaries of neighbor lands, roads, canals, etc.

$$(100 - 79) \times 1.05 = 22\%$$

F-2-5. Alternative plan of irrigation networks

1) Pipeline networks (Refer to Fig. F-2-16)

i) Irrigation block

As mentioned previously, an area to be simultaneously irrigated is formed by four plots with five days interval.

ii) Surface pipelines as an alternative of farm ditches

The pipeline networks to construct on a ground surface (Surface pipeline) are applicable to furrow or border irrigation. The length of a furrow or border is 100 meters and the width of a furrow and a border is 0.9 meters and 18 meters, respectively.

a) Length of a surface pipeline: 208 m

b) Number of gates and discharge

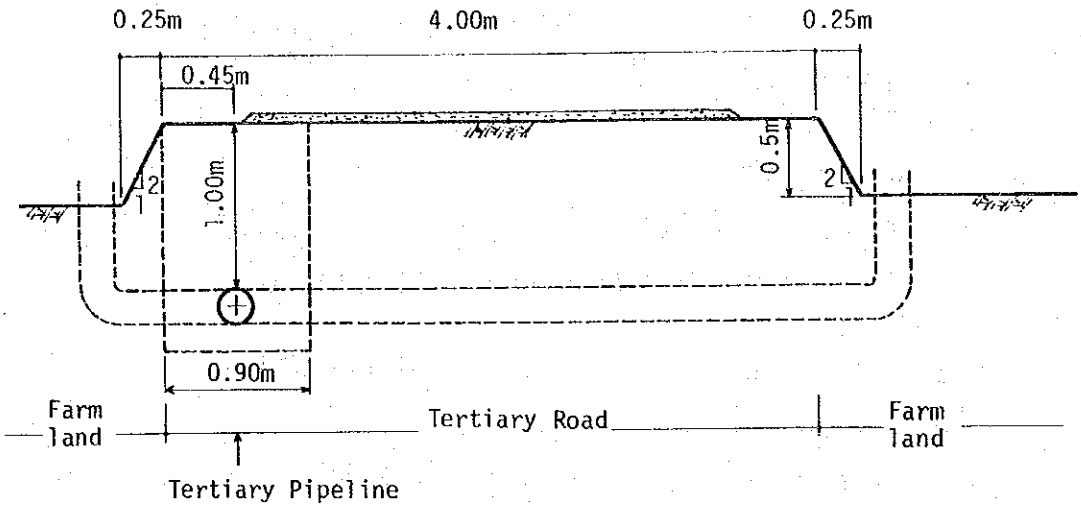
Due to field drains (type A), number of gates, in other words, number of furrows in a plot is 200. The designed discharge of 560 ℓ/hr is available from a gate at 0.45 meters of water head. Therefore, the discharge of a surface pipeline at the inlet is 32.7 litres/sec.

c) Pipe diameter and friction loss

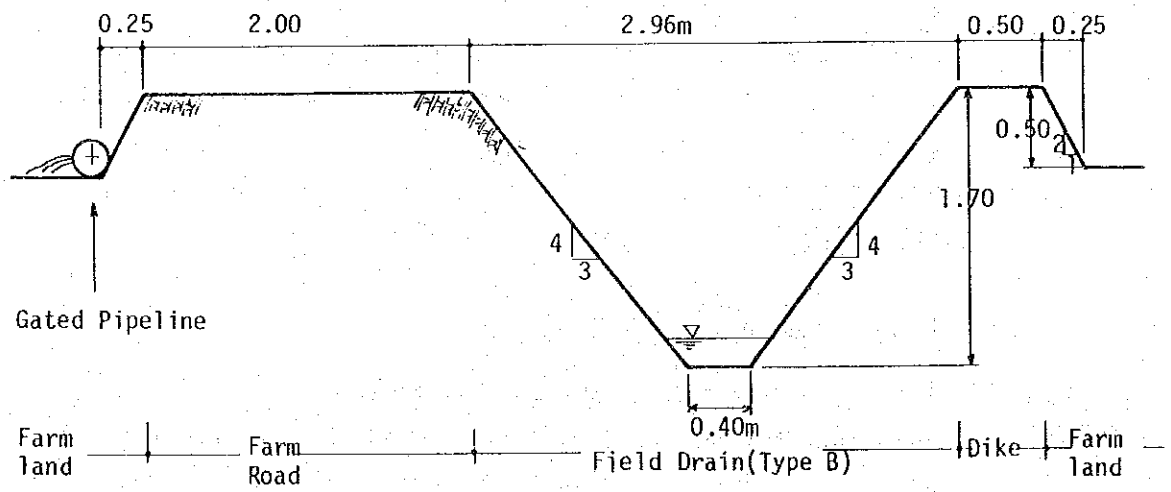
In case that a 200 mm diameter pipe is used, the friction loss head through this pipeline is calcualted from the William & Hazen's formula as 0.49 m.

Fig. F-2-16 Typical Section of Irrigation and Drainage Canal (Pipeline System)

1) Tertiary



2) Gated Pipe Line



d) Required pressure at the inlet of the surface pipeline

$$0.45 + 0.49 = 0.94 \text{ m}$$

It is not practical to operate a tertiary canal with a surface pipeline by gravity. So the water head should be given by pump.

e) Irrigation time

$$\frac{957.6 \text{ cu.m}}{0.0327 \text{ cu.m/sec}} = 8.1 \text{ hr}$$

Therefore, two times of irrigation a day is available.

iii) Pipelines instead of tertiary canals (tertiary pipeline)

a) Flow rate

Discharge of a tertiary pipeline is the double of surface pipelines: 65.4 litres/sec (= 32.7 x 2).

b) Length of tertiary pipeline: 940 m

c) Pipe diameter and friction loss

In case that 250 mm of plastic pipes are used, friction loss head through the pipeline is calcualted from the William & Hazen's formula as 7.05 m.

d) Required pressure at the inlet of the tertiary pipeline

$$0.94 + 7.05 = 7.99 \text{ m}$$

iv) Earth work per cultivation unit

Earth work for construction of a cultivation unit applying pipeline system is shown in Table F-2-2.

v) Construction cost in the pipeline system (estimated for a cultivation unit)

Table F-2-2 Earth Work for Farm Road and Drainage Canal (Pipeline method)
(per 42 ha = 100 feddan)

Item	construction cost per section: sectional length (m)	volume of excavation per meter (cu.m)	volume of excavation (cu.m)	excavation cost (L.E) (1)	volume of embankment per meter (cu.m)	volume of embankment (cu.m)	embankment cost (L.E) (2)	construction cost (L.E)	nos of section	construction cost (L.E)
1. Tert. Pipe	100	-	-	-	2.1	210	315	315	10	3,150
2. F. Drain (B)	210	1.6	336	218	1.6	336	504	722	20	14,440
3. F. Drain (A)	85 x 10	1.1	935	608	0.3	255	383	991	20	19,820
4. Tert. Drain	100	5.0	500	325	0.7	70	105	430	10	4,300
Total	-	-	1,771	1,151	-	871	1,307	2,458		41,710

Note (1) : unit price for excavation is L.E. 0.65/m^3

(2) : unit price for embankment is L.E. 1.50/m^3

a) Materials

1.	Surface Pipeline; ϕ 8 inches, L=208 m x 20	L.E.	43,000
2.	Tertiary Pipeline; ϕ 250 mm, L=915 m	L.E.	26,000
3.	Pumping Unit: 10 cu.m/min. x 15 m x 3 for 500 feddans	L.E.	20,000
	Sub-total	L.E.	89,000

b) Civil work and installation

1.	Land levelling	L.E.	6,800
2.	Earth work	L.E.	41,700
3.	Pipe laying	L.E.	3,600
4.	Pump installation	L.E.	8,000
5.	Pumping house	L.E.	4,400
	Sub-total	L.E.	64,500
	Total	L.E.	153,500

2) Portable sprinkler irrigation system

i) Amount of water for an irrigation

a) Name of crop: cotton
Effective depth of root zone: 100 cm

b) Amount of water in root zone

Soil texture: heavy texture
Field capacity: 280 mm
Depletion of moisture content for optimum growth: 98 mm
Available moisture: 182 mm

c) Net amount of water for an irrigation

48.5 mm, when 73 percent of available moisture will be supplemented.

d) Time needed to fill the effective depth of soil

From the cumulative depth infiltration curve, above time is 17.5 hours.

ii) Selection of sprinkler

a) Irrigation intensity: 48.5 / 17.5 = 2.8 mm/hr

b) Sprinkler spacing

12 m x 18 m, 15 m x 15 m are normal spacing for sprinkler, but field drains (type A) are located every 18 m in the plot as mentioned in Section F-2-4, so that 12 m x 21 m sprinkler spacing should be taken.

c) Net water requirement of a sprinkler

2.8 mm/hr x 21 m x 12 m = 0.196 litre/sec

d) Irrigation efficiency

The evaporation loss and application loss would be estimated as 10 percent and 15 percent, respectively. The total irrigation loss is estimated as 25 percent. Therefore, the irrigation efficiency is 75 percent.

e) Gross water requirement of a sprinkler:

0.196 / 0.75 = 0.261 litre/sec = 3.7 mm/hr

f) Selection of sprinkler

RB-30 type sprinkler with a 3.57 mm (9/64 inch) nozzle that has a watering capacity of 0.23 litre/sec (13.74 ℓ/min) at the pressure of 2.8 kg/sq.cm within a wetting area with the diameter of 25.3 m.

g) Irrigation time

Peak net water requirement: 9.7 mm/day
Irrigation interval: 5 days
Irrigation time: 19.6 hours $\left(= \frac{9.7 \times 5 \times 21 \times 12}{0.23 \times 3{,}600 \times 0.75}\right)$

iii) On-Farm facilities (Fig. F-2-18)

a) Lateral line

Diameter of laterals: 50 mm
Length of laterals: 90 mm
Nos. of sprinkler on a lateral: 8 pcs.
Discharge of laterals: 0.11 cu.m/min (= 13.74 ℓ/sec x 8)
Fricion loss head of laterals: 1.2 m
Required pressure at inlet of lateral: 29.2 m

b) Header line

A header line will be composed of plastic pipes and steel risers at every lateral position. This header will be buried at about 60 cm below ground level.

Dimater of headers: 50 mm/75 mm
Length of headers: 105 m/95 m
Nos. of lateral on a header: 2 lines
Discharge of headers: 0.22 cu.m/min
Friction loss head of headers: 3.3 m
Required pressure at inlet of header: 32.5 m (= 29.2 + 3.3)

c) Tertiary line

A tertiary line will be buried with pipeline and be composed with plastic pipes and turnouts.

Diameter of tertiaries: from 100 mm to 250 mm
Length of tertiaries: 910 m
Nos. of turn-outs to plots: 10
Discharge of tertiaries: 4.4 cu.m/min
Friction loss head of tertiaries: 7.6 m
Required pressure at inlet of tertiaries: 40.1 m

Fig. F-2-17 Typical Layout Plane of On-Farm Facilities

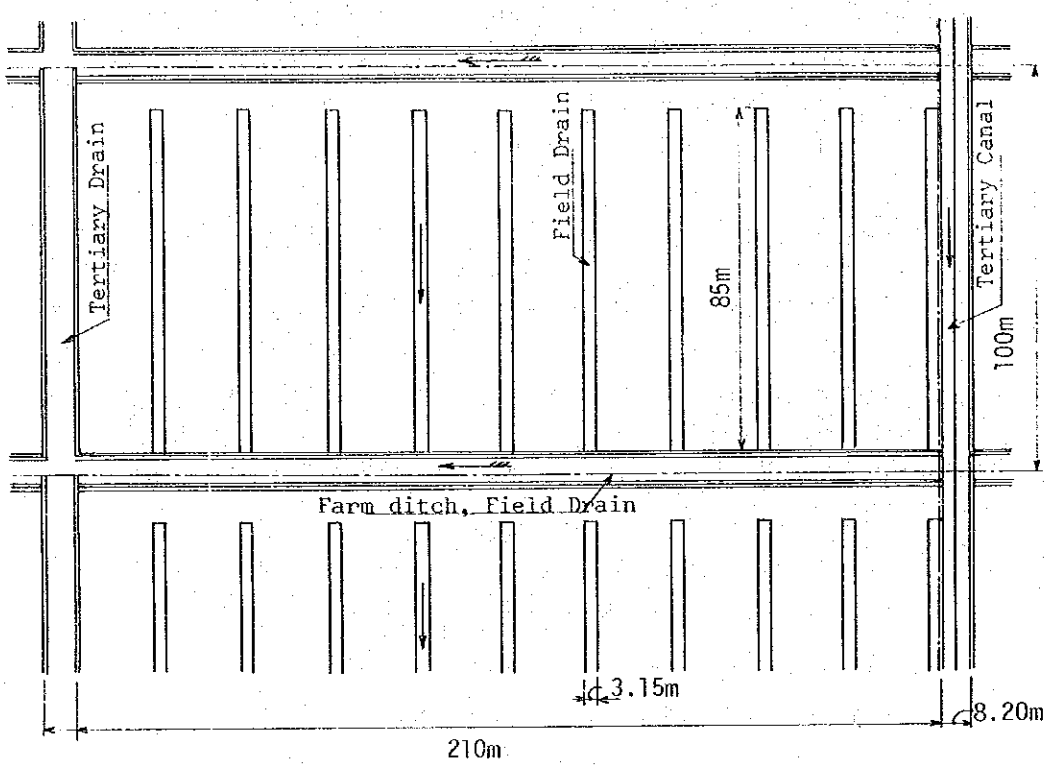
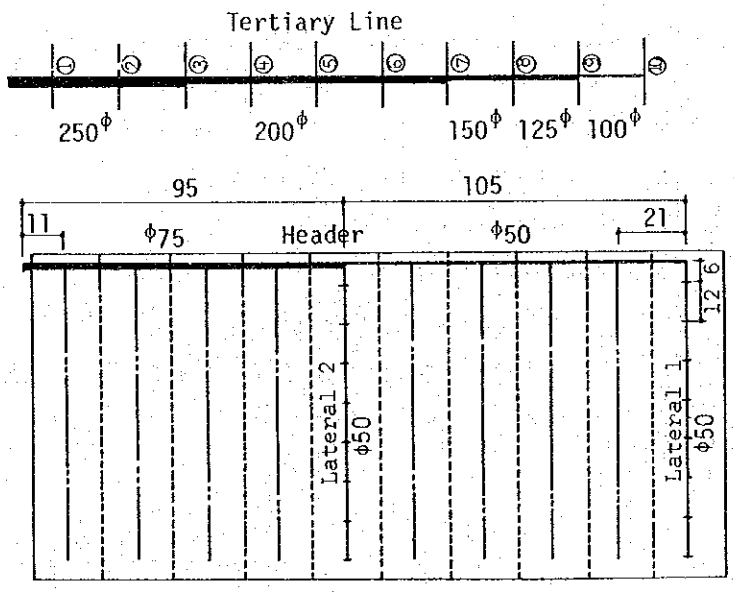


