6–3 Pilot Farm

(1) Acreage of the pilot farm is 500 feddan, of which 400 feddan is for farmland and the remaining 100 feddan is for facilities.

(2) Location of the pilot farm, based on the result of soil survey in the project area, is finally decided at the point as shown in Fig. 4–5.

(3) Items studied in the pilot farm can be considered as follows;

- cropping pattern,
- test of fertilizers,
- pest control,
- agricultural chemicals control,
- various irrigation and drainage manner,
- leaching manner, and
- mechanized farming.

(4) Research and extension services are necessary for successful implementation of the agricultural and animal husbandry project with the Government responsibilities. However, additional or applied research programs and refresher courses on behalf of the extension staff will also be taken up at the Pilot Farm.

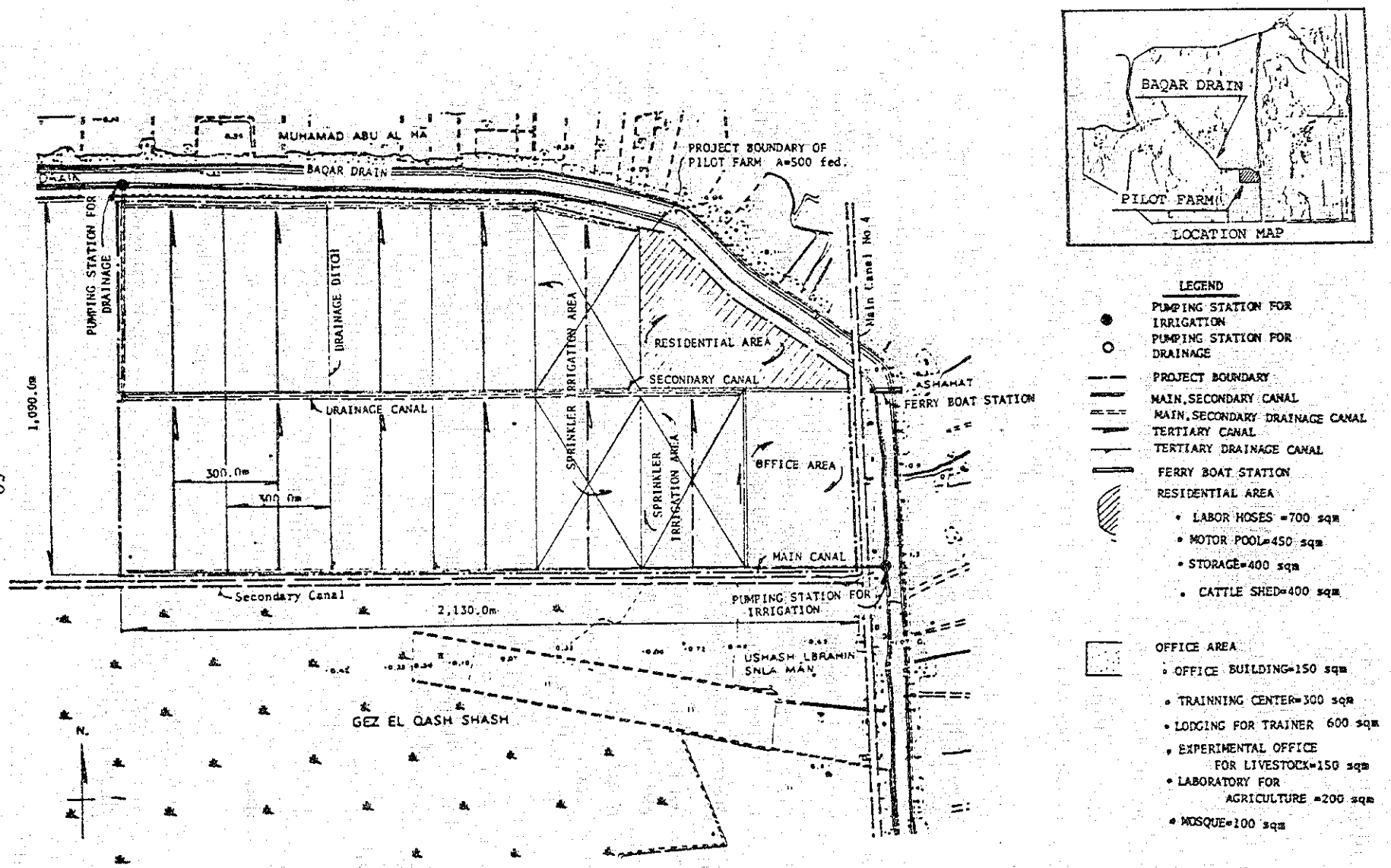


Fig. 4–5 Location of Pilot Farm

6–4 Marketing

(1) General

According to the crop cultivation plan as well as the animal husbandry plan, main outputs of the project are rice, soybean, sugar beet, vegetables, milk and beef cattle. While some portion of these products except sugar beet will be directly consumed by growers and dwellers in the project area, most of the remainders will be provided to the proposed agro-industrial complexes as raw materials.

Marketability of these products has been studied from both domestic and international viewpoints, of which details are compiled in 2. Marketing of Annex O.

(2) Domestic Marketability

In order to assess the domestic marketability of rice, soybean, vegetables, sugar, animal meat, maize and high quality flour, forecasted population in year 2000 and income elasticity for these products, and projected GDP per capita are taken into consideration. Most of all the necessary data have been obtained from the Second Five-Year Plan.

Demands for the selected commodities except white rice and vegetables exceed their supply, which means that soybean, sugar beet and beef cattle to be produced in the project area will have enough domestic marketability.

When considering those categories of seeds, loss, change in stock for material uses, the balance of white rice and vegetables is marginal or turns deficit. Especially the projection for domestic production of white rice is rather optimistic, because the rice cultivated area had gradually decreased recently and increase in rice yield could not offset the rice cultivated area in its total production.

As for dairy products, it is forecasted that the domestic demand for cheese and butter will exceed the domestic supply for them by 129,000 tons in year 2000. Thus, fresh milk to be produced in the project area is also domestically marketable after processing.

(3) International Marketability

Since the necessary data and information on the international marketability are not sufficient, the marketability of vegetables (fresh as well as preserved)to European market and Near Eastern market has been studied.

Fresh tomatoes and both fresh and dried onions grown in winter season are marketable in the European market and other vegetables including tomatoes and onion as fresh and as preserved or processed, are marketable in the Near Eastern market.

(4) Marketing Channel

The marketing of agricultural products in the project area will be made through the marketing system or marketing channels which is presently predominant in Egypt. In Egypt, government control is executed with marketing commitments and controlled prices.

Governmental marketing control is made to different extents for different commodities. Some are completely controlled, some are moderately, and others are slightly controlled.

In this sense, the products in the Project Area will be grouped into as follows:

Governmental Control	Products
Completely	Sugar beet
Moderately	Rice and soybean
Slightly	Milk, meat and vegetables

The recommendable marketing channels for vegetables, and for milk and dairy products are shown in 2. Marketing of Annex O, respectively.

CHAPTER V LAND DEVELOPMENT PLAN

CHAPTER V LAND DEVELOPMENT PLAN

1. PROJECT COMPONENT

1–1 Project Area

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

Table 5–1 Proposed Land-Use

(feddan)

Land-Use	N-Hussinia	S-Port Said	Total
Total Porject Area	69,000	41,000	110,000
Structure Lot	4,300	2,600	6,900
Housing Lot	1,950	1,350	3,300
Agro-Industry Lot	250	200	450
Farm Road Lot	1,500	900	2,400
On-Farm Facility Lot	6,800	4,000	10,800
Others	200	150	350
Sub Total	15,000	9,200	24,200
Farm Land Acreage	54,000	31,800	85,800

1–2 Boundary of the Project Area

The project area is surrounded by the following boundaries.

(1) Eastern Boundary

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

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

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

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

(2) Southern Boundary

El Salam Canal is currently under construction from west to east along the southern side of the project area and construction is expected to be completed

within two more years up to the western side of the Suez Canal. The toe line of the left side embankment of the El Salam Canal is the southern boundary of the project area.

(3) Western Boundary

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

The outside toe line of the left side embankment of the Canal is the western boundary of the Project Area. Northern half of the western part of the Project Area is cut by the Hadous Drain. The outside toe of the right side embankment of the Hadous Drain is, therefore, also the western boundary of the Project Area.

(4) Northern Boundary

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

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

(5) Northeastern Boundary

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

1–3 Project Components

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

(1) Construction Works

Pumping Stations for Drainage	: 2 Sites
Main Canal	: 106.2 km
Secondary Canal	: 264.7 km
Canal for Housing	: 47.6 km
Intake Barrage for Main Canal	: 6 Sites

Intake Barrage for Secondary Canal	:	86 Sites
Main Drain	:	109.4 km
Secondary Drain	:	218.5 km
Bridge for Canal or Drain	:	88 Sites
Land Reclamation	:	85,800 feddan
Tidal Dyke	:	80 km

(2) Pilot Farm

Acreage for Farm	:	400 feddan
Acreage for Facilities	:	100 feddan
(Machinery; Tractor with Attachment)		

(3) Agro-Industry

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

(4) Settlement

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

2. METEOROLOGY AND HYDROLOGY

2–1 Meteorological Study

The Project Area is located at the northeastern part of the Nile Delta and is about 20 km from the Mediterranean Sea.

As the result of field observations the monthly mean, maximum and minimum temperature stands on the values of Port Said and Mansura stations. From this observation it was found that the monthly mean temperature and relative humidity in the area were similar to those of Port Said (Table 5–2). Therefore, the climatic data recorded at Port Said Station were adopted for planning the climate data in the Project Area (Table 5–3).

2–2 Hydrological Study

Published water level records are not available for Lake Manzala, however, there are sources of information as follows:

- The maximum elevation was surveyed to be 0.6 meter with a minimum 0.3 meter near Port Said Town. (Port Said Master Plan)
- The water level fluctuates by ±0.2 meter. (Lake Manzala Study)
- The water level elevation of Lake Manzala was observed to be 0.4 meter near Matareya and 0.35 meter in the South Port Said area. (Topographic Survey)
  The records of the Mediterranean tide at Port Said are as follows.

Highest high water level	:	EL +0.55
Lowest low water level	:	–0.65
Average annual high W.L.	:	+0.44
Average annual low W.L.	:	+0.04

It can be said that although the data from the Port Said Master Plan are influenced by the Mediterranean tides, the water level of the area is not influenced. Therefore, the water level of the lake included in the Project Area was decided to be 0.50 meter by appling the maximum value.

Table 5–2 Temperature and Relative Humidity in the Project Area

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Temperature (°C)	Max.				28.0	29.9	30.8	32.0	31.9			25.4		
	Min.				17.8	21.8	22.0	23.1	23.9			15.7	14.5	
	Mean				22.9	25.9	26.4	27.6	27.9			20.6	19.1	
Relative Humidity (%)	Max.				93	92	91	91	91			95	96	
	Min.				46	53	51	51	53			47	51	
	Mean				73	73	71	71	72			71	74	

* Data were observed during the study periods.

Table 5--3 Data at Port Said Station (Monthly Mean) 1968 -- 1978

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Temperature (°C)	14.2	14.8	16.4	18.8	22.2	24.9	26.7	27.4	26.2	24.2	20.9	16.4	21.1
Rainfall (mm)	16.0	7.1	10.0	7.3	0.5	0.0	0.0	0.0	0.0	3.6	8.4	15.1	
R. Humidity (%)	73	71	69	72	71	72	74	73	70	69	72	74	72
Evaporation (pitch: mm)	4.9	5.4	6.5	6.6	7.1	7.7	7.9	7.7	8.1	7.6	6.3	4.8	6.7
Possible Sunshine (%)	69	73	69	71	80	86	86	88	87	82	77	67	78
Wind Speed (m/sec)	4.9	5.2	6.0	5.6	5.0	4.6	9.4	3.9	3.9	4.1	4.4	4.4	4.7

3. LAND RECLAMATION

3–1 Division of Project Area

The total Project Area is estimated at 110,000 feddan based on a 1/10,000 topographical map. The Baqar Drain and the Bastir Drain run from south to north in the middle part of the Project Area. Both of the drains are planned to be connected to each other in near future. Thus, the whole Project Area will be divided by the new Baqar Drain into two areas, i.e., the South Port Said area on eastern side of the drain (41,000 feddan) and the North Hussinia area on its western side (69,000 feddan).