Fig. F-2-18 Typical Layout Plane of Sprincler



d) Pumping Unit

Discharge: 4.5 cu.m/min
Discharge head: 43 m
Power unit: 55 KW

iv) Earth work per cultivation unit

Earth work for construction with a sprinkler irrigation system in a cultivation unit is estimated as same as that in the pipe-line systems mentioned previously. (Table F-2-2)

v) Construction cost of portable sprinkler system per a cultivation unit

a) Materials

1. Lateral line;	ϕ50 mm, L=90 m x 2 x 20	L.E. 44,000
2. Header line;	ϕ50mm/75mm, L=200 m x 20	L.E. 23,000
3. Tertiary line;	ϕ100 mm to 250 mm, L=915 m	L.E. 10,000
4. Pumping unit;	Q=4.5 cu.m/min x 43 m	L.E. 25,000
	Sub-total	L.E. 102,000

b) Civil work and installation

1. Land levelling	L.E. 6,800
2. Earth work	L.E. 41,700
3. Pipe laying	L.E. 5,200
4. Pump installation	L.E. 7,500
5. Pumping house	L.E. 5,000
Sub-total	L.E. 168,200
Total	L.E. 270,200

3) Construction cost for on-farm facilities

i) Land levelling

Although topography in the Area is generally flat, land levelling works should be made sufficiently for paddy cultivation to the extent that elevation difference with each plot ranges less

than 10 cm. The soil survey indicates that surface soil in the Area is generally thick. No factors to interrupt the land reclamation is founded in the surface layer. The surface soil treatment is not necessary. Earth moving works are considered as land levelling works.

For determining the volume of land levelling, an sample area of about 74 ha was selected in the Area and was surveyed in detail. The hauling distance and volume of land levelling are calculated by the theoretic equation used in Japan (Table F-2-3, Fig. F-2-19). As a result of the calculation, the volume of land levelling works is classified based on the typical land slopes of a plot (Table F-2-4).

As shown in Table F-2-5, average volume of land levelling works per unit area of the Project is 231.4 cu.m/ha = 97.2 cu.m/feddan.

(Land levelling cost)

Quantity	Unit Price	Total Amount
231.4 cu.m/ha	L.E. 0.70/cu.m	L.E. 161.98/ha

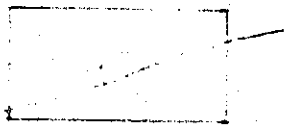
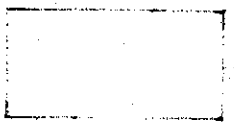
ii) Irrigation canals, drain canals and farm roads

The colume and construction cost of excavation and embankment for irrigation canals, drain canals and farm roads in a cultivation unit are shown Table F-2-6. And the cost of this earth work amounts to L.E. 623/ha or L.E. 262/feddan.

The cost of small structures such as checks and turn-outs per cultivation unit are estimated as follows:

Item	Q'ty	Unit	Unit Price (L.E.)	Amount (L.E.)
a) Check				
Steel sheet	4	pcs.	6	24
Reinforced concrete	2	cu.m	120	240

Table F-2-3. Volume and Hauling Distance for Land Leveling

	Type	Volume (cu.m)	Distance (m)
I. 	$\theta = 0°$	$-\frac{h\ell b}{4}$	$\frac{2}{3}b$
II. 	$\tan\theta < \frac{l}{k}$ $(0 \leq \theta < \tan^{-1}\frac{l}{k})$	$\frac{Ikb^3(k^2\sin^2\theta + 3\cos^2\theta)}{24\cos\theta}$	$\frac{2b\cos\theta\sqrt{k^4\sin^2\theta + \cos^2\theta}}{k\sin^2\theta + 3\cos^2\theta}$
III. 	$\tan\theta = \frac{l}{k}$ $(\theta = \tan^{-1}\frac{l}{k})$	$\frac{h\ell b}{6}$	$\frac{1}{2}\sqrt{\ell^2 + b^2}$
IV. 	$\tan\theta > \frac{l}{k}$ $90° \geq \theta > \tan^{-1}\frac{l}{k}$	$\frac{Ib^3(3k^2\sin^2\theta + \cos^2\theta)}{24\sin\theta}$	$\frac{2kb\sin\theta\sqrt{k^4\sin^2\theta + \cos^2\theta}}{3k^2\sin^2\theta + \cos^2\theta}$
V. 	$\theta = 90°$	$\frac{h\ell b}{4}$	$\frac{2}{3}\ell$

Where: $k = \frac{\ell}{b}$ $I = \tan\theta = \frac{2h}{b\cos\theta + \ell\sin\theta}$

i: Ground slope (degree) h: max. depth of excavation in a plot

Fig. F-2-19 Volume Coefficient and Hauling Distance for Land Leveling

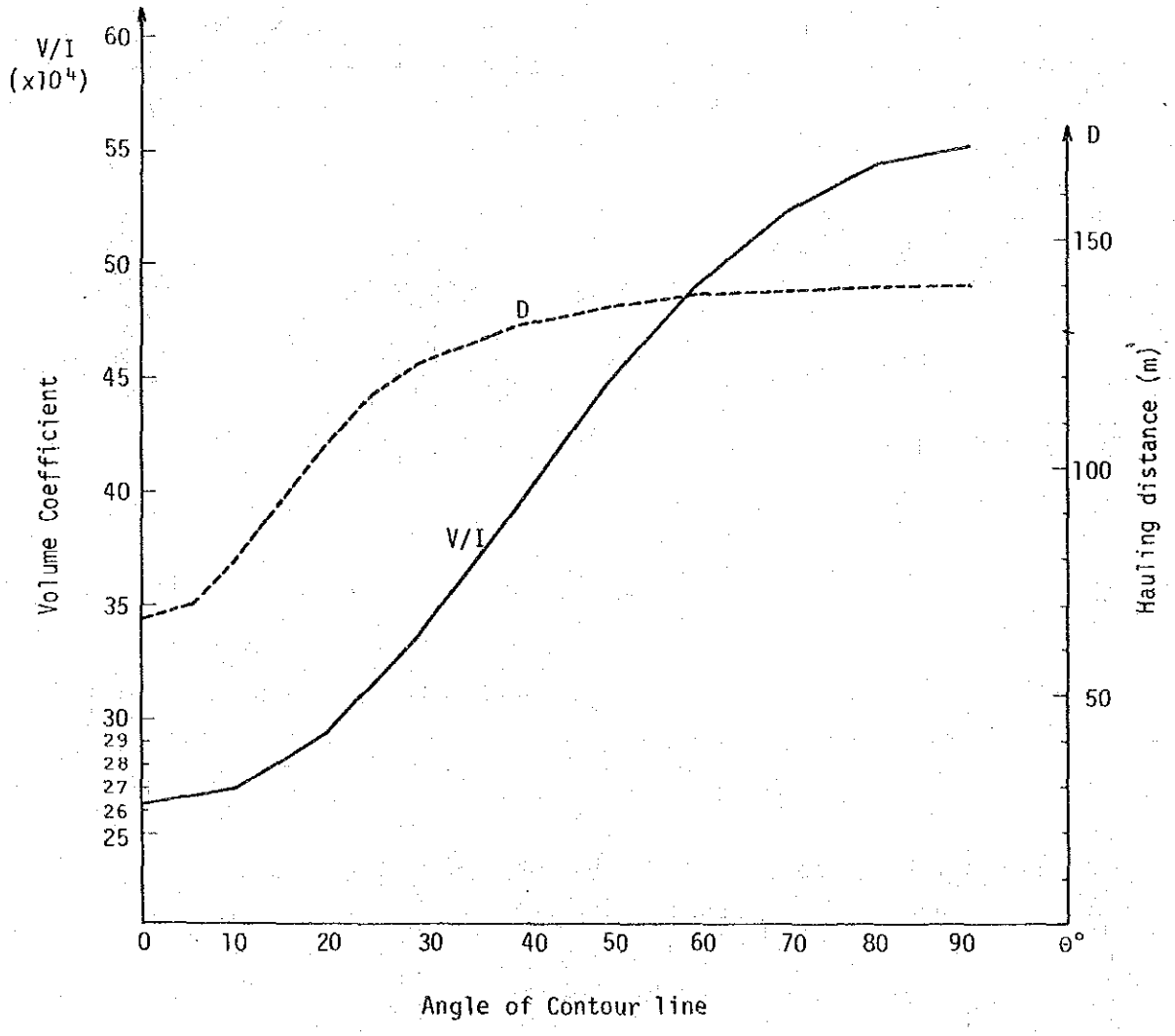


Table F-2-4 Volume of Land Leveling in the Sample Area

Classification of slope, I (%)	Classified area (sq.m)	volume of land leveling (cu.m)	volume of land-leveling per sq.m (cu.m)	volume of land-leveling per feddan (cu.m)
$I \geqq 0.5$	203,280	27,601	0.13578	570.3
$0.5 > I \geqq 0.3$	273,000	15,470	0.05667	238.0
$0.3 > I \geqq 0.1$	252,000	7,600	0.03016	126.7

Table F-2-5 Volume of Land leveling in the Project Area

classification of slope, I (%)	classified area (ha)	volume of land-leveling (10^3cu.m)	volume of land-leveling per ha (cu.m)
$I \geqq 0.5$	616.4	836.9	1,357.8
$0.5 > I \geqq 0.3$	2,036.8	1,154.3	566.7
$0.3 > I \geqq 0.1$	13,962.8	4,211.2	301.6
$0.1 > I$	10,184.0	0	0
Total	26,800.0	6,202.4	231.4 (= 97.2 cum/fed)

Table F-2-6 Earth Work for Farm Road, Irrigation & Drainage Canal
(per 42 ha = 100 feddan)

Item	Construction Cost per Section: sectional length (m)	volume of excavation per meter (cu.m)	volume of excavation (cu.m)	excavation cost (L.E) (1)	volume of embankment per meter (cu.m)	volume of embankment (cu,m)	embankment cost (L.E) (2)	construction cost (L.E)	nos of section	construction cost (L.E)
1. Tert. Canal	100	0.6	60	39	3.6	360	540	579	10	5,790
2. Farm Ditch	210	2.2	462	300	1.6	336	504	804	20	16,080
3. F. Drain (A) (3)	85 x 10	1.1	(935)	(608)	0.3	(255)	(383)	(991)	20	(19,820)
4. Tert. Drain	100	5.0	500	325	0.7	70	105	430	10	4,300
Total	-	-	1,022	664	-	766	1,149	1,813	-	26,170

Note (1) : unit price for excavation is L.E. 0.65/m^3
(2) : unit price for embankment is L.E. 1.50/m^3
(3) : cost of field drain (type A) construction would be owned by those land holders.

	Wooden form	20	sq.m	10	200
	Gravel	0.8	cu.m	10	8
b)	Turn-out				
	Asbestos pipe	72	m	8.4	604.8
	Pipe laying	72	m	2.1	151.2
			Total		1,228.0

iii) Summary of construction cost

		Unit Cost (L.E.)		Amount (L.E.)
		Per ha	Per Feddan	26,800 ha
a)	Land levelling	161.98	68.04	4,341,064
b)	Earth works	623.10	261.70	16,699,080
c)	Small structure	29.24	12.28	783,632
	Total	814.32	342.02	21,823,776

F-3. IRRIGATION METHOD OF ON-FARM LEVEL

Irrigation is the artificial application of water to soil. One purpose of irrigation is supplying moisture necessary for plant growth. Irrigation can be controlled to ensure that plants have sufficient soil moisture for optimum growth during germination and development to maturity.