(1) South Port Said Area

Since a major branch of the Bastir Drain runs from east to west in the South Port Said waste area, it was suggested during the first stage of the study that the South Port Said area could be divided into two i.e., south block and north block with the existing Bastir Drain. They would be independent, each having a separate irrigation canal network and drainage canal system with a drainage pump station. However, after more careful study during the second stage of the study, it was found that the tidal dyke to enclose the South Port Said area had been already constructed by the Ministry of Irrigation and left some channels carrying the lake water between inside and outside of the Project Area. When considering this, development of the whole area as one package was judged to be more economical, because the construction costs of the dykes along the Bastir Drain could be eliminated and because one drainage pumping station was enough to remove excessive water from the whole area rather than the two pumping stations originally planned. A major branch of the Bastir Drain is to be used as an internal main canal in this project. One drainage pumping station will be constructed at the most western end of the internal main drain, to discharge excessive water to the new Baqar Drain. Furthermore, other construction works can be executed without large changes in costs by the original plan, if there is one package construction.

(2) North Hussinia Area

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

(3) Conclusion

From the former discussion, it is recommended that the two block development i.e., the South Port Said area and the North Hussinia area be selected instead of the four block development suggested during the first stage of the study.

However, phasing of the implementation of construction in the development of the Project Area should be systematically considered. Phasing of the construction will be explained in a later chapter of this report.

3–2 Construction Phasing

After taking into consideration the topographical conditions of the Project Area, the existing major irrigation and drainage canal such as the El Salam Canal and the Baqar Drainage Canal, and the on-going civil works which are being carried out by the Egyptian Government in and around the Project Area, the total Project Area can be divided into the two blocks of the North Hussinia Block and the South Port Said Block.

However, for development of the project, when lay-out of the proposed irrigation and drainage canal system is arranged and determined in the Project Area based on the topography of the area, the whole Project Area can also be divided into 9 construction units. In other words, if an irrigation canal system is provided as one area including 9 units, 4 for the South Port Said and 5 for North Hussinia Block, which were defined by the drainage canal systems based on the topography, dewatering and construction of roads network and on-farm facilities in the unit area can be carried out independently regardless of the progress of construction in the other units. Agricultural production and benefits of the unit area can be obtained earlier than the other unit area.

For the procurement of construction equipment and availability of construction cost or recruitments of the labor force around the Project Area, it is not necessary to commence construction in the whole Project Area simultaneously. Construction can be executed on a unit area basis one by one in a sequence of nine units by considering the accessibility of the unit area and easiness of transporting the construction equipment and materials to the job site in the unit area.

In this case, attention should be paid to the construction of the major drainage pump stations which are planned to be installed one station each of two blocks, the North Hussinia and the South Port Said Blocks. For example, in whichever unit area, the construction of civil works is made at first in the South Port Said area, the proposed drainage pumping station should be commenced for construction in this area. North Hussinia, it is done in the same way.

4. LAND DISPOSAL

4–1 Land Disposal System

Land reclamation projects in Egypt have conventionally adopted three patterns of land holding as follows:

	Size of Land Holder
– Small holders	1 to 8 feddan
– Large holders	10 to 30 feddan
– Land Reclamation Cooperative Farms, Company Farms, and State Farms	500 feddans or more

Land disposal of the projects is carried out by two systems. One is the distribution by the Government and another is selling by auction. The distribution system is classified into small holders and large holders. Small holders will be composed of smaller holders, landless farmers, retired soldiers and unemployed in urban areas who might have knowledge about farm management. Large holders include agricultural secondary school diplomates and university graduates. The land holding system as mentioned above aims to develop many successful family farms.

In parallel with the two systems, the Government has established large state farms, land reclamation cooperative farms and company farms. The managing agency of these farms is classified into the government, cooperatives and companies. It is considered that the Government should attempt to mobilize private capital through execution by cooperative and companies. According to the Five Year Development Plan, 1982/87, the percentages of the land managed by government, cooperative and companies are 48, 49 and 3, respectively.

Since company farms are not so emphasized in the Five Year Development Plan, they shall be discarded in land disposal study of this project. The Government and the Land Reclamation Cooperative are preferable as managing agencies. One of reasons to take the Land Reclamation Cooperative is to mobilize the private capital.

As land disposal by the Government, distribution and auction selling is more recommendable than the state farm. Because the major aim of the North Hussinia Valley and South Port Said Project is to create employment opportunity as much as possible, small holders should be mainly selected by a distribution system. The settlers of small holder will be anxious to be land owners and should be willing to work very hard on their own land.

How to dispose of the reclaimed land is studied from a viewpoint of mobilization of the private investment and creation of employment opportunities. It is one idea to cover the local portion of the social infrastructure component which is included to the total project cost.

The reclaimed area to be disposed to the private sector which mobilize the private investment can be calculated to divide the local currency portion of the social infrastructure component by the cost of the reclaimed land. Such a private fund will be some kind of revenue for the national budget and can be utilized for preferable purpose including allocation to the Project.

A total area of 110,000 feddan to be reclaimed under the Project is disposed to the two managing agencies of the Government and the Land Reclamation Cooperatives. The alternatives of various land disposal patterns such case as that proportions of the Government and the Land Reclamation Cooperative are 9:1, 8:2, 7:3 and 6:4 are studied. The total and cost sold to the Land Reclamation Cooperative is calculated in every proportions. This cost should be more than local currency portion of the social infrastructure component.

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

As the result of studying as mentioned above, 30 percent of the total reclaimed land will be given to the cooperatives and 70 percent of the total area will be under the government administration.

4--2 Farm Size

The size of land disposed to the new settlers is shown as follows after an alternative study on the farm budget and family labor force of each size of farm land.

Small holder	5 feddan
Graduates	
Agricultural secondary school	15 feddan
University	20 feddan

The proportion of land disposal between small holders and large holders was examined from the viewpont of the balance of family labor. Large holder farmers are necessary to employ additional labor due to the labor shortage problem in farm management, particularly at the time of peak labor demand during planting and harvesting seasons.

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

The proposed cropping patterns need about 60 million days of total labor in the Project Area. The total number of family labor per day is calculated at about 24,100 persons when the average annual days is 250 per labor.

The labor balance study between small and large holders in the proportion of 9:1, 8:2, 7:3, and 6:4 was carried out, assuming family labor of 1.5 persons in average. As the result of the labor balance study the optimum proportion will be 80 percent of small holders and 20 percent of large holders considering the balance of labor.

4–3 Number of Settlers

The number of new settlers in the Project Area can be calculated by using the above-mentioned proportion.

Finally, the area to be disposed and number of settlers regarding small holders and large holders are summarized as follows:

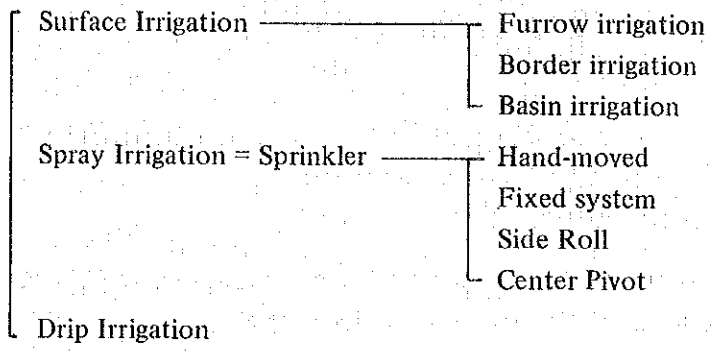
Farm Size	Area	No. of Settlers
Small holders	62,000	12,400
Large holders	26,200	1,573
Total	88,200	13,973

5. IRRIGATION

5-1 Selection of Irrigation System

(1) Irrigation Method

Irrigation methods, except the flooding used for rice growing, which can be adopted on a flat terrain will include:



The choice depends on factors such as the topographic conditions particularly gradient, soil conditions particularly their basic intake-rate, wind velocity in case of spray irrigation, and variety of crops.

Each method has its own merits. Surface irrigation does not require any equipment investment, but its irrigation efficiency is about 70 percent compared to 80 percent of spray irrigation and 90 to 95 percent of drip irrigation, and much water is required for supplementary leaching, which is technically the easiest desalting way.

The spray method has high irrigation efficiency and results in less salt accumulation but requires a large investment cost amounting to almost LE 700 to 2,100/feedan in terms of terminal spray facilities, pipe-lines, and pumps to give 4 to 5 kg/cm^2 pressure.

The drip method, on the other hand, has the highest irrigation efficiency but also requires a considerable investment cost of about LE 1,400 to 3,300/feddan for drip-hoses, pipe-lines, and a pump to give 1.5 to 2.0 kg/cm^2 pressure.

(2) Selection of Irrigation Method

Surface irrigation is adopted for this Project Area for the following reasons.

i) The construction cost for both spray and drip irrigation is high.

ii) Any irrigation method is adoptable in terms of the natural condition and the farm management conditions.

iii) Most crops can attain the target yield under relatively extensive cultivation.

iv) At the initial stage after the land reclamation and the settlement, the soil structure is not adequately improved. Farming techniques such as cultivation, farm mechanization, water management, and marketing are also incompleted. Under these conditions, it is not effective to introduce high cost irrigation systems.

Spray and drip irrigation systems, however, have the following advantages and may be introduced in the future.

i) Spray and drip irrigation systems except hand-moved can save labor, and the surplus labor can used for enlargement of the farm land and/or for improvement of farming techniques.

ii) These irrigation systems are suitable for soil moisture control. Therefore, it is possible to attain high productivity of crops.

In order to introduce these irrigation systems, it is necessary to improve the whole agricultural technology. It is also needed to establish the organization of water management for canals, and to improve supporting services and marketing.

5–2 Water Requirements

(1) Calculation Procedures

In this planning, Blaney-Criddle equation is adopted for computing the water requirements, since it shows a moderate value among four methods in FAO Irrigation and Drainage Paper No. 24.

Net Water Requirement

Requirements of evapotranspiration (ETo)	:	ETo = c {P(0.46T + 8)} mm/day Climate data at Port Said (1969 to 1978) Crop evapotranspiration (ET crop) ET crop = Kc · ETo Kc = Crop Coefficient
Leaching water requirements (LR)	:	LR = Ddw/Diw Ddw = Depth of drainage water Diw = Depth of irrigation water Leaching efficiency = 0.5
Water requirements of paddy rice	:	Puddling water + Percolation + Nursery requirements

Irrigation Efficiency

$Ep = Ec \times Eb \times Ea$	:	Ep: Irrigation Efficiency Ec: Conveyance Efficiency Eb: Field Canal Efficiency Ea: Field Application Efficiency

Project Water Requirement

Irrigation water right is given for the gross project area by the Ministry of Irrigation, therefore the project water requirement is as follows;

Gross area and arable rate	:	Total gross area A = 110,000 feddan Cropping pattern No. 1A = 83,854 feddan Cropping pattern No. 2A = 26,146 feddan
Net water requirements (NWR)	:	$NWR = \sum^{\text{all crops}} NWR\ crop \times AR\ crop$ NWR crop: Net water requirement of each crop (mm/day) AR crop: Area ratio of each crop
Gross water requirements (GWR)	:	GWR = NWR/Irrigation Efficiency
Project water requirements (PWR)	:	PWR = GWR x 4,200 m^2/fed. x 0.78 (arable rate)

(2) Results of Computations

The peak project water requirement is 44.6 m^3/feddan which appears in July, and the annual amount is 8,117 m^3/feddan. The unit duty of water for main and secondary canals is 1.032 liters/sec/feddan in the rotation system, as explained in the below:

$$\frac{44.6 \times 2}{86,400} = 0.001032\ m^3/sec/feddan = 1.032\ liters/sec/feddan$$

On the standard of the Ministry of Irrigation, the intake water volume to this project is 40 m^3/day/feddan at peak season and 8,000 m^3/year/feddan.

Therefore, lack of water supply appears when this 44.6 m^3/feddan is compared with the regulated intake water volume of 40 m^3/feddan, as follows:

Item	Volume of Water	
	Peak (m^3/day/fed.)	Year (m^3/year/fed.)
Regulated intake water	40.0	8,000
Planned requirement	44.6	8,117
Lack of water	Δ 4.6 (10.3%)	117 (1.4%)

Note: Δ shows lack of water

5–3 Rotation Irrigation

Rotation irrigation is believed to be an effective irrigation method in view of simplifying the water management and minimizing the water-loss resulting from complicated water management, particularly when rice and upland crops are planted in the same season under the proposed cropping calendar.

There are two methods of rotation irrigation. One is where water is alternately supplied to every part within a field, and another is where water is intermittently supplied to each irrigation block; the block is defined as the area supplied with water through one main canal. The latter method have been adopted in Egyptian agriculture and are also adopted in this project.

The irrigation interval for each block will be 8 days, i.e. 4 days on and 4 days off in summer peak.