Water for the maintenance of plant growth may be applied in one of three ways: subirrigation; surface irrigation; overhead (or sprinkler) irrigation.

F-3-1. Subirrigation

With subirrigation, water is applied below the ground surface rather than on it. As moisture reaches the plant roots through capillary movement, an adequate supply of good-quality water must be available throughout the growing season. The upward movement of high-saline water tends to accumulate salts in surface soil; these salts hinder crop production.

The use of subirrigation as described above will always be limited because there are few places where all of these conditions exist jointly. The Project Area has a big problem of salt accumulation. This subirrigation is not permitted.

F-3-2. Surface Irrigation

Surface irrigation includes the general methods of flood, furrow, and corrugation irrigation. There are three basic methods of flood irrigation: border strip; basin; contour border, with flooding and border ditch.

In flood irrigation, the water is permitted to cover the surface of the soil in a continuous sheet. In furrow irrigation, water is applied in the furrows between rows of plants. As water runs down the row, part of it filters into the soil to refill the soil moisture reservoir. Furrow irrigation is characterized by relatively high annual labor costs for maintenance and operation.

In corrugation irrigation, water is applied in small furrows running down the slope from a head ditch. Heavy soils, when water floods the surface, tend to seal over and bake, thus limiting both plant growth and water infiltration. Annual labor costs for corrugation irrigation are relatively high.

F-3-3. Sprinkler Irrigation

Sprinkler irrigation systems, water is delivered through a mainline from the source of supply to the lateral lines. It is discharged above the crop or soil surface through sprinkler heads on riser pipes attached to the laterals. Each sprinkler head applies water to a circular area, the diameter of which is governed by the nozzle size and pressure. For uniform coverage, the patterns are overlapped from 35% to 70%, depending on sprinkler type and wind conditions.

Sprinkler irrigation systems have many advantages. Erosion can be controlled, and efficient irrigation is possible on land too steep for other methods. Uniform application is possible on all kinds of soil. On sandy soils that have high intake rates, or nonuniform soils with variable-intake rates, sprinkler irrigation distributes water more uniformly than any other method. Water can be saved, more land can be irrigated with a designated amount of water, and drainage problems can be reduced.

The amount of water applied can be controlled to meet the needs of the crop. Light applications can be made to seedlings or young plants, or for fertilizer and herbicide applications. Land preparation is not required. Soils too shallow to be leveled properly for other methods can be irrigated safely with sprinklers. On deeper soils, the cost of land leveling can be eliminated or greatly reduced.

More land is available for cropping. Field ditches, levees, and borders are not needed. Sprinkler irrigation also decreases the weed problem, reduces wear on farm machinery, and simplifies tillage. Surface runoff of irrigation water is eliminated. Labor costs are reduced

notably on soil having a high water-intake rate and on land that is steep or rolling. Irrigation can be fitted into other farm operations as incidental work that is done once or twice a day. With solid or permanent systems, labor is negligible, and they lend themselves to automation for all water-application purposes.

F-3-4. Comparison of Irrigation Methods

According to the cost estimate of irrigation methods mentioned in the section F-2-5 of this chapter, the project cost of the sprinkler irrigation system is the highest compare with of other irrigation systems. The operation and maintenance cost is not a limitation factor to choose an irrigation system to the Area because the laborer charge is cheaper in and around the Area at present. Other factors such as topographic conditions, climate and etc. have not limited to introduce the sprinkler irrigation system to the Area.

When the laborer charge will become higher in future, the sprinkler irrigation system will be proposed to the Area. Therefore, the surface irrigation system with well water management of on-farm level is recommendable to the Area.

Annex G

RURAL DEVELOPMENT

CONTENTS

Annex G

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G-1. PRESENT LIVING ENVIRONMENT IN RURAL AREAS

G-1-1. Outline of Study

The Study Team conducted, in addition to collection of basic data, field survey to formulate a rural development plan for the Project Area. Furthermore, the Team exchanged views and opinions as much as possible with the Governmental officials of A.R.E. in charge of rural development, and deepened its understanding on the basic policy and methodology, etc., of the Government. Studies conducted by the Team during the field survey period were roughly itemized as follows;

- ° Village communities and their operation;
- ° Location, function, structure and operation/maintenance of roads;
- ° Extension and utilization of domestic water;
- ° Disposal of sewage drained from villages;
- ° Electrification of villages;
- ° Function and operation of public facilities; and,
- ° Agro-industries.

Study-results of the above-mentioned will be briefly described below:

G-1-2. Morphology and Operation/Management of Villages

About 95% of the Project Area is occupied by wastelands or the flooding area of Manzala lake. Barh Saft drain runs along the western boundary of the Project Area. Around this drain existing farm lands of 1,500 ha in total are cultivated by individual farmers. Villages lie scattered in the farm lands. None of farm lands along the drain has been officially registered by the Government.

On the contrary, the Government has promoted, under its farm land development plan, land reclamation and settlement of farmers in the Project Area and its vicinity since more than 10 years ago. Therefore,

an appropriate scale of villages, road networks, public facilities, etc., have been functionally located in these areas.

In land reclamation, an intensive on-farm development has been introduced, resulting in farm lands fully equipped with irrigation and drainage canals. Farmers live at collective housing villages. One farm village consists of 300 to 400 farm households as a whole. The relation between farm lands and farm households in a small village, service village and central village is roughly tabulated below;

Village	Small village	Service village	Central village
Farm land	Approx. 3,000 feddan	12,000 feddan	48,000 feddan
No. of Farm households	Approx. 600	2,400	9,600

Note: Four to five small villages are under the jurisdiction of one service village office whereas four to five service villages under jurisdiction of one central village office.

G-1-3. Roads and Transportation

A national road runs through the western edge of the Project Area from the north to south. This national road is the only route connecting the Project Area and Cairo via Zagazig. From the national road feeder roads branch off to villages. Feeder roads have been, as a rule, located along irrigation and drainage canals, and utilized for dual purpose of operation and maintenance of these canals and for transportation of agricultural input and output. Structurally the national road is paved with asphalt, and has two lanes for vehicle transportation whereas most feeder roads are not paved at all, and have a surface width of four to six meters which is slightly wider than an one lane road.

It cannot be said that these roads are well maintained. Specially, the national road in and around San El Hagar has been severely damaged, resulting in difficulty of transportation by heavy vehicle. Buses and trucks are the major means of transportation between the Project Area and the major cities. Frequent national bus service is available between

Cairo to Zagazig city or between Cairo and Faqus city. However, between Faqus city and San El Hagar the round trip bus service is available only seven times a day. Transportation from the national road to villages is privately made by farmers etc. Animal carts (with donkey) are one of the major means of transportation specially in the rural areas.

Mainly heavy trailers and trucks are operated for transportation of agricultural output and daily necessities whereas transportation of them on farmers's level is made by cart pulled by donkey and horse.

Both Ramses drain passing through the Project Area and Bahr Bagar drain forming the southern boundary of the Project Area are utilized for navigation from the Project Area inclusive of neighboring areas to the major cities located around Manzala lake.

G-1-4. Water Supply

There is no drinking water supply system in the Project Area and its vicinity as well. Groundwater of a well along the national road is the main water source for drinking water supply to the Project Area. A heavy tractor equipped with a water tank are operated for distribution of drinking water from this well to each village. Taking into consideration the limited water source as well as the poor transportation capacity by heavy tractor, drinking water supply at present is estimated at two to three liters/day/person.

A water supply project is under going by the Ministry of Housing in order to convey drinking water from Faqus city to San El Hagar via Hosainia setting the target year of the project implementation in 1981. However, the Project Area is out of the service area of this water supply project. Thus, a drinking water supply plan shall be formulated for the Project Area separately from the said water supply project.

G-1-5. Sewage System

There is no modernized clarification facility of sewerage drained from farm houses and public facilities. Sewage from houses is stored

in house inlets for a while, and then discharged to the ground, and is infiltrated and clarified by soils. This method of simple and easy clarification seems sufficient to prevent inhabitants from public pollution under the meteorological conditions of the Project Area with dry air.

G-1-6. Electric Power Supply

No settlement project has been carried out in the Project Area. Therefore, the Project Area is not equipped with power supply and distribution facilities. Electric power has been supplied to the neighboring areas from Aswan dam through 66 KV transmission lines. People are graced with the benefit of electric power supply with a few exception.

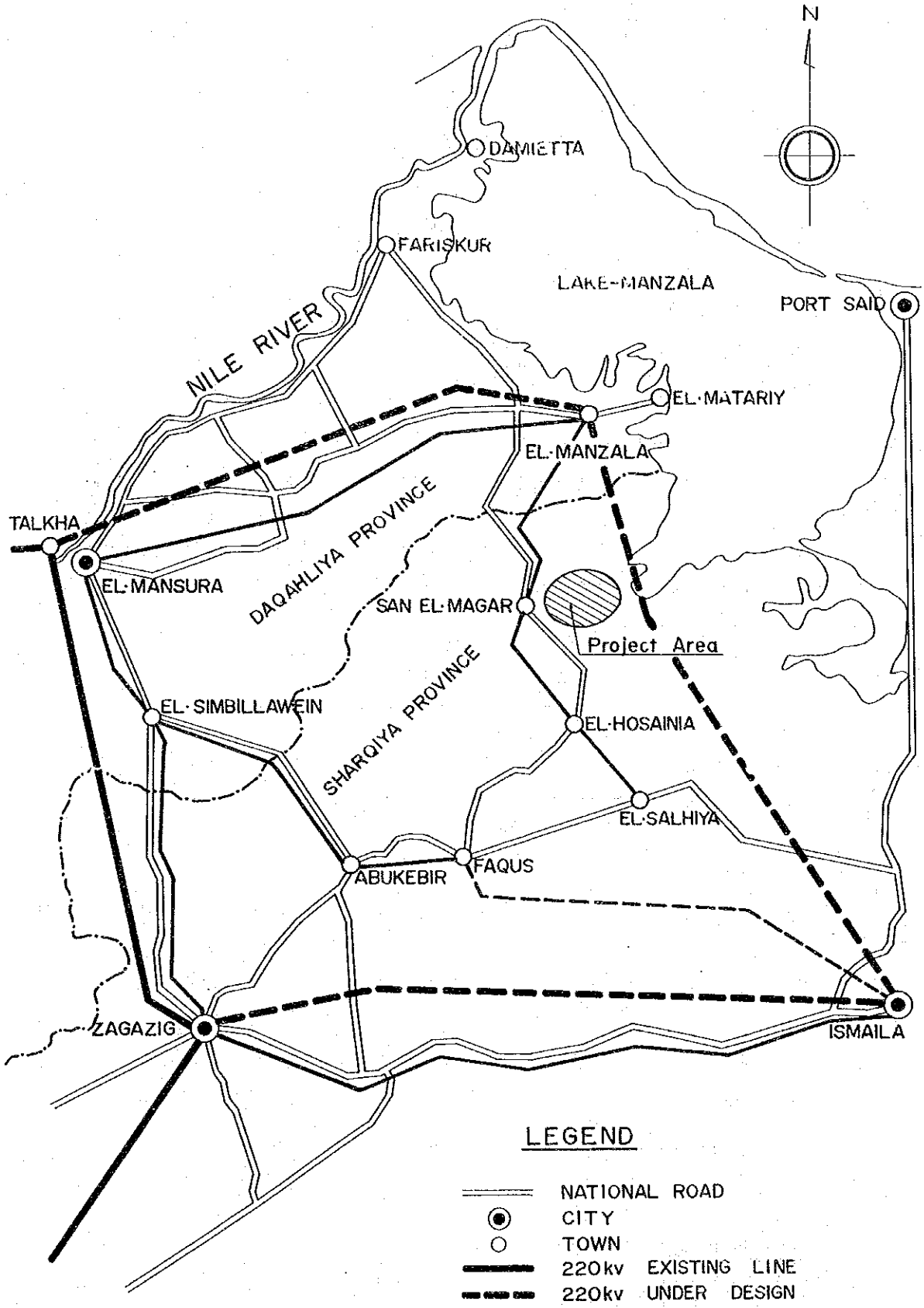
Planning and implementation of electrification works in A.R.E. have been made by the three Governmental organizations of the Egypt Electrification Authority (EEA), the Rural Electrification Authority (REA) and the Ministry of Electrication (MOE). The former two are in charge of formulation of electrification projects whereas the latters is in charge of implementation of such projects.

The Project Area and neighboring areas fall in the Low Egypt district under the national electrification program. The national electrification program has set forth the major features of electrification in the areas as follows;

- Aswan - Cairo 500 (KV)
- Cairo - Zagazig 220 (KV)
- Zagazig-San El Hagar - Hosainia 60 (KV)
- Hosainia sub-station 11 (KV)

The electric power will be supplied to houses and small to medium scaled factories from the 11 KV sub-station through a transformer, and the voltage at each house will be 220 V with 50 cycles. The route and capacity of the existing transmission lines around the Project Area are shown in Fig. G-1-1.