However, when the farm management, marketing, and the farmers' organization are stable, it is recommended to always supply water to field plots by comprehensively managing the water distribution system from water sources to field lots.

6. DRAINAGE

6–1 General

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

In existing condition, since about 90 percent of this Project Area is the lake and swamp having low elevation and in poor drainage condition, the soil texture is undeveloped and has properties such as poor saturation and poor permeability.

Most soils of the area contain salinity of 8 to 32 mmhos/cm in electric conductivity. In such situation the improvement of drainage system is considered to be an essential factor for the successful agricultural development.

Surface water and/or gravitywater in the soil flow into open drains or tile drains through pore space in soil layers; no farming would be possible if the soil had a low permeability to make movement of water difficult through it.

Therefore, it is important to artificially provide cracks in the soil, to apply organic matter and/or chemicals making soil have an aggregated structure.

6–2 Soil Layer Improvement

Soil has generally both capillary porosity and non-capillary porosity. The lifting height by capillary action is different according to the soil particles. Small particles of soil have strong capillary action and large particles of soil have weak capillary action. Most soils in this Project Area have high capillary porosity that will be 100 to 200 cm from the water level.

In order to improve the three-phase distribution of soil, it is necessary to input gypsum as well as to improve soil by civil engineering method; the improvement implies cutting-off of capillary routes resulting in prevention of rise of groundwater containing salinity.

Sub-soil breaking should be conducted after construction of open and tile drainage work which is effective in raising the drainage quality.

6–3 Open Ditch and Tile Drain

(1) Water Table

Root depths of proposed crops are generally 0.6 to 1.5 m. Soil moisture is mostly absorbed by plant roots from where roots are concentrated in the soil. Generally,

50 to 70 percent absorption occurrs in the range of 30 to 50 cm from the soil surface. It can be said that there is no significant difference in the yields for most crops with a groundwater depth of 60 to 80 cm in loam and clay soils.

However, in the Project Area the yield of sugar beet is maximum at 110 to 150 cm of the groundwater depth, therefore it is recommended to lower the water table for this crop, which is weak against too much soil moisture. Hence, the proposed water table is set at 1.0 m deep.

(2) Drainage Discharge from Fields

Drainage discharge corresponds to the balance between the irrigation requirements and crop evapotranspiration values; its value for sorghum and soybean is 3.0 mm/day.

(3) Spacing of Drain

In upland field, assuming the water table is at 1.0 m and the bottom of drains is at 1.3 m from the soil surface, and that the soil property is homogeneous, the spacing of drains can be calculated by Donnan equation for the pipe drain and Hooghoudt equation for the open drain.

Using 4×10^{-4} cm/sec as a permeability coefficient, the space between drains is 26 m for tile drains and 22 m for open drains. Since the permeability coefficient will increase by improvement of the soil structure, the drainage system will function well with a spacing of less than 25 m.

(4) Open Drain and Tile Drain

The significant difference between open drain and tile drain is that the former works with certainty and the soil structure is promptly improved starting from the immediate neighborhood of the open drain. Tile drains have advantages in that the arable land can be utilized to full through mechanized farming.

From an economical viewpoint the unit cost of an open drain is 1.3 LE/m and that of tile drain is 2.2 LE/m. Therefore in the primary leaching period whole drains will be open drains for the effective leaching.

After the primary leaching period, however, whole open drains should be shifted to the tile drains. Drain spacing between both open and tile drains is planned at 23.3 m, and their depth at 1.3 m.

6–4 Leaching

(1) Primary Leaching

From the results of soil analysis, the values of "Electrical Conductivity (EC) showing a value of salt content in soil are 8 to 16 mmhos/cm in the most points of the area, and the points having an EC of more than 32 mmhos/cm are very few. The allowable EC values are less than 4.0 to 7.0 mmhos/cm for field crops such as sorghum, soybean and sugarbeet, and less than 1.5 to 3.0 mmhos/cm for most of the vegetables. Thus, leaching must be planned in this project. Leaching should be practiced in an early term after land reclamation to rapidly obtain the expected production.

Primary leaching is practiced after improving the low permeability caused by salinity, by adding gypsum over the area, providing drainage facilities and executing physical improvement of soil by engineering.

Table 5–4 EC Distribution Area Ratio

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

Primary leaching water requirements are calculated by the formula cited from FAO Irrigation and Drainage Paper No. 7.

The weighted average of EC values obtained at the measuring points all over the Project area is 14 mmhos/cm (900 ppm) and the leaching water volume for infiltration is estimated at 1,200 mm.

When 200 mm-deep water is kept on the ground surface at any time, the drainage value is 28 mm/day, and the standard days required for leaching will be 43 days.

The leaching water requirement is determined by 3 factors, i.e. the rate of evaporation from the water surface during the leaching period, the irrigation efficiency, and the infiltration volume. As the leaching period, 6 months from October to March of small evaporation have been selected. The mean evaporation rate over this period would be 4.4 mm/day. Thus, the total leaching water requirements would be 1,500 mm/annum and 90 m^3/day/feddan.

After executing the primary leaching, the EC values which range from 8 to 16 mmhos/cm all over the area are expected to be lowered to approx. 6 mmhos/cm. But even this new EC value is too high for proper growth of vegetables and other field crops. Supplementary leaching is therefore recommended in terms of a continuous use of the reclaimed land for paddy cultivation through flooding irrigation method. Such flooding irrigation would enable infiltration of water into the soils to the extent of 500 mm so that after 3 years' continous caltivation of paddy rice EC value should come down to 2 to 4 mmhos/cm which are not harmful for almost all the crops recommended under the proposed cropping patterns.

(2) Supplementary Leaching

Even after enterring the normal cultivation stage, it is necessary to wash away from the field the salt which will be accumulated on it due to the fact that irrigation water itself has a considerable salt content; such supplementary leaching shall be effected several times during each cropping season and volume of water required for this purpose would be 120 percent of each crop's normal irrigation requirements.

6–5 Drainage Requirement in the Project Area

Drainage requirement through the main and secondary drainage canals as well as the drainage pumps are determined by an equation and the results obtained are 21.3 m^3/day/feddan in the peak season and 3,681 m^3/year/feddan.

Since 25 percent excess capacity is given to all kinds of drainage facilities, the gross drainage discharge amounts to 27.5 m^3/day/feddan.

7. STRUCTURE DESIGN

7–1 Irrigation Canals

Irrigation canals are composed of main canal, secondary canal and tertiary canal. Spacing between the main canals is 4 to 10 km, and that between the secondary canals is about 2 km. Height of freeboard and banking ranges from 0.5 to 1.25 m according to the water quantity by using the data of U.S.B.R. The cross section of the main and the secondary canals is shown in Fig. 5–1.

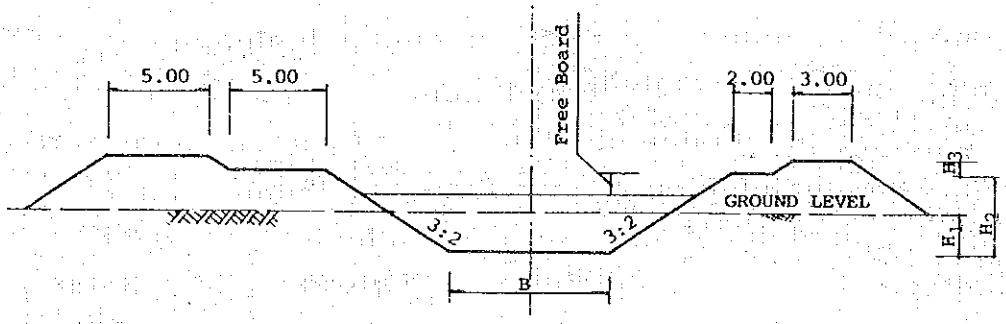


Fig. 5–1 Typical Cross Section

7–2 Gravity vs. Lifting Irrigation

On deciding the main canal slope and its design height, three case studies have been made by taking into consideration the following points:

- Lowest velocity which prevents weed growing.
- Earth work by taking the balance between cutting and banking, into consideration.
- Gravity irrigation or lifting irrigation.

Case 1. Gravity irrigation for all the area, gentle slope and low velocity.

Case 2. Gravity and lifting irrigation, slope depending on velocity of 0.4 to 0.5 m/sec.

Case 3. Lifting irrigation for all the area, gentle slope and low velocity.

Co-relationship of the slope, velocity, earth balance and construction/O & M costs among these three cases are shown in Table 5–5 and Table 5–6.

Table 5–5 Velocity and Earth Balance

Case	Slope	Velocity (m/sec)	Earth Balance (000 m^3)		
			Cutting	Banking	Surplus
1	1/10,000∿1/40,000	0.23∿0.49	1,364	2,634	−1,270
2	1/2,500 ∿1/ 9,000	0.44∿0.55	1,976	974	1,002
3	1/10,000∿1/40,000	0.23∿0.49	2,529	664	1,865

Table 5–6 Construction Cost of Gravity or Lifting Irrigation (LE/year/110,000 fed.)

Case	Irrigation	Earth work	Pump	Operation	Total
1	Gravity	39,000	–	–	39,000
2	Gravity & Lifting	27,000	317,000	518,000	862,000
3	Lifting	33,000	429,000	934,000	1,390,000

Note: Durable period – Canal = 50 years
Pump = 7 years

Ultimately, Case 1 has been adopted for this project on the following grounds:

i) Total cost is the lowest with Case 1, and the cost-gaps between Case 2 and Case 3 are enormous.

ii) Although Case 1 results at shortage of earth, most of such shortage can be recovered from nearby the canal and the balance can be met by spoils available from drainage canals.

iii) Topographic features on one hand and economicality on the other do not justify a larger velocity than 0.7 m/sec. Weed-control along the canal may be effected by either concrete-lining of the canal or periodical canal clearings, preferably the latter.

iv) Only a sound and efficient water management system can prevent pilferage of irrigation water by use of pumps owned by individual farmers.

7–3 Drainage Canals

Drainage canals are composed of main canal, secondary canal and tertiary canal. The main drainage canal is constructed one each in North Hussinia and South Port Said at the low elevation part between the main irrigation canals, and is connected to the drainage pump station.

The depth of the drainage canal is decided according to the height between the planned ground surface and the water level, that is 2.0 m for the main canal and more than 1.6 m for the secondary canal.

7–4 Pumping Station

Since the ground level of the Project Area is lower than the water level of Lake Manzala, pumping drainage method is proposed.

In North Hussinia area, it is located at north-west part. In South Port Said area, it is located at the middle of west part where Baqar Drain will be extended.

Discharge amount of the pump is shown in Table 5–7. Bore of the pump is determined at 1,200 mm to drain 3 m^3/day/feddan of water in April.

Seven pumps in North Hussinia and four pumps in South Port Said are planned to be set up.

Each pump is provided with one spare pump. The specifications of the pump stations are shown in Table 5–8.

Table 5–7 Discharge Amount

Project Area	Area	Discharge Amount	
North Hussinia Section	69,000 feddan	1,318 m^3/min	254 million m^3/year
Port Said Section	41,000	783	151

Table 5–8 Dimension Table of Pumping Station

Items \ Station Name	North Hossinia Pumping Station	South Port Said Pumping Station
Discharge Area	69,000 feddan	41,000 feddan
Unit Discharge Capacity	27.5 cum/day/fed.	27.5 cum/day/fed.
Type of Pump	Mixed Flow Vertical Pump	Mixed Flow Vertical Pump
Diameter & Unit	1,200 mm x 8	1,200 mm x 5
KW and HP	320 KW	320 KW
Total Head	7.0 m	7.0 m
Actual Head	6.0 m	6.0 m
Suction Water Head	EL. –5.50 m	EL. –5.50 m
Discharge Water Head	EL. 0.50 m	EL. 0.50 m
Pumping Station Area	12.00 x 55.00 m	12.00 m x 43.00 m

7–5 Appurtenant Structures

As the appurtenant structures, following five facilities are planned to be set up.

1. Intake
2. Check gate (Radial gate)
3. Crossing work (Bridge for main and secondary canal Box culvert for the other)
4. Water measuring gage (Pershal flume)
5. Spill way

7–6 Farm Consolidation

There are two units of farmland: one is the Field Lot which is the smallest unit for farming being encircled by irrigation/drainage canals, borders and roads, and another is Farm Block which is comprised of 15 field lots. Size and form of these two units of farmland have important bearing on farm labour, irrigation/drainage and productive use of the given land.

The factors to be taken into consideration in determining the shape of the farm lot are the operating efficiency of farm machinery, the working efficiency of the farmers, the O & M of irrigation/drainage facilities, the topographic condition, the farm management method, the construction cost, and the marginal area for various facilities. As a result, the length of standard farm lot has been decided at 100 m as the maximum.

For flooding irrigation which is required for paddy cultivation, the field would require a considerable length and accordingly its width will have to be limited so as to regulate its total size at 1 to 1.5 feddan in total.

For mechanized farming by heavy machinery, the minimum width of the field should be 45 to 50 m.

For the 3–year rotation system involving cultivation of paddy and other crops, the farmers' unit lot will be divided into 3 equal parts of 1.67 feddan each.

Thus, the configuration of the farmer's land will be 210 m x 100 m, being divided into 3 unit-lots of 100 m x 70 m, as are showin in Fig. 5–2.

The length of the Farm Block has been decided at about 1,000 m by considering the density of secondary canals and drains, their construction cost, farm labor efficiency, and the interval between farm roads.

There are two alternative plans concievable for configuration of farm land. One is that the farm land will be so shaped as to suit mechanized farming in parallel to the farm road, and the other is for mechanized farming in right angle to the farm road. The former plan may be termed Alternative 1 and the latter, Alternative 2; their specifications are shown in Table 5–9.

Table 5--9 Alternative Plan for the Farm Configuration

Items	Alternative No. 1	Alternative No. 2
1. Farm block shape (m)	1,050 x 100	1,000 x 210
area (feddan)	25	50
2. Farmer's land shape (m)	210 x 100	210 x 100
area (feddan)	5	5
3. Field lot shape (m)	100 x 70	100 x 70
area (feddan)	1.67	1.67
4. Cultivated area (%)		
(1) On farm road		
Tertiary canal and drain	13.3	14.1
(2) Cultivated area	86.7	85.9
Total	100	100
5. Construction Cost (LE/feddan)	1,839	1,932

Upon comparison between these two in terms of construction cost, density of roads and canals as well as operation and maintenance, No. 1 has been adopted for this Project.

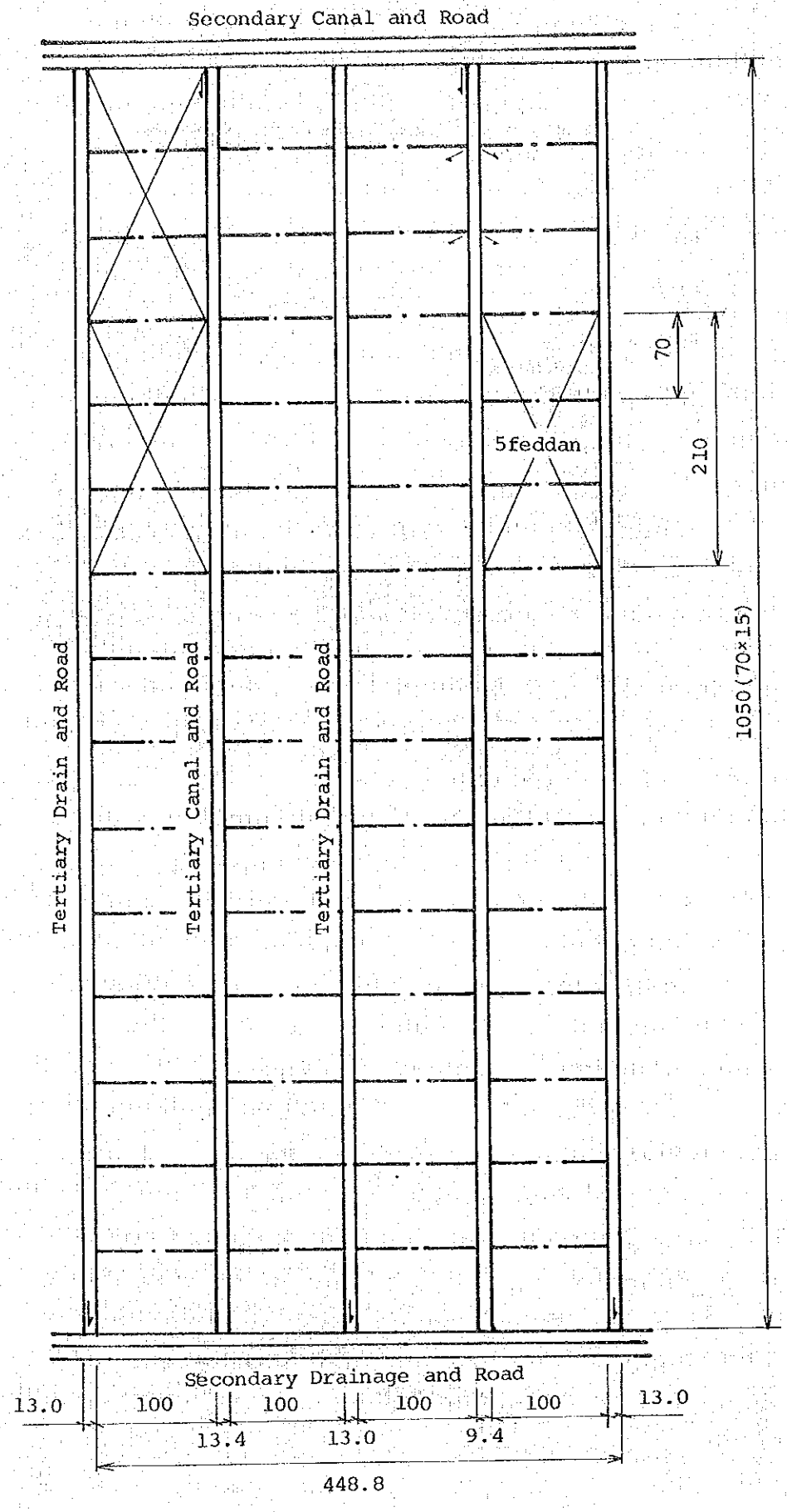


Fig. 5–2 Standard Lot (TYPE–I)

8. RURAL DEVELOPMENT PLAN

8–1 General

This project will be one of the major projects in Egypt which aims at an overall agricultural development through large-scale land reclamation. Agricultural and agriculture-based activities in the Project Area will be initiated, pushed forward, and completed by different categories of settlers.

The facilities necessary to accommodate incoming settlers will be provided, stage by stage, in accordance with the progress of project implementation. While every amenity indispensable for wholesome living should be furnished on the standards which are considerably higher than those prevailing among the ordinary rural villages, settlement plans have to take into full consideration the social, economic and local administrative aspects as well as agricultural development aspects.

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

- Settlement
- Housing
- Infrastructures

a) Village facilities
b) Main and village roads
c) Potable water
d) Sewage and refuse treatment
e) Electric power
f) Telecommunication

8–2 Settlement Plan

(1) Organization of the Settlement

This settlement plan is a part of the comprehensive development plan covering about 240,000 feddan including 80,000 feddan of South Hussinia Project Area, 50,000 feddan of South Port Said South Project Area (henceforth referred to as "the wide area"). About 230,000 people will settle down in this wide area in future. Such being the case, social and technical services shall be appropriately rendered for the wholesome life of the new settlers.

In order to develop and administer this area, a town will be established in its center at the crossing of El Salam Canal and Bahr El Baqar in the North Hussinia Project Area.

The settlements in the Project Area shall be established as so many groups of inhabitants according to their farming level and social activities so that the social and technical services can be rendered more effectively and efficiently. Under the conditions, the settlement pattern is considered to be a three-tiered, hierarchical setup of: a) sattlelite village, b) service village, and c) central village. The project will employ clustered village community planning.

a) Satellite Villages

Stellite villages will be established in a moderately clustered formation as cores of the local activity zones and will be located within 2 km walking distance to farmland of the inhabitants.

The social function of the communities should be maintained by limiting the size of the communities to 300 households or 2,000 in population. Consequently, the satellite villages will occupy an average size of approximately 2,000 feddans.

Smaller size satellite villages may be more advantageous for farming management, but they will bring some demerits in rendering efficient public services.

b) Service Villages

One service village is provided for each four to six satellite villages at a service position among them. They are given the role to cater for the benefits of satellite villages encircling it.

The service village will be furnished with intermediate facilities for the public amenities on behalf of the satellite villages coming under its umbrella.

c) Central Village

The central village will be located at a pivotal position in the settlement area covering so many service villages and their satellite villages, and will have the necessary facilities to meet the demands arising in its settlement area.

(2) Location of Villages

The settlements will be located along irrigation canals as far as possible so that roads to be constructed along canals will be utilized for the dual purposes of village roads and operation and maintenance roads of the canals. It has also been taken into consideration that water management will be easy if villages are located along the irrigation canals.

A settlement pattern has been established so as to let all farmers have their houses within a walking distance of about 2 km from their fields.

The proposed number of villages classified by type is as follows:

Settlement	South Port Said	North Hussinia	Total
Satellite village	16	24	40
Service village	3	5	8
Central village	1	2	3
Town	1	–	1
Total	21	31	52

(3) Number of Settlers and Population

The number of settlers and population in each standard hierarchical settlements will be estimated approximately as follows;

	Satellite Village	Service Village	Central Village	Town
Farm households	250	230	187	–
Owner households	33	30	18	–
Non-farm households	45	95	422	2,000
Population	1,700	1,800	3,000	10,000

The total unmber of households and population after settlement are summarized as follows;

	Households	Population
Farm households	12,400	62,000
Owner households	1,573	7,865
Non-farm households	5,827	29,135
Total	19,800	99,000

9. COST ESTIMATION

9–1 Conditions of Cost Estimation

The following assumptions have been adopted for estimating the Project costs:

(1) The exchange rate between Egyptian Pound and U.S. Dollar:

U.S. $1.00 = Egyptian Pound (LE) 0.80

(2) All the construction of civil works are to be executed on a full contract basis through international competitive bidding. The equipment required for construction will be provided by the constractors. Therefore only the depreciation cost of equipment is included to the estimated Project cost.

(3) The construction cost is divided into foreign and local currency portions. Local currency portion is estimated based on the data collected in Port Said, Ismailia, and Cairo. Foreign currency portion is estimated based on the C.I.F. prices of materials and equipment being imported through the neighboring port to the Project site. The classification of local and foreign currency portions is defined as follows:

Local Currency Portion:

- labor wages,
- sand, gravel,
- fuel, oil, ets.,
- inland transportation costs and local insurance.

Foreign Currency Portion:

- gates and steel,
- expenses and fees of engineering services of foreign consultants,
- vehicle required for the construction supervision and O & M equipment for the project operation.

9–2 Unit Price

The unit prices of construction materials were decided based on the data obtained in the meetings between the Government officials and the Team members as well as the data collected in Cairo, Ismailia, and Port Said.

9–3 Project Cost

The total Project cost was estimated at 481,836,000 LE of which 334,826,000 LE will be local currency and 147,010,000 LE (equivalent to US$183,763,000) will be foreign currency. The breakdown of the Project cost is shown in Table 5–11. The unit cost is 1,980 LE/feddan at 1983 price.

The annual disbursement schedule is worked out based on the implementation schedule as Table 5–10.