Fig. G-1-1 ILLUSTRATION OF ELECTRIC LINES



G-1-7. Public Facilities (Education and Medical Treatment, etc.)

1) Education

The education system of A.R.E. is roughly shown below;

Schools	Educational period	Special Course	Remarks
Primary school	6 years		
Preparatory school	3 years	English	
Secondary school	3 years	English and Others	
University	4 to 7 years		

Note: After graduating from a secondary school, some graduates proceed to a training college.

The cores of education in and around the Project Area are located in San El Hagar and Hosainia. Education is carried on at 14 primary schools, 5 preparatory schools, 2 religious schools and one secondary school. The number of pupiles or students is about 2,000 at primary schools, about 600 at preparatory schools and 300 to 400 at high schools.

Primary school education is made in two shifts since the educational facilities are not enough to accommodate the said number of pupils.

2) Medical Facilities

Nine medical treatment units are located around San El Hagar, and are responsible for health check and medical treatment of inhabitants. The following diseases are predominantly found in the area.

- Bilharziasis
- Dysentery
- Malaria
- Flu (Influenza)
- High blood pressure
- Heart attack

- Diabetes
- Fever
- Tuberculosis
- Rabies
- Skin Disease
- Leprosy
- Venereal disease
- Cancer

3) Communication facilities

No one can stay that telegraphic, telephone and postal systems in the Project Area and its vicinity are satisfactory. A telephone service system is available between Cairo and San El Hagar, however, this system is unfavorably operated because of the shortage of telephone circuits, deterioratation of facilities and poor operation and maintenance, etc.

In general, it takes two days or more for postal matters to reach San El Hagar from Cairo, and two hours or more for connecting these two cities by telephone.

G-1-8. Agro-industries

As for agro-industries, rice mill for farmers' self-consumption and a small repair shop for vehicles and farm machinery, etc., are operated in villages.

For extension of livestock husbandry, the Government of A.R.E. has operated a MOLR collective beef cattle breeding center near San El Hagar. Presently about 2,000 heads of cattle are raised in the center.

G-2. IMPROVEMENT PLAN OF FARM VILLAGES

G-2-1. Outline of Improvement Plan

An improvement plan of farm villages inclusive of a settlement plan has been formulated, on the basis of field survey, to cope with the land reclamation plan, irrigation & drainage plan, agricultural facilities plan and farm management plan proposed for the Project. In formulating the improvement plan, studies were focused on the following;

- ° Farm village plan;
- ° Road plan;
- ° Drinking water supply plan;
- ° Sewage treatment plan;
- ° Village facilities plan;
- ° Electric power supply plan;

In planning a road networks for the Project Area, attentions were paid to make the most use of operation and maintenance roads to be constructed along irrigation and drainage canals. Taking into consideration difficulty in groundwater use for drinking water supply, it has been planned that El Salam canal water will be supplied to village houses for this purpose. Village facilities to be materialized under this Project have been determined through various discussions made between the Governmental officials of A.R.E. and the Team members.

G-2-2. Farm Village Plan

The Team exchanged views and opinions with the Governmental officials of A.R.E. in charge of rural development to grasp firmly the concept of farm village improvement or rural development in this country, and based on this concept so obtained, the essential features of village improvement plan has been determined. As seen on the schematic map shown in Drawing No. GL-1, the rural community of the Project Area will consist of small villages, service villages and one central village as follows;

1) Small Villages

A small village will be an aggregate of 300 to 400 farm households, and a unit to constitute the rural community of the Project Area. The location of farm houses and branch offices of the Governmental organizations is shown in Drawing No.GL-2.

2) Service Villages

A service village will be responsible to control four to five small villages. A small village topographically situated in the center of four to five villages will function as the service village among them. Drawing No.GL-3 indicates the location of farm houses, branch offices of the Governmental organizations and the other public facilities within a service village.

3) Central Village

It has been planned to establish one central village in the entire Project Area. The central village will function to control seven service villages. A service village topographically situated in the center of the Project Area will be selected to be the central village. Drawing No. GL-4 shows various facilities which are considered necessary for operation of the central village.

G-2-3. Road Plan

Small villages will be located along irrigation canals as much as possible so that roads to be constructed along the canals will be used for dual purpose of village roads and operation and maintenance roads for canals. It has been also taken into consideration that the water management will become easy if small villages are located along irrigation canals. The length and structure, etc., of roads are detailed in Annex E, E-2-3. and the alignment of them is shown in General Planning Map.

G-2-4. Drinking Water Supply Plan

1) Water Source

As a result of discussions made between the Governmental officials

of A.R.E. and the Team, El Salam canal water will be utilized as the water source for drinking water supply to villages in the Project Area.

2) Benefited Population

About 13,000 households are estimated to reside permanently in the Project Area in future. A household consisting of six persons on an average, the population in the Project Area will be 78,000 persons accordingly. In general, a drinking water supply plan shall be formulated in consideration of a future increase of population. In this plan, the benefited population has been computed at 88,000 persons based on the following formula;

$$Pw = (1 + a)^{n} Po$$

Where, Pw: Population in the year 2000
Po: Population in the year 1995
A : Increase rate of population, 2.5%
n : Passage of time, 5 years

3) Water Supply for Cattle Breeding

The establishment of three livestock centers has been planned in the Project Area in order to breed beef cattle. Therefore, water supply to these livestock centers should be taken into consideration in planning. The water requirement for cattle breeding has been computed on the assumption that about 55,000 cattle will be raised in future.

4) Design Water Requirement

(i) Unit Water Requirement

It is generally accepted that the designed water requirement for rural development projects ranges in 100 to 200 liters/day/person. In this plan the volume has been determined at 150 liters/day/person.

The water requirement has been determined at 60 liter/day/head for cattle breeding.

(ii) Averaged daily water requirement

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

150 liters x 88,000 persons	=	13,200 cu.m/day
60 liters x 55,000 heads	=	3,300 cu.m/day
Total		16,500 cu.m/day

(16,500 cu.m/day/86,400 ≒ 0.2 cu.m/sec)

5) Water Supply Facilities

(i) Intake and water conveyance facilities

The irrigation canal M2 will be utilized for diversion and conveyance of EL Salam canal water in this drinking water supply plan to villages.

(ii) Water clarification facilities

One unit of water clarification facilities will be installed near the central village to meet the daily maximum water requirement of 20,000 cu.m/day. Pumping facilities for water distribution will be also installed in the clarification site (See Drawing No. GL-5).

(iii) Water conveyance facilities

The clarification facilities will be connected, by pipeline, to 27 service villages, 6 service villages and one central village in the Project Area as well as to three livestock centers to be located at the southern most of the Project Area. The water supply pipes will be laid along trunk roads and village roads. Booster pumps will be installed where necessary to keep the water pressure in pipe at an appropriate value. The trunk pipeline will be about 28 km long in total whereas branch pipeline about 100 km long. Ductile pipes will be used for pipelines. The diameter of pipes for trunk lines will be 450 mm whereas that of pipes for branch lines will range in 100 to 200 mm.

G-2-5. Sewage Treatment

Since 37 small villages will be laid scattered within the Project Area as seen in the General Planning Map, household waste water and night soil treatment facilities have been planned for each of these small villages. In this improvement plan of farm villages each farm house will be provided with a flush toilet. Filth will be flushed through pipelines to a public filth treating tank. Household waste water will be treated as same as filth. Facilities to treat garbage will be installed separately from the household waste water and night soil treatment facilities.

1) Waste Treatment Facilities

Filth and sanitary sewage from 50 to 100 farm houses will be first stored in a public soil tank for a while, and sent by vacum tanker to a plain treatment facilities for the secondary treatment. The plain treatment method means the septic tank method to purify filth perfectly in a maturation pond. Sanitary sewerage will infiltrate into soils at the first soil tank, and be naturally decontaminated through this process.

2) Treatment of Garbage

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

G-2-6. Village Facilities Plan

The small villages, service villages and central village will be equipped with necessary village facilities so that each village will be able to function as expected.

1) Small Village

Farm households of 300 to 400 will immigrate into a small village. In order to give technical guidance to settlers in farm management, an agricultural administration office will be established in each small village. Accomodation for the office staff and technical officials will be also required, accordingly.

2) Service Village

Service villages shall be responsible for the administrative aspect of the surrounding small villages (four to five villages). Therefore, an administration office will be required for the service villages in addition to the agricultural administration office mentioned previously. Furthermore, educational facilities such as a nursery school, primary school and preparatory school will be indispensable in service villages. A medical service unit to keep health of villagers and administer first aid, a market and store for daily necessities and miscellaneous goods, workshop to repair simple farm machines and vehicle, etc., and rice mill to process rice for self-consumption of farmers will be installed in service villages in addition to the facilities mentioned before.

3) Central Village

The central village will be equipped with the similar facilities to these of service villages. However, the scale of facilities will be larger than these of service villages. For instance, a hospital will be established in place of a medical service unit. As for educational facilities, a secondary school will be maintained village for higher education in the central. The main post office will be operated in the central village to control post offices to be located in service villages. Furthermore, facilities for veterinary service and multiplication of domestic animals will be installed here.

G-2-7. Electric Power Supply Plan

The existing high voltage line of 66 KW running at the western most of the Project Area will be the power source for villages, pumping facilities for irrigation & drainage and drinking water supply as well as water clarification, etc. A high voltage transmission line will be constructed along Saft drain from the existing line to the sub-station planned at the crossing point of the said drain and the trunk road. The voltage will be lowered from 66 KW to 11 KW at the sub-station. From the sub-station, 11 KW line will be extended to each village, pumping stations, clarification plant, etc. Villages and various facilities which will require power supply will be provided with a transform equipment in order to obtain an appropriate voltage.

G-3. DEVELOPMENT PLAN OF AGRICULTURAL FACILITIES

G-3-1. Outline of the Plan

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

- Agricultural extension sercices;
- Marketing;
- Water management;
- Education of farmers; and,
- Operation and maintenance of livestock centers.

In planning these facilities, the scale and function of a village to which such facilities will be introduced should be taken into consideration. The type and location of agricultural facilities in each village are shown in Drawing No. GL-2 to GL-4.

1) Facilities for Agricultural Extension Services

An agricultural administration office will be established for each of small villages, service villages and the central village, and staff of the Governmental organizations will be permanently stationed at the office to make guidance to farmers. Apart from this office, a model farm will be necessary for each service village in order to carry out practical guidance in fields as well as demonstration to farmers. For this purpose, farm fields of 4 to 5 ha in total will be leased from few farmers who cultivate his field enthusiastically.

2) Facilities for Marketing

It has been planned to establish marketing facilities to handle daily necessities in small villages, service villages and the central village. A small store will be put side by side with the agricultural administration office in each small village. A market consisting of several stores will be open in each of service villages and the central

village.

The provincial administration office will be responsible to collect the agricultural outputs in the Project Area such as rice, cotton and wheat, etc., at service villages or at the central village, and to distribute them to the major cities outside the Project Area.

3) Facilities for Water Management

The Ministry of Irrigation is in charge of operation and maintenance of major irrigation and drainage facilities. The main office for such facilities in Sharqiya province is located at Zagazig city, and controls the activities of each project office within the province. The operation and maintenance office whose jurisdiction covers the Project Area and its vicinity is located at Hosainia. Therefore, this Hosainia office will be responsible for operation and maintenance of major irrigation and drainage facilities in the Project Area after the implementation of the Project, however, the present office is very poor in the aspects of office space and staffing. Under the situations, it is recommendable to establish one field office in each irrigation block, that is, totally three field offices in the Project Area, in addition to the strengthening of the existing office.

Specially it has been planned that a part of the operation and maintenance of terminal facilities will be entrusted to farmers' organizations. The field office will, therefore, play an important role to make coordination among such farmers' organizations.

4) Facilities for Education of Farmers

The secondary school to be maintained in the central village will be utilized for preliminary education of farmers though its major function is the education of students who wish to enter universities and upgrading the educational level of inhabitants. It is naturally considered that such preliminary education to be rendered in the secondary school might overlap the guidance to be made in extension services.

5) Facilities for Operation and Maintenance of Livestock Centers

The agricultural administration office to be established near the livestock centers will be given the function to operate and maintain livestock centers. The organization chart of it is shown in Annex D. In addition to the said office, an office will be established in each livestock center for management by laborers themselves who engage in cattle breeding, etc., in the center.

G-4. MARKETING

G-4-1. General

The Egyptian government is, both directly and indirectly, controlling the marketing of Agricultural products as well as agricultural inputs by designating cropping patterns to farmers, by controlling prices of agricultural inputs/outputs, by participating in procurement and process of agricultural products, and by distributing and providing selected agricultural inputs and institutional services.

From marketing viewpoints, agricultural products can be divided into three groups, namely cotton and sugarcane are marketed only through the public channel, such crops for export-oriented as well as import substitution as wheat, rice, beans, lentils and groundnuts are marketed both by the public and the private channels, other crops like vegetables, maize, fruits, dairy products, etc., are not under the government control, but public agencies participate partly in their marketing and processing.