Table 5–10 Annual Disbursement Schedule

(LE '000)

	Project Year	South Port Said			North Hussania			Total Project		
		L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total
1	1986	104	527	631	178	894	1,072	282	1,621	1,903
2	1987	162	256	418	277	434	711	439	690	1,129
3	1988	6,879	6,161	13,040	15,957	9,633	26,590	23,836	15,794	39,630
4	1989	10,855	5,771	16,626	19,455	10,646	30,101	30,310	16,417	45,727
5	1990	11,207	5,900	17,107	19,025	10,339	29,364	30,222	16,239	46,471
6	1991	14,520	7,041	21,561	24,784	12,416	37,200	39,304	19,457	58,761
7	1992	11,572	6,849	19,421	22,509	10,522	33,031	34,081	16,371	51,452
8	1993	17,161	7,185	24,346	21,014	8,993	30,007	38,175	16,178	54,353
9	1994	504	0	504	10,455	4,192	14,647	10,959	4,192	15,151
10	1995	16,389	5,061	21,450	6,190	2,444	8,634	22,579	7,505	30,074
11	1996	0	0	0	14,818	4,805	19,623	14,818	4,805	19,623
12	1997	23,583	7,432	31,015	17,048	5,416	22,464	40,331	12,848	53,479
13	1998	0	0	0	21,093	6,272	27,365	21,093	6,272	27,365
14	1999	0	0	0	28,087	7,819	35,906	28,087	7,819	35,906
Total		112,936	52,183	165,119	221,890	94,827	316,717	334,826	147,010	481,836

Table 5–11 Estimation of the Total Project Cost

(LE '000)

Description	L/C	F/C	Total
Stage I			
1. Preparatory Work	157	–	157
2. Civil Works			
– Main Irrigation Canals	3,084	3,613	6,697
– Secondary I. Canals	4,129	9,948	14,077
– Main Drainage Canals	5,542	4,001	9,543
– Secondary D. Canals	1,152	988	2,140
– Housing Canals	402	380	782
– Roads and Dykes	4,094	242	4,336
– On-farm Facilities	52,595	40,496	93,091
– Pumping Station	2,671	6,386	9,057
– Tidal Dyke	3,000	–	3,000
Sub-Total	76,669	66,054	142,723
3. O & M Cost for Civil Works	720	–	720
4. Administration Cost	7,120	0	7,120
5. Consulting Service	1,621	4,796	6,417
Sub-Total	86,287	70,850	157,137
6. Physical Contingency	8,629	7,083	15,712
Total (Gross Construction Cost)	94,916	77,933	172,849
7. Price Escalation	119,565	32,272	151,837
Sub-Total	214,481	110,205	324,686
Stage II			
1. Tile Drains	21,194	17,333	38,527
2. O & M Cost for Civil Works	–	–	–
3. Administration Cost	1,921	0	1,921
4. Consulting Service	129	285	414
Sub-Total	23,244	17,618	40,862
5. Physical Contingency	2,324	1,763	4,087
Total (Gross Construction Cost)	25,568	19,381	44,949
6. Price Escalation	94,777	17,424	112,201
Sub-Total	120,345	36,805	157,150
Total Project Cost	334,826	147,010	481,836

Table 5–12 Estimation of the South Port Said Project

(LE '000)

Description	L/C	F/C	Total
Stage I			
1. Preparatory Work	56	–	56
2. Civil Works			
– Main Irrigation Canals	1,202	1,266	2,468
– Secondary I. Canals	1,288	2,898	4,186
– Main Drainage Canals	1,738	1,263	3,001
– Secondary D. Canals	410	352	762
– Housing Canals	154	146	300
– Roads and Dykes	1,449	181	1,630
– On-farm Facilities	19,603	15,094	34,697
– Pumping Station	1,239	2,704	3,943
– Tidal Dyke	–	–	–
Sub-Total	27,083	23,904	50,987
3. O & M Cost for Civil Works	–	–	–
4. Administration Cost	2,538	0	2,538
5. Consulting Service	612	1,787	2,399
Sub-Total	30,546	25,691	56,237
6. Physical Contingency	3,054	2,568	5,622
Total (Gross Construction Cost)	33,600	28,259	61,859
7. Price Escalation	39,364	11,431	50,795
Sub-Total	72,964	39,690	112,654
Stage II			
1. – Tile Drains	7,900	6,460	14,360
2. O & M Cost for Civil Works	–	–	–
3. Administration Cost	718	0	718
4. Consulting Service	58	93	151
Sub-Total	8,676	6,553	15,229
5. Physical Contingency	868	656	1,524
Total (Gross Construction Cost)	9,544	7,209	16,753
6. Price Escalation	30,428	5,284	35,712
Sub-Total	39,972	12,493	52,465
Total Project Cost	112,936	52,183	165,119

Table 5–13 Estimation of the North Hussinia Project

(LE '000)

Description	L/C	F/C	Total
Stage I			
1. Preparatory Work	101	–	101
2. Civil Works			
– Main Irrigation Canals	1,882	2,347	4,229
– Secondary I. Canals	2,841	7,050	9,891
– Main Drainage Canals	3,804	2,738	6,542
– Secondary D. Canals	742	636	1,378
– Housing Canals	248	234	482
– Roads and Dykes	2,645	61	2,706
– On-farm Facilities	32,992	25,402	58,394
– Pumping Station	1,432	3,682	5,114
– Tidal Dyke	3,000	–	3,000
Sub-Total	46,586	42,150	88,736
3. O & M Cost for Civil Works	463	–	463
4. Administration Cost	4,582	0	4,582
5. Consulting Service	1,009	3,009	4,018
Sub-Total	55,741	45,159	100,900
6. Physical Contingency	5,575	4,515	10,090
Total (Gross Construction Cost)	61,316	49,674	110,990
7. Price Escalation	80,201	20,841	101,042
Sub-Total	141,517	70,515	212,032
Stage II			
1. – Tile Drains	13,294	10,873	24,167
2. O & M Cost for Civil Works	–	–	–
3. Administration Cost	1,203	0	1,203
4. Consulting Service	71	192	263
Sub-Total	14,568	11,065	25,633
5. Physical Contingency	1,456	1,107	2,563
Total (Gross Construction Cost)	16,024	12,172	28,196
6. Price Escalation	64,349	12,140	76,489
Sub-Total	80,973	24,312	104,686
Total Project Cost	221,890	94,827	316,717

Table 5–14 Estimation of Civil Work Costs

(LE '000)

Description	L/C	F/C	Total
South Port Said			
· Block 1	11,439	11,010	22,449
· Block 2	10,478	8,568	19,046
· Block 3	6,501	5,330	11,831
· Block 4	6,565	5,456	12,021
[Sub-Total]	34,983	30,364	65,347
North Hussinia			
· Block 1	13,569	13,913	27,482
· Block 2	13,377	11,321	24,698
· Block 3	14,830	13,037	27,867
· Block 4	12,522	10,186	22,708
· Block 5	5,582	4,566	10,148
[Sub-Total]	59,880	53,023	112,903
Tidal Dyke	3,000	–	3,000
Total	97,863	83,387	181,250

9–4 Related Projects

Related projects with this agricultural development project are new village construction, pilot farm establishment and agro-industries establishment. The construction costs are estimated as showing Table 5–15.

Table 5–15 Estimation of Related Projects

(LE '000)

Project	L/C	F/C	Total
New Village Construction	553,791	180,653	734,444
Pilot Farm	1,923	2,680	4,603
Agro-Industry			
Sugar Beet Factory	16,500	68,000	84,500
Milk Processing Factory	3,600	16,000	19,600
Vegetable Factory	3,610	5,410	9,020
Slanghter House	1,820	9,225	11,045

Table 5–16 Estimation of Pilot Farm Construction Cost

(Unit: LE)

Description	Unit	Volume	Unit Price L/C	Unit Price F/C	L/C x 1,000	F/C x 1,000	Total x 1,000
1. Land Reclamation							
Land consolidation	fed.	350	800	700	280	245	525
Sprinkler	fed.	150	1,200	1,500	180	225	405
Pumping Station	PS	1	–	–	22	58	80
Windbreaker	L.S.	1	–	–	20	–	20
[Sub-Total]					[502]	[528]	[1,030]
2. Building and Furniture							
Office	s.q.m	150	180	40	27	6	33
Labour houses	s.q.m	700	150	30	96	18	114
Furniture	L.S.		–	–	7	5	12
Building for training	s.q.m	300	120	60	36	18	54
Quarters	s.q.m	600	120	40	72	24	96
Laboratory	s.q.m	200	200	80	46	26	72
Storehouse		400	70	20	28	8	36
Equipment shed	s.q.m	400	100	50	45	23	68
Animal shed	s.q.m	400	40	10	16	4	20
Building for Animal experiment	L.S.	1	–	–	77	336	413
Mosque	s.q.m	100	150	40	15	4	19
[Sub-Total]					[465]	[472]	[937]
3. Equipment							
Equipment (O & M)	L.S.	1	–	–	–	124	124
Equipment (Agriculture)	L.S.	1	–	–	–	858	858
Spare parts	L.S.	1	–	–	–	80	80
[Sub-Total]					[–]	[1,062]	[1,062]
4. Attendant Works							
Road	L.S.				200	–	200
Generator	L.S.				20	80	100
Generator shed	s.q.m.	50	80	20	4	1	5
Ferry boat	Set	1			0	50	50
Ferry jetty	L.S.	1	–	–	7	–	7
Water Tank	L.S.				25	40	65
Sawage works					2	6	8
Portable water works					2	12	14
Fence					7	0	7
[Sub-Total]					[267]	[189]	[456]
5. Miscellaneous expenses	L.S.				128	76	204
6. Overhead					176	109	285
7. Total					[1,538]	[2,436]	[3,974]
8. Price escalation					385	244	629
[Total]					[1,923]	[2,680]	[4,603]

CHAPTER VI PROJECT IMPLEMENTATION AND OPERATION

CHAPTER VI PROJECT IMPLEMENTATION AND OPERATION

1. IMPLEMENTATION AND OPERATION

1–1 Implementation and Operation Organization

The Project would measure its degree of success by its own performance – how well it might accomplish its self-imposed tasks of attaining highly productive agriculture and animal husbandey combined with agro-industries meant for processing of their products, while maintaining wholesome livelihood environment of its residents. The responsibility for discharging such an ultimate duty rests with the project management body as a central pivot for implementing and executing the entire project. As such, the project management body will have to be established as an inter-Ministerial organization comprising various enpowered agencies of the Government. Since, however, the practical issues as regards which agencies would be involved and who might represent what authority is the Government responsibility, this Report will remain to deal with the description of the minimum necessary functions desired of the Project management body and their convenient grouping into a few Sections or Departments.

The Project Management Body will be of three-tiered structure, i.e. the Headquarters in the Town, the Central Village Office at the Central Village level, and the Service Village Outpost at the Service village level. Its headquarters will have at least four Sections as follows:

(1) Promotion;

(2) Agriculture;

(3) Community, and

(4) Administration.

As (1) Promotion deals mainly with agricultural matters and (2) Agriculture, entirely with agricultural production, they may be alternately designated as (i) Agricultural Development and (ii) Agricultural Production. In either case, 'agriculture' implies not only crop cultivation but animal husbandry also. (3) Community handles the residents' livelihood aspects, and (4) Administration is a Section meant for the project management body's own operation and maintenance. Its general framework and Sectional functions will be discussed in the Annex P of Vol. IV.

1–2 Construction Mechanization

(1) General

Major civil works and their quantities proposed for the project are as follows:

i)	Drainage Pumping Station	2 places	
ii)	Drain	N. Hussinia	S. Port Said
	– Main Drain	84.1 km	25.3 km
	– Secondary Drain	77.7 km	140.8 km

iii)	Canal		
	– Main canal	66.4 km	39.8 km
	– Secondary canal	173.5 km	91.2 km
iv)	Dykes	41.9 km	30.9 km
v)	Reclaimed land	53,820 feddan	31,980 feddan

Almost all the construction works are accounted for earthwork except for drainage pumping stations and bridges. Therefore heavy equipment required for the civil works is estimated based on the work quantity, construction schedule, and natural conditions of the Project Area.

(2) Bearing Capacity for Construction Equipment

The bed of Manzala Lake is covered with sludge. This stratum is about 70 centimeters thick. At the area like this condition, it is impossible to use heavy equipment immediately after land drainage work because of the poor bearing capacity of the land.

Deployment of heavy equipment will become possible within seveal months during which the surface soil will dry up. At the other area which has already been dried up, the trafficability for medium size equipment will be secured. The result of bearing capacity survey (Corn Penetration Test) at the Project site is shown in the Annex P.

(3) Equipment for Construction Work under Water

As mentioned in the next clause 1–3, Earthwork required for construction of pumping station and main drainage canal will involve excavation work under the water. Therefore drag-lines and microdredgers will need to be introduced.

(4) Necessary Units of Construction Equipment

Necessary units of various construction equipment required for construction works in the Project Area are listed in Table 6–1.

Table 6–1 Necessary Units and Cost of Construction Equipment

(LE' 000)

Name of Equipment	Specification		Nos.	Unit Price (FC)	Cost (FC)
Bulldozers	21 ton	183 ps	123	90	11,070
" (Swampy)	18 ton	108 ps	5	51	255
"	8 ton	76 ps	172	34	5,848
Backhoes	0.35 cum	80 ps	95	43	4,085
"	0.60 cum	127 ps	17	65	1,105
Drag-lines	1.20 cum	170 ps	5	210	1,050
"	0.60 cum	105 ps	5	89	445
Micro Dredgers	ϕ300	370 ps	33	216	7,128
Tire Rollers	20 ton	85 ps	29	30	870
Road Rollers	10 ton	58 ps	48	44	2,112
Scrape-dozers	6.4 cum	192 ps	29	121	3,509
Ripper-dozers	21 ton	190 ps	35	102	3,570
Wheel-type Loaders	2.1 cum	134 ps	28	61	1,708
Motor-graders		126 ps	5	48	240
Dump Trucks	8 ton	244 ps	285	21	5,985
"	10 ton	312 ps	18	31	558
Trucks	4 ton	159 ps	18	10	180
"	8 ton	244 ps	18	20	360
Water Trucks	10 cum	310 ps	57	20	1,140
Fuel Trucks	8,000 lit.	224 ps	9	30	270
Trailers	25 ton		4	82	328
Diesel Pile Hammers	2.5 ton		1	38	38
Crawler Cranes	35 ton		3	136	408
Concrete Mixers	0.5 cum	7.5 kw	27	9	243
Generators	45 kVA		9	10	90
Belt Conveyers	L–7.00 m		18	1	18
Concrere Vibrators	2.5 ps		27	1	27
Water Pumps	ϕ100 mm	5.5 kw	30	1	30
Trenchers		36 ps	13	27	351
Boling Machines		5 ps	3	10	30
Car Jeeps			18	10	180
Car Wagons			9	17	153
Motorcycles	90 cc		36	1	36
Sub-Total					53,420
Spare Parts (10% of above)					5,342
Total					58,762

1–3 Implementation Schedule

(1) Basic Idea of Construction Schedule

Basic idea of the construction schedule is defined as follows:

1) Apart from the limited amount to be consumed through evaporation, most of the closed water needs to be drained by use of pump and provision of main drainage canal, to avoid accumulation of salt on the reclaimed soil. Hence, the boundary of each block is composed of the main drainage canal and dyke.

   Final closure of the tidal dyke will have to be done at the next stage of the main drain and pumping station construction; blocks whose land consolidation work will not yet been started will need to be left under the closed water.

2) Consequently, the facilities which will have to be completed at the first stage include dykes, pumping stations and main drains. The earthwork required for their construction involves excavation work under water. Furthermore, coffer-dams will have to be constructed around the pumping station in North Hussinia section.

3) In spite of the above discussions, in any part or parts of 4 blocks (NH-2, NH-3, PS-1 and PS-2) which is near El Salam Canal and has already been dried up, it is possible to start construction work with irrigation facilities, drainage facilities and land consolidation (ref: Fig. 6–1 below).

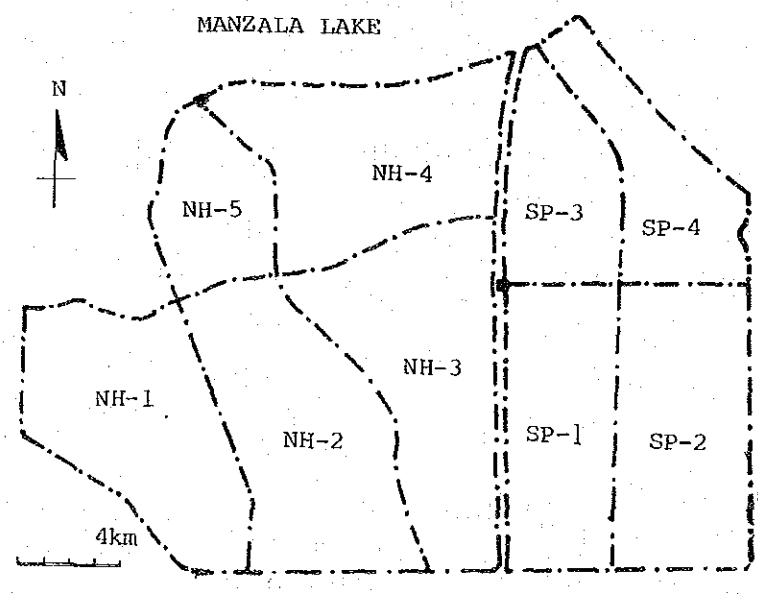
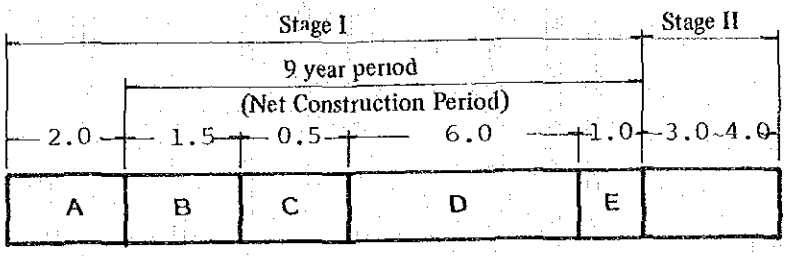


Fig. 6–1 Construction Phasing Blocks

(2) Implementation Schedule

Stage I construction period lasts for 11 years, including 2 years' preparation for Detailed Design, Tender Procurement and Tendering. The first phase (1.5 years) is meant for construction of dykes, pumping stations and the main drainage canals, then follows the second phase (0.5 year) for drainage of the closed water and drying-up. Third phase (6 years) is for construction of irrigation canals, secondary drainage canals and reclamation work. The final phase is for the primary leaching.

The implementation schedule in bar-chart is shown in Fig. 6–2, and the basic pattern of the construction schedule is as follows:



Working item

Stage I
- A: preparatory work
- B: dyke, pumping station, and main drainage canal
- C: drainage of closed water and dry up
- D: irrigation canal, secondary drainage canal, and land reclamation work. (1,800 fed./year)
- E: leaching work

Stage II Tile drain construction

(3) Basic Pattern of Construction Schedule

The basic pattern of construction schedule ranging for 9 years has been worked out. Such decision was made from the lessons learned from past experiences in land reclamation projects which were aimed at agricultural development. More concretely speaking, the optimal volume of the construction work of this nature has been identified at about 2,000 feddan per year from such practical considerations as the provision of numerous construction materials, the mobilization of labor, the deployment of construction machinery and equipment, and the organization and training of farmers. 9-Year Construction Plan is shown in Fig. 6–3.

However, in reply to the request made by the Egyptian Government, the alternative construction schedules for 5 years and 7 years are discussed in Annex P.

Fig. 6–2 Project Implementation Schedule

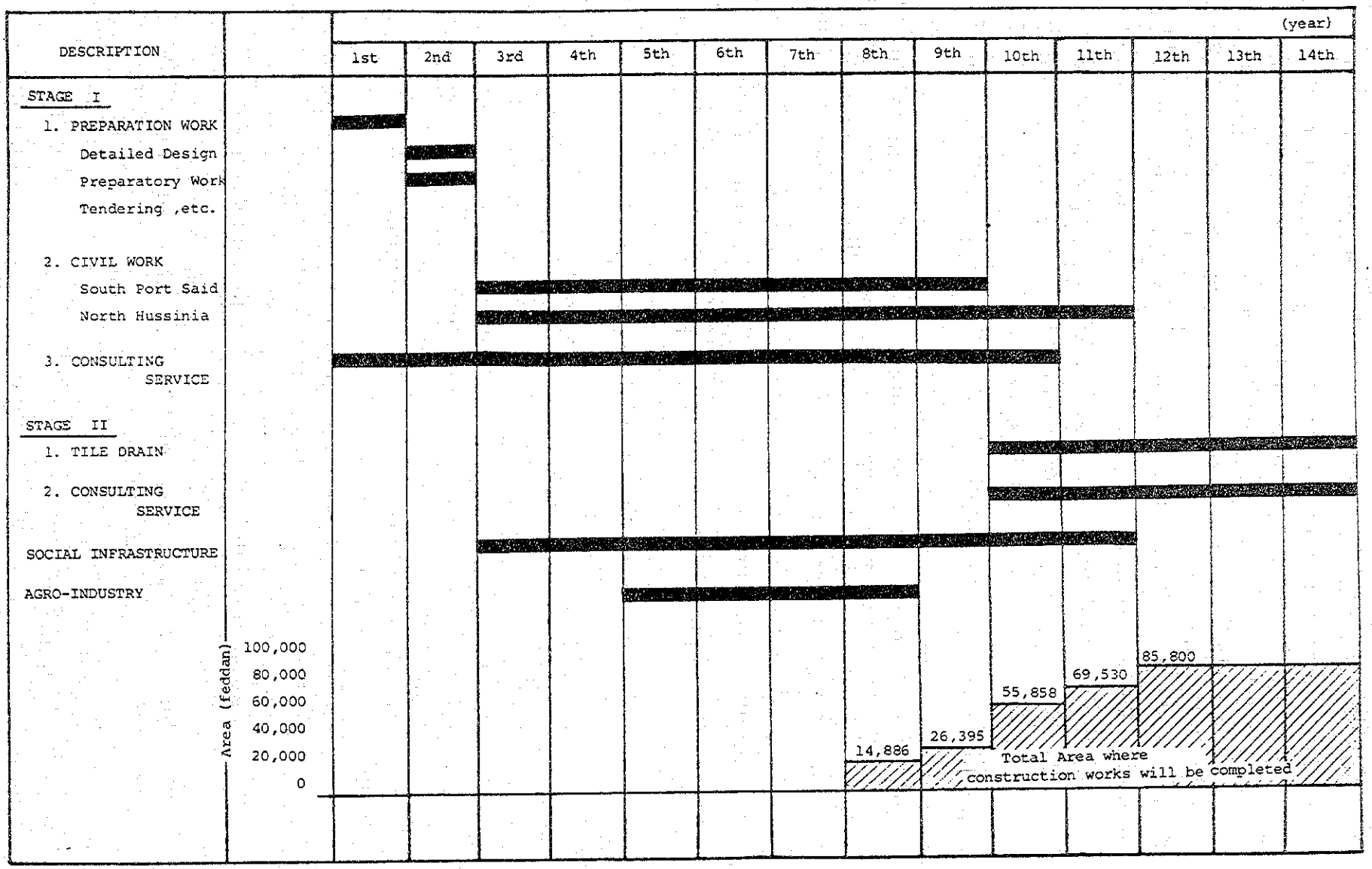
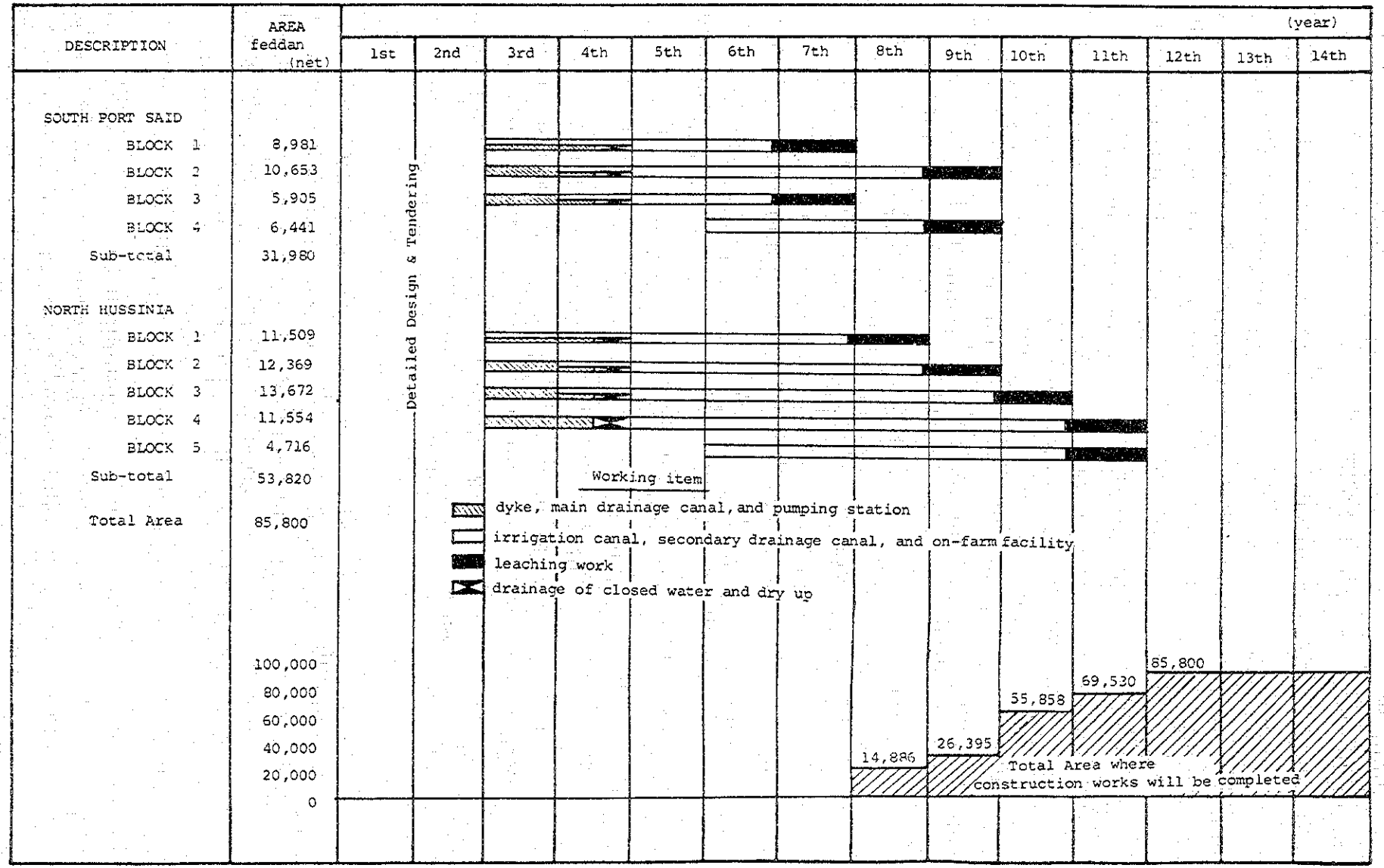


Fig. 6–3 Construction Schedule



2. OPERATION AND MAINTENANCE

2–1 Operation and Maintenance Cost

The annual operation and maintenance costs include the salaries of project administration and water control staff, the materials and labour cost for repair and maintenance of project facilities, the costs for operation, repair and maintenance of O & M equipment, runnig costs of project facilities, and replacement costs of the mechanical works. These annual costs are shown in Table 6–2.