G-4-2. Market Prospects

According to the proposed cropping pattern, main agricultural products are rice, cotton, wheat, maize, meat and fodder crops, of which berseem and soiling corn are considered intermediate crops for meat production.

Among the project products, while cotton and rice are export crops, wheat, maize and meat are import products. Table G-4-1 shows situation of demand and supply for rice, wheat, maize and meat.

1) Cotton

Since 1973, export amount of raw cotton has gradually decreased from about 898,000 tons to 457,000 tons in 1979, due to increasing demand for domestic use. In the world market, the Egyptian cotton is famous for its good quality, hence about 20,000 tons of raw cotton which will be produced in this project, is marketable to both the world market and the domestic market.

2) Rice

As shown in Table G-4-1, export amount of milled rice has recently declined from 191,000 tons in 1976 and 1977 to 95,000 tons in 1979, and average annual amount is 142,000 tons over the recent five years.

Considering the present and future world-wide food crisis, rice export may still have big potentials. The proposed project would bring the full production of paddy of about 49,000 tons, namely 29,400 tons of milled rice, which could be still marketable to the world market.

3) Wheat

Egypt has imported a considerable amount of wheat and wheat flour, amounting to three million tons to four million tons in wheat equivalent, therefore, it is very important to increase domestic production of wheat from viewpoints of foreign exchange savings.

The proposed project would produce about 30,000 tons of wheat, which will contribute somewhat to foreign exchange savings.

4) Maize

Maize is also an import crop, and the annual import amount ranges about 400,000 tons to 700,000 tons, averaging 500,000 tons over the recent five years. About 19,000 tons of maize which would be produced under this project, would substitute a part of the present import amount.

5) Meat

Similar to wheat and maize, meat is an import product, and the import amount has been increasing from 36,000 tons in 1976 to 56,000 tons in 1978. Under the proposed project, about 8,000 tons of beef production would be expected, by which a part of the present amount of meat import would be also substituted.

G-4-3. Marketing

Fundamentally, marketing of agricultural products except beef and maize should be managed by the proposed RUZGs (Rotational Unit Zone Group) which will be established at small village level.

1) Cotton

Marketing of cotton is exclusively handled by the public sector, hence all cotton production should be collected and marketed by the RUZGs.

2) Rice and Wheat

These two crops are quota crops, and these quota should be collected and marketed under the management of the RUZGs. Farmers can dispose their exceeded amount of products over the quotas at the private market in which middlemen take care for marketing of these two crops.

3) Maize

Maize is non-controlled crop by the public sector, therefore, all products except farmers' own consumption should be handled at the private market.

4) Meat

The proposed livestock centers are only the organization to be responsible for marketing of meat. A part of their meat production will be consumed within the project area, and the rest will be transported to big markets like Cairo, Zagazig, etc.

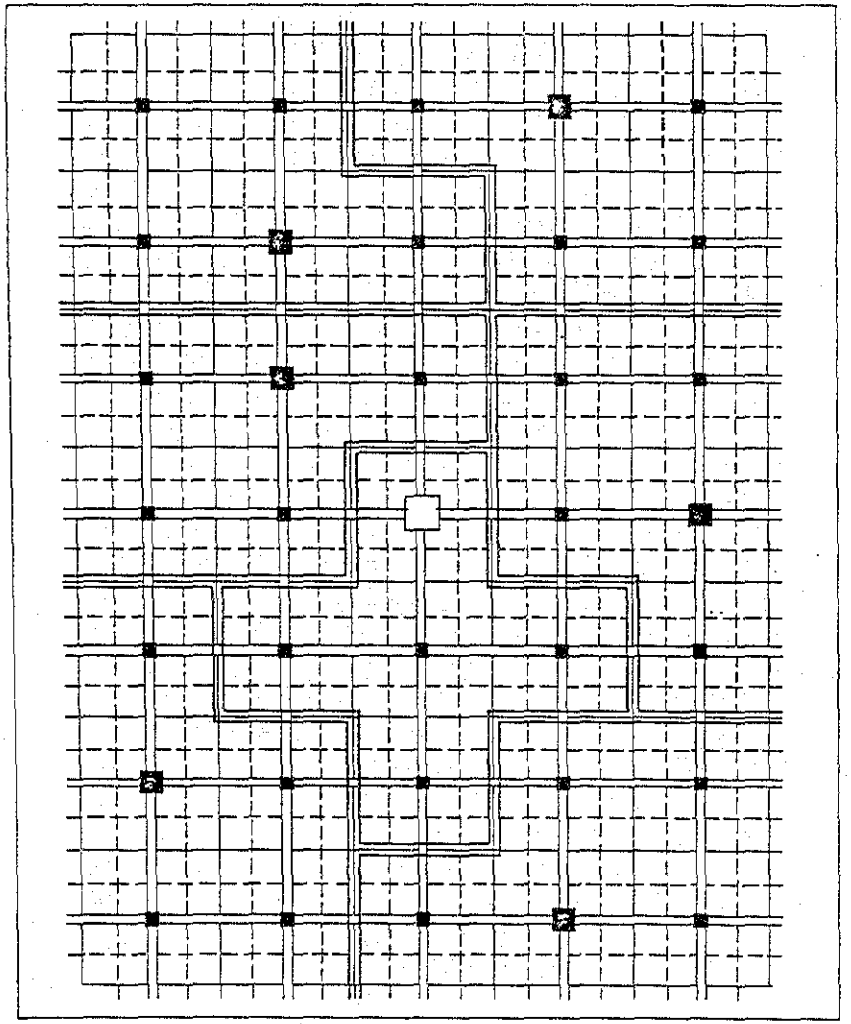
Table G-4-1 Domestic Consumption of Agricultural Products

(Unit: 1,000 tons)

	1975	1976	1977	1978	1979	Average
Population (in thousand)	37,011	37,866	38,845	39,882	40,839 1/	38,889
Milled Rice						
Domestic Production	1,454	1,380	1,363	1,410	1,506	1,423
Export	100	191	191	133	95	142
Domestic Consumption	1,354	1,189	1,172	1,277	1,411	1,281
Per Capita Consumption 2/	36.6	31.4	30.2	32.0	34.6	32.9
Wheat						
Domestic Production	2,033	1,960	1,697	1,933	1,856	1,896
Import	3,279	2,863	3,188	4,201	3,132	3,333
Domestic Consumption	5,312	4,823	4,885	6,134	4,988	5,229
Per Capita Consumption 2/	143.5	127.4	125.8	153.8	122.1	134.5
Maize						
Domestic Production	2,781	3,047	2,724	3,117	2,938	2,921
Import	418	459	591	730	494	538
Domestic Consumption	3,199	3,506	3,315	3,847	3,432	3,459
Per Capita Consumption 2/	86.4	92.6	85.3	96.5	84.0	88.9
Meat						
Domestic Production	n.a.	675	688	695	n.a.	686
Import	-	36	47	56	-	46
Domestic Consumption	-	711	735	751	-	732
Per Capita Consumption 2/	-	18.8	18.9	18.8	-	18.8

Note: 1/ Provisional
2/ Kg per capita

Drawings



Central Village

Service Village

Small Village

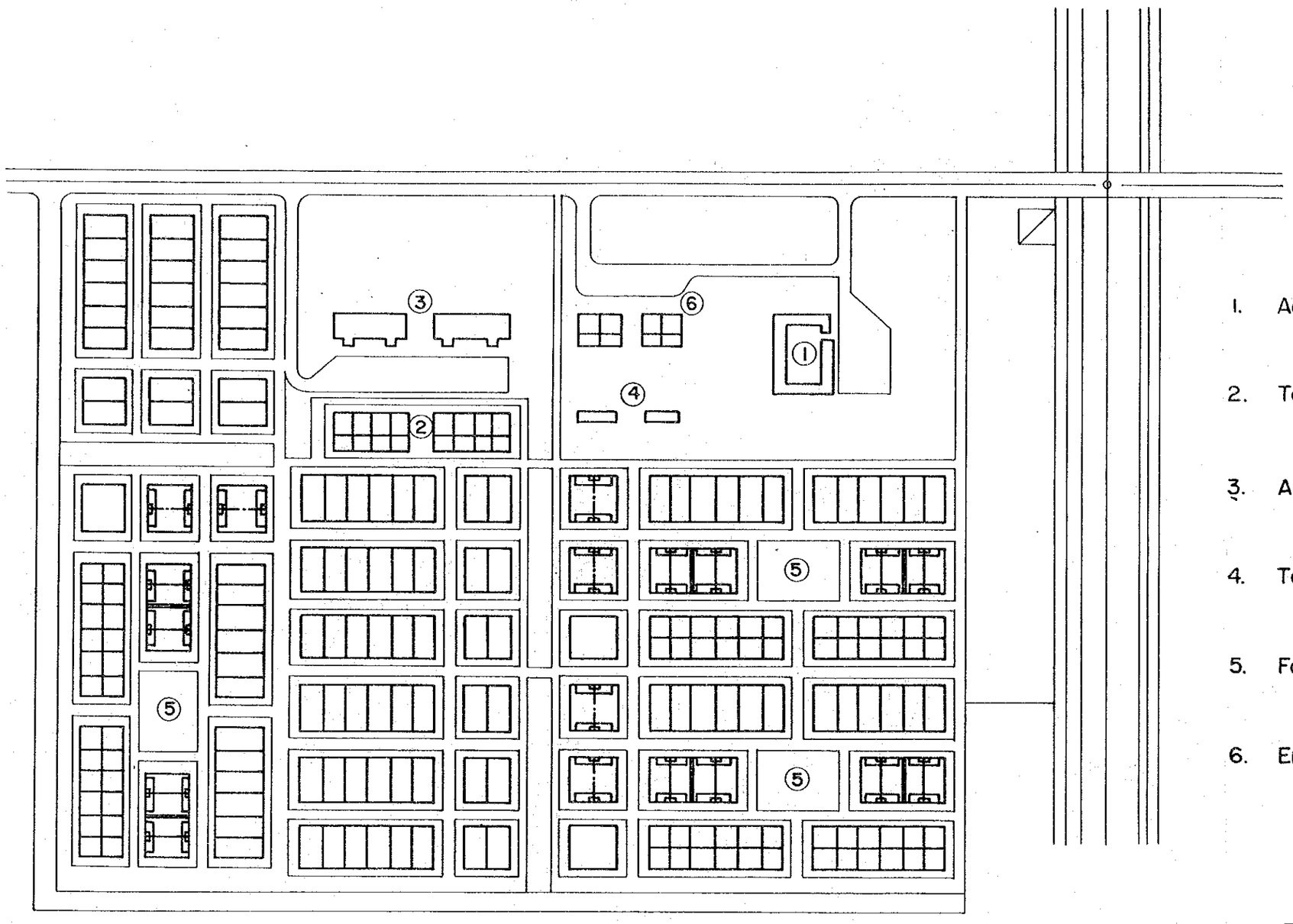
Territories of Service Village

Feeder Road

Sub-Feeder Road

Farm Road

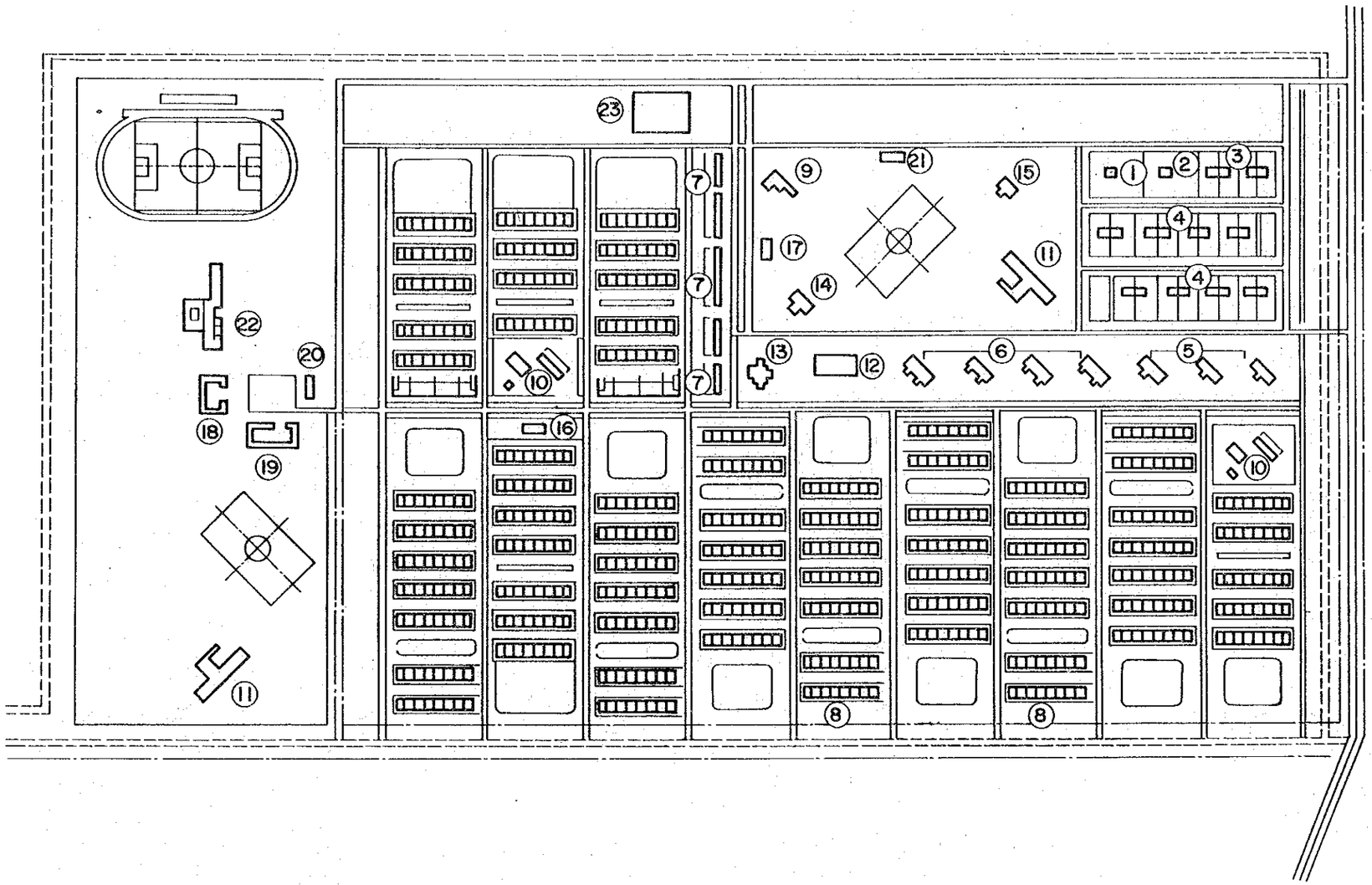
THE ARAB REPUBLIC OF EGYPT MINISTRY OF IRRIGATION	
THE SOUTH HOSAINIA VALLEY AGRICULTURAL DEVELOPMENT PROJECT	
Schematic Map of Small, Service and Central Village	
DATE	D.W.G NO. GL-1
JAPAN INTERNATIONAL COOPERATION AGENCY	



1. Agri Administration Office
2. Technical Labour's House
3. Apartment
4. Technical Labour's House
5. Farmer's House
6. Employer's House

Scale 1 : 2,000

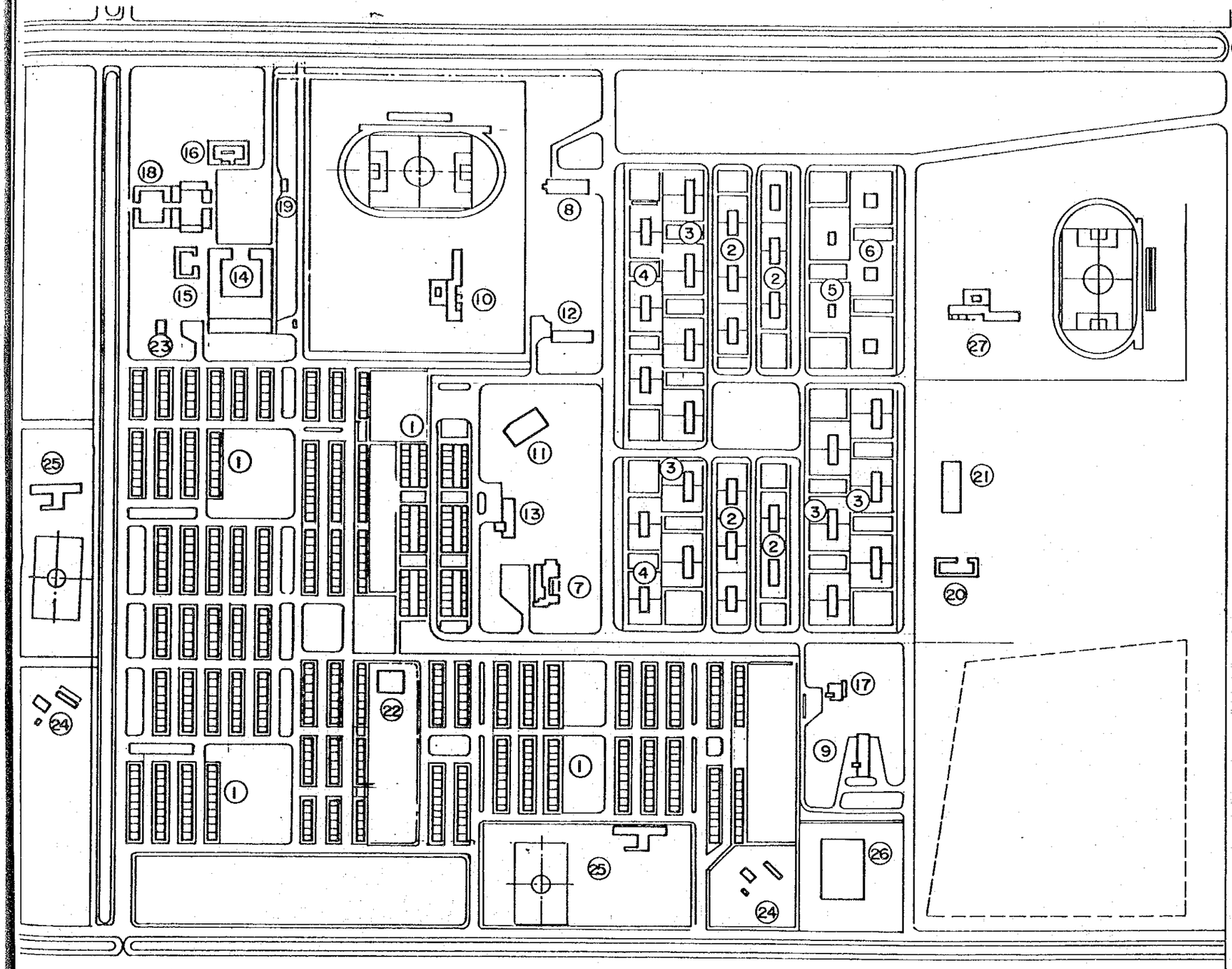
THE ARAB REPUBLIC OF EGYPT MINISTRY OF IRRIGATION			
THE SOUTH HOSAINIA VALLEY AGRICULTURAL DEVELOPMENT PROJECT			
Location of Buildings at Small Village			
DATE		D.W.G NO.	GL-2
JAPAN INTERNATIONAL COOPERATION AGENCY			



1. Director's House
2. Ass t, Director's House
3. Employeer's House
4. Do
5. Apartment
6. Do
7. Technical Labour's House
8. Farmer's House
9. Office of Administration
10. Nursery School
11. Primary School
12. Market with Bakery
13. Mosque
14. Rest House for Employeer
15. Club
16. Group of Shop
17. Fire Station
18. Agri, Administration Office
19. Auto Service Station
20. Store
21. Medical Treatment Unit
22. Preparatory School
23. Workshop

Scale 1 : 5,000

THE ARAB REPUBLIC OF EGYPT MINISTRY OF IRRIGATION			
THE SOUTH HOSAINIA VALLEY AGRICULTURAL DEVELOPMENT PROJECT			
Location of Buildings at Service Village			
DATE		D.W.G NO.	GL-3
JAPAN INTERNATIONAL COOPERATION AGENCY			



1. Farmer's House
2. Employeer's House
3. Do
4. Technical Labour's House
5. Ass't, Director s House
6. Director's House
7. Market with Bakery
8. Office of Administration and Inspection
9. Rest House for Employeer
10. Preparatory School
11. Mosgue
12. Nospital
13. Police Station
14. Store
15. Agri, Administration Office
16. Animal Treatment Unit
17. Club
18. Artificial Insemination Center
19. Fire Station
20. Auto Service Station
21. Cinema House
22. Group of Shop
23. Post Office
24. Nursery School
25. Primary School
26. Workshop
27. High School

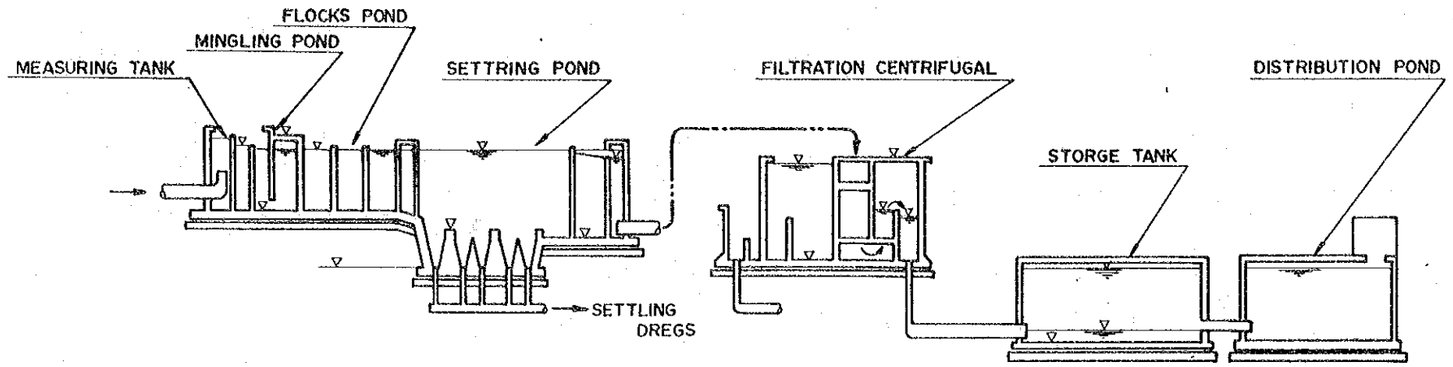
THE ARAB REPUBLIC OF EGYPT
MINISTRY OF IRRIGATION

THE SOUTH HOSAINIA VALLEY AGRICULTURAL DEVELOPMENT PROJECT

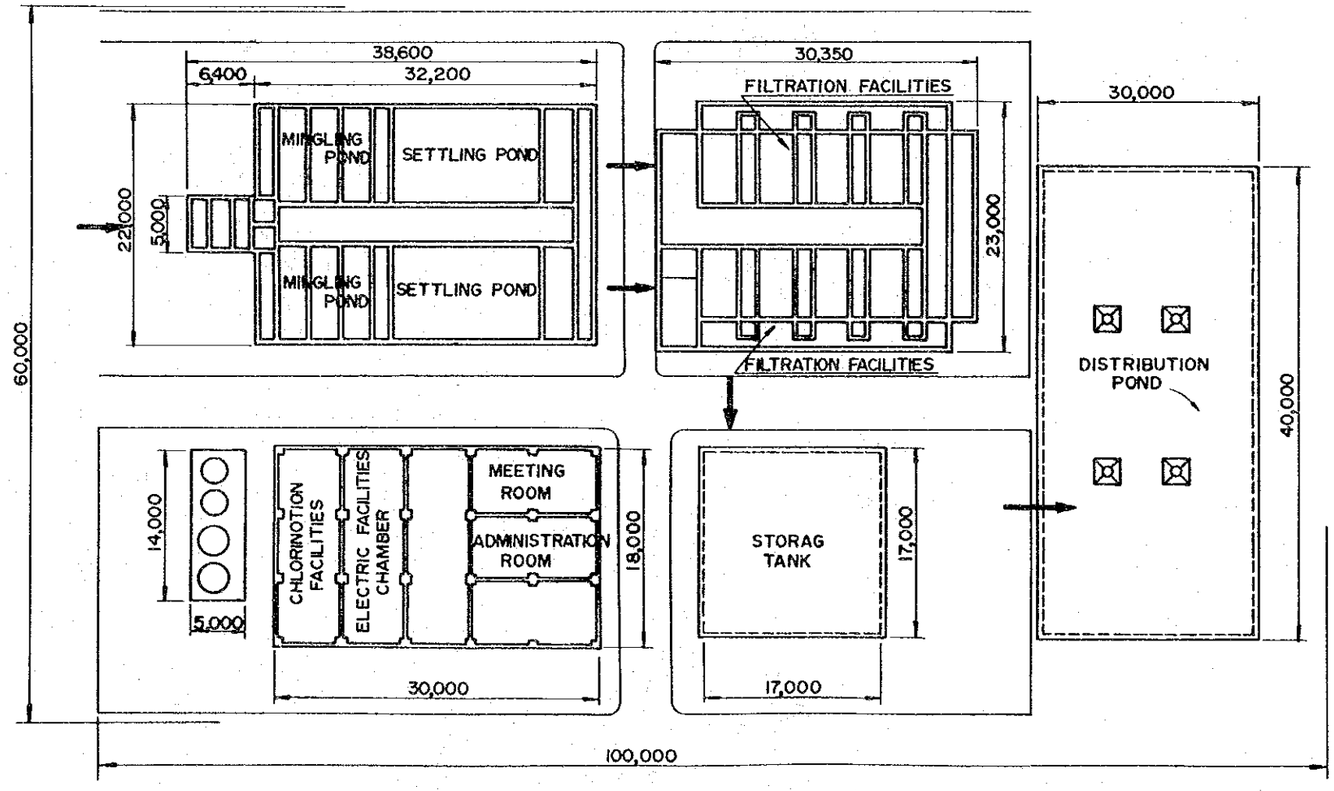
Location of Buildings at Central Village

DATE		D.W.G NO.	GL-4

JAPAN INTERNATIONAL COOPERATION AGENCY



FLOW CHART OF TREATMENT SYSTEMS NO SCALE



PLOT PLAN OF TREATMENT STRUCTURES

THE ARAB REPUBLIC OF EGYPT MINISTRY OF IRRIGATION			
THE SOUTH HOSAINIA VALLEY AGRICULTURAL DEVELOPMENT PROJECT			
PLOT PLAN OF TREATMENT STRUCTURES			
DATE		D.W.G NO.	GL-5
JAPAN INTERNATIONAL COOPERATION AGENCY			

ANNEX II

PROJECT COST ESTIMATE

CONTENTS

Annex H

Appendix H

List of Table

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H-1. Bases of Cost Estimate

H-1-1. Unit Costs

Basic data employed in construction cost estimate of the proposed facilities in the Project such as labor wages and unit prices of construction materials, etc., have been selected from various related data obtained in A.R.E. through discussions between the Government official in charge and the Team members. Unit prices as of 1980/81 have been employed in this cost estimate.