Table 6–2 Annual Operation and Maintenance Cost

(Unit : LE/year)

Description	L/C	F/C	Total
Building	24,300	10,400	34,700
Equipment	8,500	161,000	169,500
Salary and Wages	142,800	–	142,800
Electric Power and Fuel charge	513,000	–	513,000
Office Supplies	138,000	–	138,000
Replacement Cost	213,000	714,000	927,000
Total	885,400	1,039,600	1,925,000

2–2 Water Management

(1) Basic Thinking

Scope of the water management includes a) saving and rational utilization of irrigation water, b) applicable drainage and c) operation and maintenance of facilities for irrigation and drainage. The following three organizations are in charge of water management of the project, i.e. the Ministry of Irrigation (MOI), the Project Authority (P.A) and Farmers Association (F.A).

Scope of MOI

MOI will manage six intakes for the main canals from El Salam Canal. Measurement of discharge and operation of intake gates should be carried out very severely, as the water requirement varies from time to time. The measurement is carried out with parshall flume set at each point, and the conversion table of water level and discharge is made to measure the direct current.

Scope of Project Authority

The Rational Irrigated Agriculture Office (RIAO) which is under organization of the Project Authority is in charge of the water management of the Authority. Followings are the responsibilities of RIAO.

a) to divert the water to secondary canals from main canals.

b) to maintain and repair the main canals and the secondary canals.

c) to maintain and repair the main drains and the secondary drains.

d) to operate and maintain the drainage pumping stations.

Scope of Farmers Association

F.A. is consisted by 14,000 farmers households and they carry out water management is small groups. The water Users Group, is a main unit of the water management of tertiary level canals and drains, each coverings 400 feddans. There are about 200 groups. The sub-Water Users Group consists of ten farmers and covers 50 feddans. They check and control the water capacity for each farm and also maintain and repair their tertiary canals and drains.

(2) Water Distribution Plan

The following four remarks based on the Rotation Irrigation are to be maintained.

1) Water diversion from the main canal to secondary canal is executed to keep the design volume defined within the entire schedule under one main canal.

2) Irrigation plan on a field unit is built on the main canal water supply program.

3) Maintenance of the diversion water depth at a fixed level in a main or secondary canal is controled by gate provided in the canal.

4) Additional intake to the design volume is denied to keep the design water depth in a main canal during intermittent irrigation.

All the above operations are organized under the water management system, and thus, a stable system is to be established to efficiently control these operations.

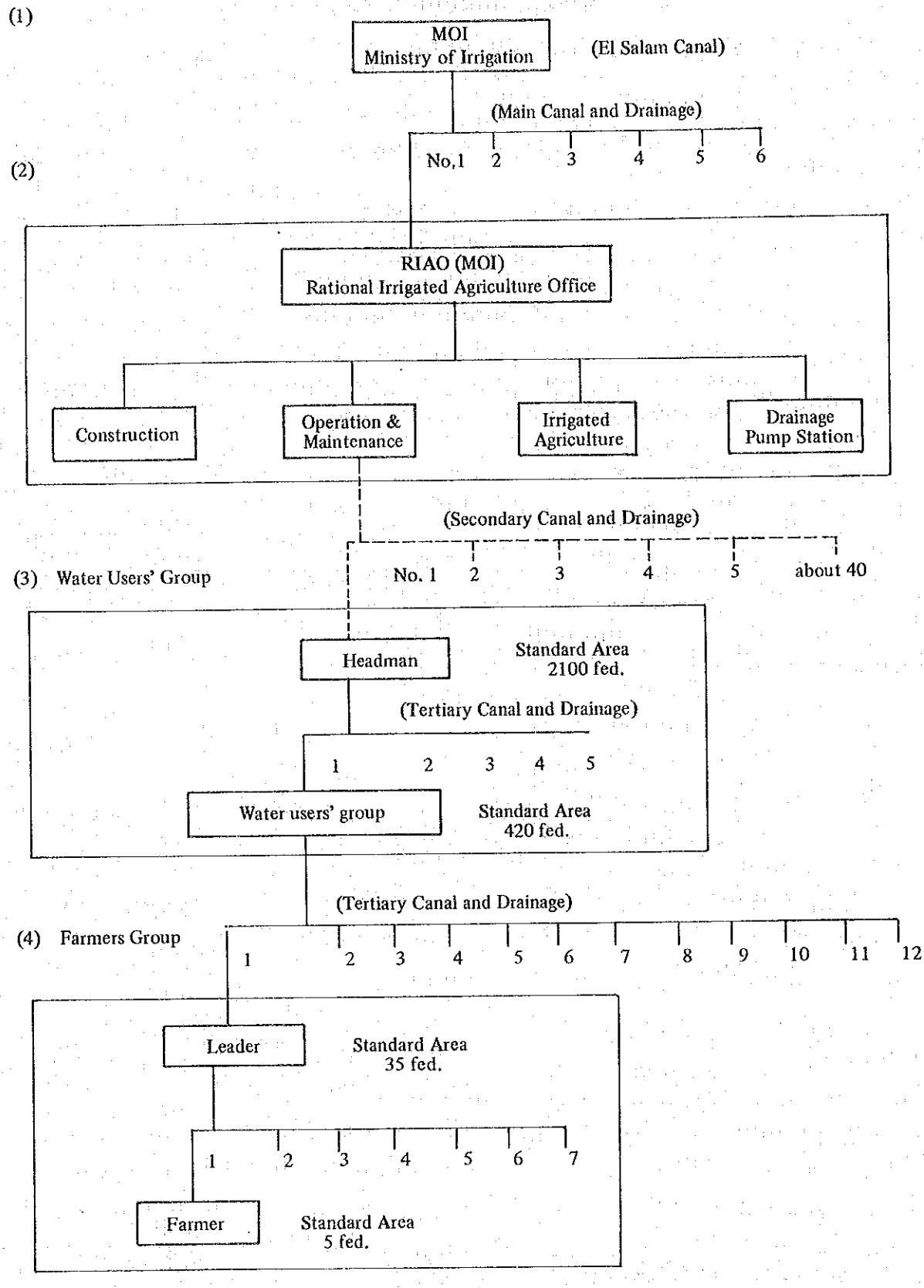


Fig. 6–4 Proposed Organization of Water Use

(3) The construction cost is divided into foreign and local currency-portions. Local currency portion is estimated based on the data collected in Port Said, Ismailia, and Cairo. Foreign currency portion is estimated based on the C.I.F. prices of materials and equipment which are imported through the neighboring port to the Project site. The classification of local and foreign currency portions is defined as follows:

Local Currency Portion:

- labor wages,
- sand, gravel,
- fuel, oil, etc.,
- cement,
- inland transportation costs and local insurance,

Foreign Currency Portion:

- gates and steel,
- expenses and fees of engineering services of foreign consultants,
- vehicle required for the construction supervision and O & M equipment for the project operation.

3. CONSULTING SERVICES

An experienced foreign consultant is to be in charge of the implementation work of the Project to assist GARPAD, which is responsible for the implementation of the Project, and other related Organizations. In general, consulting services can be grouped broadly into the following categories;

(a) Detailed engineering of the project, including

i. Detailed investigations;

ii. Preparation of detailed designs, specifications and contract documents;

iii. Pre-qualification of contractors, manufacturers, and suppliers;

iv. The evaluation of bids and recommendation regarding award of contract

(b) Supervision of construction work,

(c) Technical and administrative services for the operation and maintenance of the project, and

(d) Other services necessary for the project.

The consultant works have been estimated at 188 man/months for the detailed design and 371 man/months for construction supervision. The following highly qualified experts and engineers will be employed.

- Project Manager
- Irrigation Engineer
- Land Reclamation Engineer
- Civil Engineer
- Design Engineer
- Construction Engineer
- Mechanical Engineer
- Electric Engineer
- Architect
- Cost Estimator
- Topographic Surveyor
- Agronomist
- Agro-Economist
- Livestock Specialist
- Soil Specialist
- Farm Management Specialist
- Farm Machinary Engineer
- Document Specialist

– Back Support

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

The foreign consultant shall carry out the works jointly with a local consultant. The local consultant will be employed by the GARPAD before the arrival of the foreign consultant to carry out investigations and preliminary designs. The foreign consultant will have 95 man/month support from the local consultant for preparing the work schedule, the detailed design and the contract documents, and 296 man/month support of the local engineers during construction supervision including agricultural development. The foreign consultant shall cooperate with the offficers of the GARPAD to effectively carry out the Project. Total Consulting Fee is estimated as follows:

(LE '000)

Item	Foreign Currency	Local Currency	Total
Detail Design	1,974	365	2,339
Supervision	3,107	1,385	4,492
Total	5,081	1,750	6,831

PROJECT JUSTIFICATION

CHAPTER VII ECONOMIC JUSTIFICATION AND FINANCIAL ANALYSIS

CHAPTER VII ECONOMIC JUSTIFICATION AND FINANCIAL ANALYSIS

1. GENERAL

The components of the Project consist of three plans, viz, agricultural development plan, land reclamation plan, and rural development plan. The Project aims to contribute to the Five Year Plan for Economic and Social Development, especially, the Delta region development strategy. The gross Project Area totals 110,000 feddan or 46,200 ha. The net cultivated area is projected at 85,800 feddan. The farmlands will be cultivated by newly settled farmers of about 14,000 households. Successful attainment of the Project benefits depends upon the timely execution of these components.

It is reported that since the early 1950's, approximately 1.1 million feddan of land have been reclaimed in Egypt, but less than 60% of this land is actually under cultivation and possibly as little as 35% is being cultivated with Project[1]. The major reasons for this are inadequate soil studies made before reclamation started, inadequate reclamation works, breakdown in irrigation pumping systems, failure to provide adequate drainage and shortage of funds. Implementation of this Project shall never repeat the failure of this kind.

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[1] The Appraisal Report, New Land Development Project, West Nubariya, Oct. 1980, World Bank

2. ECONOMIC EVALUATION ON LAND RECLAMATION PROJECT

2–1 Method of Evaluation

The measurable economic benefits and costs are expressed in monetary terms and the both streams of benefits and costs on the annual basis over the evaluation period are converted into the respective present worth values. An economic internal rate of return (EIRR) is used as a key parameter for the economic justification of the Project.

The Project was evaluated on the basis of the difference between incremental benefits and costs for the cases of "With Project" and "Without Project".

In calculating an economic internal rate of return, the following premises are taken into consideration;

a) In the price analysis, economic prices of the Project input and output are computed on the basis of the world market prices and their projected ones as far as data are available, and the rest are referred with those figures obtained from the field investigation and the data provided by GARPAD as well as the relevant reports.

b) In order to decide the project life, it must be considered that there are various project facilities which have respective durable life. In this project, it is assumed that most of all project facilities except pumping equipment has enough durable life to evaluate the project over 50 years as far as maintenance works for these facilities will be sufficiently implemented.

For pumping equipment, the required replacement costs are taken into account in the operation and maintenance cost.

c) The gestation period for attaining the full project benefit shall be 8 years after completion of primary leaching, taking development of crops yield into consideration.

d) The negative benefit arising from the fishery sector will occur after the 4th project year when the Bashtir canal and the Bahr El Baqar are connected.

2–2 Price Analysis

According to the World Bank Report titled Agricultural Price Management in Egypt, 1980, part of goods in Egypt are subsidized. The prices received by farmers, therefore, do not represent the real prices. Hence it is necessary to estimate the economic or shadow prices in economic evaluation. The economic or shadow price is estimated using the conversion factor. Standard Conversion Factor (SCF) is estimated at 0.8 as shown in Table Q–2–1 of Annex Q.