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

Unit costs of labor and construction materials are shown in Table H-1-1.

H-1-2. Necessary Units of Construction Equipment

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

1) Working Days in a Year

The working days in a year excluding holiday in each week, the national holidays and Remadan are about 265 days a year, that is, 22 day/month.

2) Actual Working Hours in a Working Day

The actual working hours in a working day, that is, working hours minus preparatory time and lunch break, are 6 hour/day.

Table H-1-1 Unit Cost of Labor and Materials

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

Source: Egyptian government agency concerned.

H-2. Outline of Construction Costs

The breakdown of construction costs for each item of construction works is shown in Table H-2-1 (Refer to Appendix H-1.). In this table construction costs are divided into the foreign currency portion and the local currency portion, however, all figures in the table are expressed in Egyptian Pound.

The construction costs under the Project are itemized as follows:

1) Civil Works

(i) Preparation works

The cost item covers the supplemental topographic survey, supplemental soil survey and geological investigations for the major facilities.

(ii) Pumping station (Irrigation)

The cost item covers the purchase of booster pumps for the irrigation and pumps for return-flow water use, installation of these pumps and construction of pumping stations.

(iii) Pumping station (Drainage)

The cost item consists of the purchase and installation of drainage pump and the construction of pumping station.

(iv) Irrigation canals

The cost item covers the construction of main and secondary irrigation canals inclusive of slightly small-scaled irrigation canals which, however, fall in the category of secondary irrigation canals and their incidental structures. The tertiary canals and farm ditches are included in the item of on-farm facilities.

Table H-1-2 Project Cost (Financial)

(Unit: 1,000 LE / US$)

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

(v) Drainage canals

The cost item covers the construction of main and secondary drainage canals and their incidental structures. The tertiary drains and farm drains (collector drain and field drains) are included in the item of the on-farm facilities.

(vi) On-farm facilities

The cost item covers the construction of tertiary canals, farm ditches, collector drain, field drains, tertiary drains and related structures for these and land leveling cost, however does not cover the construction of farm drain which will be shoulded by farmers.

(vii) Roads

The cost item covers the construction of trunk roads, village roads, farm roads and their incidental structures.

Note:

° The cost for earth works is included in the construction cost of canals.

° The construction cost of operation and maintenance roads is not herein summed up taking into consideration that these roads are also used as farm roads and others.

2) Land Aquisitions and Compensation

The whole Project Area is situated in a national land. Therefore, land aquisitions and compensation might not be necessary. However, a compensation has been summed up taking into account that some existing farm lands will be devastated during the construction works.

3) Construction Equipment

This cost item consists of the C.I.F. cost of construction equipment and their spareparts as well as the inland transportation cost of them from a neighboring port to the Project site.

4) Project Facilities

The cost item consists of costs for construction offices and office equipment and supplies.

5) Operation and Maintenance

The cost item consists of the salary and wedge and other miscellaneous expenses in relation with the operation of implementation offices.

6) Consultant Services

The cost item covers the cost for engineering consultancy services to be rendered in the detail design and construction supervision.

7) Contingency

The amount equivalent to 15% of the total cost under the above items 1) to 8) has been summed up.

8) Price Escalation

The price escalation during construction period has been imposed on both foreign and local currency portion with annual compound rate of 10 percent, in accordance with the proposed disbursement schedule.

9) Foreign Currency and Local Currency Portions

Costs for construction equipment and materials, etc., to be imported have been estimated in the foreign currency whereas the cost for others in the local currency.

Table H-2-1 Disbursement Schedule of the Project Cost
(Financial Cost)

(Unit: 1,000 LE)

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

Appendix H-1. Project Cost Estimate

Break Down of the Project Cost

(Unit: LE)

Item No.	Description	Quantity	Unit	Price	Total Cost	Foreign Currency (FC) Depreciation	Foreign Currency (FC) Materials	Foreign Currency (FC) Total	Local Currency (LC) Fuel & Materials	Local Currency (LC) Labor	Local Currency (LC) Total
1.	Civil Works										
1-1.	Preparation										
	Access Road (6 = 0.0 m, 10 km)										
	Companction A	90,000	cu.m	0.36	32,400	23,400	-	23,400	7,200	1,800	9,000
	Shortage Amount	90,000	"	0.80	72,000	51,300	-	51,300	17,100	3,600	20,700
	Survey Works (Profile & cross section)										
	Irrigation Canal	323.1	km	50.-	16,155	1,615	-	1,615	7,270	7,270	14,540
	Drainage Canal	295.6	"	50.-	14,780	1,478	-	1,478	6,651	6,651	13,302
	Geological Investigation										
	Bore Hole Drilling	630	m	30	18,900	5,670	-	5,670	5,670	7,560	13,230
	Supplemental Soil Survey	L.S.			10,000	-	-	-	5,000	5,000	10,000
	Total				164,235 (164,000)	33,463 (83,000)	(-)	33,463 (83,000)	48,891 (49,000)	31,881 (32,000)	80,772 (81,000)
1-2.	Pumping Station (Irrigation)	(6 stations)									
1-2-1.	Pump, Motor and Others										
	ø800 mm V. Mixed Flow Pump	1	set		821,000	-	821,000	821,000	-	-	-
	ø700 "	1	"		699,000	-	699,000	699,000	-	-	-
	ø800 "	1	"		1,562,000	-	1,562,000	1,562,000	-	-	-
	ø600 "	1	"		641,000	-	641,000	641,000	-	-	-
	ø500 "	1	"		524,000	-	524,000	524,000	-	-	-
	ø600 "	1	"		1,105,000	-	1,105,000	1,105,000	-	-	-
	(Sub-total)				(5,352,000)	(-)	(5,352,000)	(5,352,000)	(-)	(-)	(-)
1-2-2.	Substation and Distribution Power Line										
	Substation	1	pc		723,000	-	568,000	568,000	-	155,000	155,000
	11 KV Distribution Line	65	km		2,022,000	-	1,513,000	1,513,000	273,000	236,000	509,000
	(Sub-total)				(2,745,000)	(-)	(2,081,000)	(2,081,000)	(273,000)	(391,000)	(664,000)
1-2-3.	Pumping Station										
	Excavation A	3,500	cu.m	0.49	1,715	1,295	-	1,295	350	70	420
	Excavation D	3,500	"	1.08	3,780	2,835	-	2,835	805	140	945
	Backfill A	5,400	"	0.36	1,944	1,404	-	1,404	432	108	540
	Iron Pile ø400	550	ton	400.-	220,000	-	220,000	220,000	-	-	-
	Pile Drive ø400	250	pc	112.52	28,130	21,875	-	21,875	5,505	750	6,255
	Pump House	607	sq.m	500.-	303,500	-	-	-	212,450	91,050	303,500
	Reinforced Concrete	1,520	cu.m	120.-	182,400	152	-	152	145,798	36,450	182,248
	Form	4,000	sq.m	10.-	40,000	-	-	-	32,000	8,000	40,000
	(Sub-total)				(781,000)	(27,000)	(220,000)	(247,000)	(397,000)	(137,000)	(534,000)
	Total				9,042,000	27,000	7,653,000	7,763,000	719,000	560,000	1,279,000

(Unit: LE)

Item No.	Description	Quantity	Unit	Price	Total Cost	Foreign Currency (FC)			Local Currency (LC)		
						Depreciation	Materials	Total	Fuel & Materials	Labor	Total
1-3.	Pumping Station (Drainage)										
1-3-1.	Pump, Motor & Others ø1,000 V. Mixed Flow Pump	1	set		1,195,000	-	1,195,000	1,195,000	-	-	-
	(Sub-total)				(1,195,000)	(-)	(1,195,000)	(1,195,000)	(-)	(-)	(-)
1-3-2.	Pumping Station										
	Excavation A	1,000	cu.m	0.49	490	370	-	370	100	20	120
	Excavation D	1,000	"	1.08	1,080	810	-	810	240	30	270
	Backfill A	1,000	"	0.36	360	260	-	260	80	20	100
	Iron Pile ø400	154	ton	400.-	61,600	-	61,600	61,600	-	-	-
	Pile drive	70	pc	112.52	7,876	6,125	-	6,125	1,540	211	1,751
	Pump House	128	sq.m	500.-	64,000	-	-	-	44,800	19,200	64,000
	Reinforced Concrete	400	cu.m	120.-	48,000	36	-	36	38,371	9,593	47,964
	Form	1,100	sq.m	10.-	11,000	-	-	-	8,800	2,200	11,000
	Total				1,389,406 (1,389,000)	7,601 (7,000)	1,256,600 (1,257,000)	1,264,201 (1,264,000)	93,931 (94,000)	31,274 (31,000)	125,205 (125,000)
1-4.	Irrigation Canal										
1-4-1.	Main Canal										
	Excavation - M	93,600	cu.m	0.60	56,160	-	-	-	-	56,160	56,160
	Excavation - A	187,200	"	0.49	91,728	69,264	-	69,264	18,720	3,744	22,464
	Excavation - B	187,200	"	1.13	211,536	160,992	-	160,992	44,928	5,616	50,544
	Embankment - M	164,400	"	0.24	39,456	-	-	-	-	39,456	39,456
	Embankment - A	103,000	"	0.43	49,440	32,960	-	32,960	10,300	6,180	16,480
	Embankment - B	1,479,600	"	0.31	458,676	192,348	-	192,348	207,104	59,104	266,328
	Concrete Lining (t = 10 cm)	212,600	sq.m	5.00	1,063,000	-	-	-	850,400	212,600	1,063,000
	Reinforced Concrete	2,600	cu.m	120.-	240,000	180	-	180	191,956	47,954	239,910
	Form	9,400	sq.m	10.-	94,000	-	-	-	75,200	18,800	94,000
	Gravel	260	cu.m	10.-	2,600	-	-	-	2,080	520	2,600
	Gate	54	ton	10,000.-	540,000	-	540,000	540,000	-	-	-
	Shortage Amount	634,600	cu.m	0.80	511,600	364,515	-	364,515	121,506	25,580	147,086
	Total				3,358,196 (3,358,000)	820,259 (820,000)	540,000 (540,000)	1,360,259 (1,360,000)	1,522,133 (1,522,000)	476,291 (476,000)	1,998,424 (1,998,000)

(Unit: LE)

Item No.	Description	Quantity	Unit	Price	Total Cost	Foreign Currency (FC)			Local Currency (LC)		
						Depreciation	Materials	Total	Fuel & Materials	Labor	Total
1-4-2	Secondary Canal										
	Excavation - M	92,000	cu.m	0.60	55,200	-	-	-	-	55,200	55,200
	Excavation - A	368,000	"	0.49	180,320	136,160	-	136,160	36,800	7,360	44,160
	Embankment - M	228,900	"	0.24	54,936	-	-	-	-	54,936	54,936
	Embankment - A	170,700	"	0.48	81,936	54,624	-	54,624	17,070	10,242	27,312
	Embankment - B	2,060,100	"	0.31	638,631	267,813	-	267,813	288,414	82,404	370,818
	Concrete Lining (t = 10 cm)	-	"	-							
	Reinforced Concrete	4,000	"	120.00	480,000	360	-	360	383,712	95,928	479,640
	Form	27,100	sq.m	10.-	271,000	-	-	-	216,800	54,200	271,000
	Gravel	1,330	cu.m	10.-	13,300	-	-	-	10,640	2,660	13,300
	Gate										
	1.5 m x 1.5 m, 2.0 m x 2.0 m	24	ton	10,000.-	240,000	-	240,000	240,000	-	-	-
	1.5 m x 0.75 m	106	pc	3,000.-	318,000	-	318,000	318,000	-	-	-
	0.6 m x 1.0 m	111	"	1,750.-	194,250	-	194,250	194,250	-	-	-
	0.6 m x 0.6 m	111	"	1,500.-	166,500	-	166,500	166,500	-	-	-
	RC Pipe ø600	670	m	20.-	13,400	-	-	-	10,720	2,680	13,400
	Shortage Amount	1,768,000	cu.m	0.80	1,414,400	1,007,760	-	1,007,760	335,920	70,720	406,640
	Total				4,121,873 (4,122,000)	1,466,717 (1,467,000)	918,750 (919,000)	2,385,467 (2,386,000)	1,300,076 (1,300,000)	436,330 (436,000)	1,736,406 (1,736,000)
1-5.	Drainage Canal										
1-5-1.	Main Drainage Canal										
	Excavation - M	212,300	cu.m	0.60	127,380	-	-	-	-	127,380	127,380
	Excavation - A	955,350	"	0.49	468,121	353,479	-	353,479	95,535	19,107	114,642
	Excavation - B	955,350	"	1.13	1,079,545	821,601	-	821,601	229,284	28,660	257,944
	Embankment - M	48,800	"	0.24	11,712	-	-	-	-	11,712	11,712
	Embankment - B	439,200	"	0.31	136,152	57,096	-	57,096	61,488	17,568	79,056
	Surplus Amount	817,500	cu.m	0.38	310,650	220,725	-	220,725	73,575	16,350	89,925
	Rainforced Concrete	300	cu.m	120.-	36,000	-	-	-	28,800	7,200	36,000
	Form	1,400	sq.m	10.-	14,000	-	-	-	11,200	2,800	14,000
	Rc Pipe ø1,000	80	m	60.-	4,800	-	-	-	3,840	960	4,800
	Rc Pipe ø1,500	190	m	120.-	22,800	-	-	-	18,240	4,560	22,800
	Total				2,211,160 (2,211,000)	1,452,901 (1,453,000)	- (-)	1,452,901 (1,453,000)	521,982 (522,000)	236,297 (236,000)	758,259 (758,000)

(unit: LE)

Item No.	Description	Quantity	Unit	Price	Total Cost	Foreign Currency (FC) Depreciation	Materials	Total	Local Currency (LC) Fuel & Materials	Labor	Total
1-5-2.	Secondary Canal										
	Excavation - M	312,400	cu.m	0.60	187,440	-	-	-	-	187,440	187,440
	Excavation - A	2,811,600	"	0.49	1,377,684	1,040,292	-	1,040,292	281,160	56,232	337,392
	Embankment - M	272,500	"	0.24	65,400	-	-	-	-	65,400	65,400
	Embankment - B	2,452,500	"	0.31	760,275	318,825	-	318,825	343,350	98,100	441,450
	Surplus Amount	199,500	"	0.38	75,810	53,865	-	53,865	17,955	3,990	21,945
	Reinforced Concrete	900	"	120.-	108,000	81	-	81	97,128	10,791	107,919
	Form	7,900	sq.m	10.-	79,000	-	-	-	63,200	15,800	79,000
	Rc Pipe ø400	650	m	10.-	6,500	-	-	-	5,200	1,300	6,500
	Rc Pipe ø600	90	"	20.-	1,800	-	-	-	1,440	360	1,800
	ø1,000	310	"	60.-	18,600	-	-	-	14,880	3,720	18,600
	Total				2,680,509	1,413,063	-	1,413,063	824,313	443,133	1,267,446
					(2,681,000)	(1,413,000)	(-)	(1,413,000)	(824,000)	(443,000)	(1,268,000)
1-6.	On-Farm Facilities (per ha)										
1-6-1.	Earth Leveling	231.4	cu.m	1.31	303.13	217.52	-	217.52	67.10	18.51	85.61
1-6-2.	Farm Ditch, Farm Road and Field Drain										
	Excavation - M	110	cu.m	0.60	66.00	-	-	-	-	66.00	66.00
	Excavation - C	110	"	0.45	49.50	35.20	-	35.20	9.90	4.40	14.30
	Embankment	160	"	0.24	38.40	-	-	-	-	38.40	38.40
	Ac Pipe	1.7	m	10.50	17.85	-	-	-	14.28	3.57	17.85
1-6-3.	Tertiary Canal										
	Excavation	14.3	cu.m	0.60	8.58	-	-	-	-	8.58	8.58
	Compaction A	85.7	"	0.36	30.85	22.28	-	22.28	6.86	1.71	8.57
	Reinfaced Concrete	0.05	"	120.0	6.00	-	-	-	5.00	1.00	6.00
	Form	0.50	sq.m	10.0	5.00	-	-	-	4.00	1.00	5.00
	Gravel	0.02	cu.m	10.0	0.20	-	-	-	0.16	0.04	0.20
	Steel Gate	0.10	pc	6.0	0.60	-	-	-	0.60	-	0.60
1-6-4.	Tertiary Drain										
	Excavation - M	59.5	cu.m	0.60	35.70	-	-	-	-	35.70	35.70
	Excavation - C	59.5	"	0.45	26.78	19.04	-	19.04	5.35	2.39	7.74
	Embankment - M	16.7	"	0.24	4.01	-	-	-	-	4.01	4.01
	Total (per ha)				592.60	294.04	-	294.04	118.26	186.30	304.56
	For the Project (A = 26,800 ha) G.Total				15,881,680	7,880,272	-	7,880,272	3,169,368	4,986,504	8,155,872
					(15,882,000)	(7,880,000)	(-)	(7,880,000)	(3,036,000)	(4,966,000)	(8,002,000)

(Unit: LE)

Item No.	Description	Quantity	Unit	Price	Total Cost	Foreign Currency (FC)			Local Currency (LC)		
						Depreciation	Materials	Total	Fuel & Materials	Labor	Total
1-7.	Road										
	Surfacing (Asphalt Pavement)										
	Trunk Road	290,500	sq.m	3.00	871,500	-	-	-	697,200	174,300	871,500
	Leveling	290,500	"	4.71/100	136,826	96,737	-	96,737	26,726	13,363	40,089
	Compaction C	290,500	"	5.83/100	169,361	111,842	-	111,842	30,793	26,726	57,519
	Bridge (B = 8.0 m L = 30 m 4 spans)										
	Rainforced Concrete	120	cu.m	120	14,400	11	-	11	11,511	2,878	14,389
	Form	480	sq.m	10	4,800	-	-	-	3,840	960	4,800
	Mass Concrete	100	cu.m	40	4,000	9	-	9	3,193	798	3,991
	Piar ø400	23	ton	400.-	9,200	-	9,200	9,200	-	-	-
	Pile Drive	10	pc	112.52	1,125	875	-	875	220	30	250
	Total				1,211,212	209,474	9,200	218,674	773,483	219,055	992,538
					(1,212,000)	(210,000)	(9,000)	(219,000)	(774,000)	(219,000)	(993,000)
2.	Land Acquisition and Compensation										
		30	ha	3,000	90,000	-	-	-	90,000	-	90,000
	Total				(90,000)	(-)	(-)	(-)	(90,000)	(-)	(90,000)

3. Cost of Construction Equipment

(Unit: 1,000 LE)

Name of Equipment	Specification	Nos.	Price F.C.	Price L.C.	Cost F.C.	Cost L.C.
Bulldozer	15 ton 140 ps	46	63	-	2,898	-
"	21 ton 240 ps	18	87	-	1,566	-
" (Swampy)	16 ton 140 ps	47	71	-	3,337	-
Backhoe	0.7 cum 105 ps	16	55	-	880	-
"	1.2 cum 150 ps	14	108	-	1,512	-
Dragline	0.8 cum 127 ps	1	119	-	119	-
"	1.2 cum 155 ps	10	225	-	2,250	-
Diesel Pile Hammer	2.5 ton	1	32	-	32	-
Crawler Crane	30 ton	1	100	-	100	-
Motor Grader	3.7 m 125 ps	4	71	-	284	-
Dump Truck	8 ton 197 ps	2	20	-	40	-
"	11 ton 281 ps	1	29	-	29	-
Truck	4 ton 154 ps	4	11	-	44	-
"	8 ton	2	20	-	40	-
Water Truck	10 cum	2	20	-	40	-
Fuel Truck	8,000 ℓ	2	30	-	30	-
Tire Roller	20 ton 82 ps	1	26	-	26	-
Vibro-roller	0.6 ton 6.5 ps	4	5	-	20	-
Concrete Mixer	0.5 cum 22 KW	3	11	-	33	-
Generator	50 KVA	4	10	-	40	-
Belt Conveyor	L = 7 m	10	0.8	-	8	-
Concrete Vibrator	2.5 ps	10	0.8	-	8	-
Welder	20 KVA	1	4	-	4	-
Water Pump	ø100 5.5 KW	20	0.9	-	18	-
Lubricating Car		2	43	-	86	-
Repair Workshop		1	55	-	55	-
Car Jeep		15	10	-	150	-
Car Wagon		4	17	-	68	-
Motorcycle	90 cc	20	1	-	20	-
Tele-communication Facility	L.S.		5	-	5	-
Truck Mixer	3 cum	3	36	-	108	-
Trailar	25 ton	2	82	-	164	-
Pick up Truck	4 ton	4	14	-	56	-
Boling Machine	20 - 200 m, 5 ps	1	10	-	10	-
Sub-total					14,080	
Spare Parts (15% of above)					2,112	
Total					16,192	810 1/

Note: 1/ Inland transportation (5% of F.C. portion)

(Unit: LE)

Item No.	Description	Quantity	Unit	Price	Total Cost	Foreign Currency (FC)			Local Currency (LC)		
						Depreciation	Materials	Total	Fuel & Materials	Labor	Total
4.	Agricultural Development										
4-1.	Office Building										
	Management Office	4		20,000	80,000	-	-	-	48,000	32,000	80,000
4-2.	Lobour Housing										
	Labour Houses	4		6,000	24,000	-	-	-	12,000	12,000	24,000
4-3.	Stock Farm Facilities										
	Storages	4		75,000	300,000	-	-	-	180,000	120,000	300,000
	Cattle Sheds	3		486,000	1,458,000	-	-	-	874,800	583,200	1,458,000
	Cattle Sheds	1		1,215,000	1,215,000	-	-	-	729,000	486,000	1,215,000
	Feed Rack	49,000	m	2	98,000	-	-	-	58,800	39,200	98,000
	Electric Fence	25,000	m	5	125,000	-	-	-	75,000	50,000	125,000
4-4.	Slaughter House	L.S.			140,000	-	-	-	8,400	56,000	140,000
4-5.	Refrigeration Facilities	4		121,000	484,000	-	484,000	484,000	-	-	-
	Total				3,924,000	-	484,000	484,000	2,061,600	1,378,400	3,440,000
					(3,924,000)	(-)	(484,000)	(484,000)	(2,062,000)	(1,378,000)	(3,440,000)
5.	Operation and Maintenance										
5-1.	Salary and Wage	L.S.			378,000	-	-	-	-	378,000	378,000
5-2.	Equipment Operation	L.S.			68,900	-	-	-	68,900	-	68,900
	Total				446,900	-	-	-	68,900	378,000	446,900
					(447,000)	(-)	(-)	(-)	(69,000)	(378,000)	(447,000)

6. Project Facilities

Item	Description	Qunt'y	Unit	Rate (LE) F.C.	Rate (LE) L.C	Amount ('000 LE) F.C.	Amount ('000 LE) L.C.
6-1	Building and furniture						
	Building						
	Main project office	1,500	sq.m	-	100	-	150
	Operation office	250	sq.m	-	100	-	25
	Housing						
	Government staff	1,000	sq.m	-	100	-	100
	Guest house	200	sq.m	-	100	-	20
	Equipment shed	3,000	sq.m	-	50	-	300
	Furniture	L.S.		-		-	5
	Sub-total					-	600
6-2	Equipment						
	Office equipment						
	Auto-level, staff and tape	5	set	1,000	-	5	-
	Theodolite, pool and tape	5	set	2,600	-	13	-
	Copy-machine	2	set	2,000	-	4	-
	Micro-computer	1	set	15,000	-	15	-
	Electric calculator	5	set	400	-	2	-
	Miscellaneous tools and equipment	L.S.				20	-
	Sub-total					59	-
6-3	Other equipment						
	Meteorological equipment	L.S.				20	-
	Other equipment	L.S.				10	-
	Sub-total					30	-
	Total					89	600

7. Consulting Service

Item	Description	Quant'y	Unit	Rate (LE) F.C.	Rate (LE) L.C.	Amount ('000 LE) F.C.	Amount ('000 LE) L.C.
7-1	Foreign currency portion						
	Detail design						
	Consultant's remuneration	49	Man-month	6,300	-	308.7	-
	International travel expenses	8	R. trips	3,100	-	24.8	-
	Miscellaneous and communication	L.S.				3.3	-
	Sub-total					336.8	-
	Construction supervision						
	Consultant's remuneration	115	Man-month	6,300	-	724.5	-
	International travel expenses	14	R. trips	3,100	-	43.4	-
	Miscellaneous and communication	L.S.				7.7	-
	Sub-total					715.6	-
	Total					1,112.4	-
7-2	Local currency portion						
	Detail design						
	Consultant's per diem	1,470	days	-	60	-	88.2
	Construction supervision						
	Consultant's per diem	3,450	days	-	60	-	207.0
	Total			-		-	295.2
	G. Total					1,112.4 (1,112)	295.2 (295)

Proposed Schedule for Consultant's Services