On the basis of the field investigation in the Project Area, market wage rate of rural unskilled labor is 5.00 LE per man-day. Although conversion factor of rural unskilled labor is 0.22 according to the World Bank Report, using the results of labor balance study, shadow wage rate is estimated as 2.5 LE (See Table Q–2–2 of Annex Q) The following is summary of the financial and economic prices of main commodities (See Table Q–2–3 of Annex Q);

Item	Unit	Financial (LE)	Economic (LE)
Paddy	ton	105	182
Soybean	ton	230	228
Tomato	ton	70	70
Sugar beet	ton	30	30
Urea	ton	312	326
TSP	ton	290	304
Farm Labor	man/day	5	2.5

2–3 Economic Benefit

(1) With Project

Although total project area is 110,000 feddan, net cultivable area is estimated at 85,800 feddan after completion of tile drain construction and the balance is considered to be those areas for canals, roads, new villages and so on.

Cropped area after full development stage is summarized below;

(Unit: feddan)

Crop	North Hussinia		South Port Said		Total	
	Summer	Winter	Summer	Winter	Summer	Winter
Rice	17,940	–	10,660	–	28,600	–
Soybean	17,940	–	10,660	–	28,600	–
Sorghum	16,599	–	8,602	–	25,201	–
Sugar beet	–	17,940	–	10,660	–	28,600
Vegetables	1,341	17,940	2,058	10,660	3,399	28,600
Berseem	–	17,940	–	10,660	–	28,600
Total	53,820	53,820	31,980	31,980	85,800	85,800

Thus, cropping intensity after full development is 200 percent against the net cultivable area.

Economic profitability of crop cultivation per feddan and livestock breeding per feeding unit are given in Tables Q–3–1 and Q–3–2 of Study Report, respectively.

Since a benefit arising from such fodder crops as sorghum and berseem is evaluated in the livestock sector, total net production values of crop cultivation and livestock breeding are estimated at 41,142,000 LE and 36,123,000 LE respectively, after full development stage.

(2) Without Project

At present, about 6,000 feddan are under cultivation by using drain water of Bahr El Baqar, Ramsis Drain and Hadous Drain, of which net production value is estimated at 160 LE per feddan. The low productivity is mainly due to water quality of these drains as well as lack of enough extension services on modern agricultural techniques.

(3) Negative Benefit

The negative benefit arising from the fishery sector is estimated at 5,630,000 LE at the time of connecting the Bashtir canal with the Bahr El Baqar, and annually 2,540,000 LE after that. Details on estimation of the negative benefit is being explained in "4. FISHERIES PLAN OF CHAPTER IV" of this report.

2–4 Economic Cost

The economic initial investment cost which is based on the national economic point of view, is calculated by re-valuing fuel costs and costs for common labor in the land reclamation component and by applying the standard conversion factor for the other local currency portion in the land reclamation component as well as the whole local currency portion in the infrastructure component after deducting price escalation cost from the financial initial investment, the economic cost of the initial investment is estimated 430.3 million LE as shown below;

	Land Reclamation (LE '000)	Infrastructure (LE '000)	Total (LE '000)
F/C	97,314	110,276	207,590
L/C	88,932	133,759	222,697
Total	186,246	244,035	430,281

According to the South Hussinia Feasibility Study Report (Phase II), the initial investment cost allocated by the El Salam Canal was estimated at 378,000 LE per gross feddan, thus the allocated cost to the North Hussinia and South Port Said Project is calculated at 37,153 thousand LE which is taken into account in the first project year of the cost stream.

The operation and maintenance cost for the project facilities as well as for the proposed agricultural supporting services and project management body, is estimated at 1,925,000 LE or 22.4 LE per net cultivated feddan inclusive of the replacement cost for some pumping equipments and the operation and maintenance equipment.

The annual operation and maintenance cost allocated by the El Salam Canal is estimated at 2,341 thousand LE or 27.3 LE per net cultivated feddan.

Since durable life of rice straw which covers tile drain is less than 50 years of project life, replacement cost of rice straw amounting to 461 LE per feddan (financial) or 410 LE per feddan (economic) has been taken into consideration every 15 years after installation.

2–5 Economic Internal Rate of Return

On the basis of the above factors, internal rate of return for the land reclamation component are computed showing the rates of 11.3 percent and 13.8 percent including and excluding the allocated cost by the El Salam Canal, respectively. Since the marginal productivity of capital in Egypt at border prices is estimated at 10 percent on the basis of the accounting ratios evaluated in the World Bank Staff Working Paper No. 521, the proposed project is economically feasible.

2–6 Sensitivity Analysis

A sensitivity analysis is an effective measure of testing a risk of a project. The analysis for the Project was made for the following cases.

EIRR in Sensitivity Analysis
(excluding Cost of El Salam Canal)

Item	EIRR
Land Reclamation Only	
1. Original (Base Case)	
Whole Project	13.8%
North Hussinia Project Only	12.8%
South Port Said Project Only	16.0%
2. 10% decrease in Project Benefit	13.0%
3. 10% increase in Initial Investment Cost	13.2%
4. Construction Period: 5 years	14.8%
5. Construction Period: 7 years	14.1%
Land Reclamation + Social Infrastructure	8.7%
Land Reclamation + Agro-Industry	14.0%

2--7 Socio-Economic Impact

The project economy should be also evaluated in terms of indirect benefits. Besides the direct benefits mentioned above, the Project will create the indirect benefits and give the socio-economic impacts on the regional and national economy.

- Employment opportunity would be created.
- The new settler can earn a higher farm income. Agro-industry can not only employ much labor but also bring the production value added to the regional economy. The tax revenue of the Governorate shall be reinvested to the social infrastructure. Milk processing factory would be constructed in 1992 and begin an operation in 1993.
- The consumer goods market in the vicinity of the Project Area shall be expanded through an increase in the population of about 99,000 persons.
- Income of the local people will increase during the construction period.
- The production of crops as substitute for imports shall save foreign currency.
- The Project will serve as a model of the water resources development strategy in the Five Year Plan for Economic and Social Development.

3. ECONOMIC EVALUATION ON AGRO-INDUSTRIES

3-1 Sugar Beet Processing

Sugar Beet processing factory would be constructed from 1993 to 1995 and its operation starts in 1996 corresponding to the annual supply of raw sugar beet. The financial project cost excluding price escalation amounts 89.4 million LE and the economic project cost is estimated at 85.4 million LE. The gross production income would be gained as follows in 9th years after the onset of operation of factory.

GROSS PRODUCTION VALUE (2004)

Products	Quantity ('000 tons)	Financial G.P.V. (LE '000)	Economic G.P.V. (LE '000)
White sugar	89.42	35,768	42,993
Dry molasses & beet pulp	15.00	1,500	1,500
Dry non-molasses & beet pulp	28.80	4,320	4,320
Molasses	35.91	5,387	5,387
Total	–	46,975	18,012

Production cost consists of variable cost such as raw materials, fuel, chemical and packing material and fixed cost such as salaries & wages and buildings.

Production cost in the year 2004 is estimated using raw beet price of 30 LE per ton as follows.

PRODUCTION COST

Items	Financial (LE '000)	Economic (LE '000)
Raw material cost	18,012	18,012
Variable Cost	5,928	5,812
Fixed Cost	1,805	1,444
Total	25,745	25,268

The conversion factors of fuel are 1,010 for crude oil, 6.75 for diesel and 15,299 for fuel oil as estimated from the World Bank Staff Working Paper No. 521, 1982. Management of factory will be in the negative using the conversion factors of diesel and fuel oil mentioned above. IRR is estimated using project life of 30 years as follows.

Unit Price of raw beet	FIRR	EIRR
20 LE/ton	18.9%	22.7%
30 LE/ton	16.9%	19.7%

3–2 Milk Processing

Milk processing factory would be constructed in 1992 and begin an operation in 1993. The financial project cost including processing facilities, buildings, transportations vehicles and refrigerator but excluding price escalation amounts to 17.9 million LE. The economic project cost is 16.1 million LE.

The gross production income in the 15th Factory year (2006) after the onset of operation of factory would be projected as follows.

GROSS PRODUCTION VALUE (2006 YEARS)

Products	Quantity (tons)	Financial G.P.V. (LE '000)	Economic G.P.V. (LE '000)
UHT Milk	65,760	26,304	25,462
Butter	1,270	3,810	3,688
White Cheese	9,733	14,600	14,132
Total		44,714	43,282

The conversion factor of milk products is 0.968 of tradable urban consumer goods. Production costs are variable cost of raw milk, packing and chemical and fixed cost of salary & wages and repayment cost. The production cost in 2006 is estimated as follows.

PRODUCTION COST (2006)

Items	Financial (LE '000)	Economic (LE '000)
Raw Milk Cost		
0.29 LE/kg (X)	47,676	47,554
0.25 LE/kg (Y)	41,100	40,639
0.20 LE/kg (Z)	32,880	32,173
Other Variable Cost	3,413	3,232
Fixed Cost	2,561	2,085
Total (X)	52,650	52,871
(Y)	46,074	45,956
(Z)	37,854	37,490

IRR is calculated using project life of 30 years.

	FIRR (%)	EIRR (%)
Raw Milk Cost		
0.29 LE/kg (X)	–	–
0.25 LE/kg (Y)	–	–
0.20 LE/kg (Z)	12.2	13.5

3-3 Tomato Processing

According to the projection of tomato production, quantity of tomatoes supplied for processing in the full development stage of 2003 would be expected at 75,000 tons.

The plant facilities to process 450 tons per day under one shift (one line for 150 ton per day) would be invested at first, because of limited availability of raw material. Operation of factory would be enlarged into two shifts corresponding to an increase in production of tomatoes.

One line plant is implemented in 1995, 1997 and 1999 respectively. Initial costs are as follows.

	Financial Cost	Economic Cost
	– Million LE –	
Base Cost	4.55	3.98
Physical Contingency	0.45	0.45
Sub-total	5.00	4.43
Total	21.62	

The economic gross production value of tomato paste in the year 2003 is assumed as the same value with the financial gross production value of 11.44 million LE. The production cost consists of raw material, other materials and fixed cost items. The processing cost in the year 2003 under two shift is estimated as follows;

PRODUCTION COST (2003)

Items	Financial	Economic
	(LE '000)	(LE '000)
Tomato Purchase Price		
60 LE/ton (X)	4,500	4,500
70 LE/ton (Y)	5,250	5,250
80 LE/ton (Z)	6,000	6,000
Other Variable Cost	2,460	2,390
Fixed Cost	407	306
Total (X)	7,367	7,196
(Y)	8,117	7,946
(Z)	8,867	8,696

Internal rate of return for tomato paste processing plant is calculated in the following;

	Financial	Economic
	(%)	(%)
Tomato Purchase Price		
60 LE/ton	31.8	48.5
70 LE/ton	26.4	41.8
80 LE/ton	20.7	34.4

3–4 Comprehensive Agro-Industries

On the basis of results obtained from the economic evaluation on each agro-industry, namely, the sugar beet processing, the tomato paste processing and the milk processing, EIRR for overall agro-industries has been worked out at 14.5 percent.

4. FINANCIAL ANALYSIS

4–1 Farm Budget Analysis

Farm budget study is carried out for three types of farmers, ie., 5.0 feddan (smallholder), and 15.0 feddan and 20.0 feddan (largeholders), by different type of cropping patterns which are cropping pattern No. 1 applied for clayey soil and No. 2 for loamy soil. Labor balance of 15.0 feddan and 20.0 feddan holders is in deficit as calculated below;

FARM LABOR DEFICIT (MAN-DAY)

	Friesian Farm		Baffalo Farm	
Farm Size (feddan)	15.0	20.0	15.0	20.0
Cropping Pattern				
No. 1	699.6	1,131.2	367.4	689.6
No. 2	771.6	1,214.6	490.6	842.4

General conditions of calculating annual amortization on land and house as well as cattle loan are as follows;

	Land and House		Cattle Loan
	Smallholder	Largeholder	
Repayment Period (year)	25	25	5
Interest Rate (%)	None	1	6
Grace Period (year)	3	3	None

Other assumptions applied for the farm budget analysis are given below;

	Smallholder	Largeholder
Living Cost (LE)		
Subsistence level	1,200	1,440
Desirable level	2,040	2,400
Other Annual Charges	50	100
Irrigation Water Charge	22 LE per feddan	
Land Tax	5 LE per feddan	

Table 7–1 summarizes results of the farm budget analysis, showing annual farm economy surplus from about LE 1,500 to LE 2,900 in smallholder and from about 6,000 LE to 10,000 LE in largeholders.

According to the financial cash flow which is detailed in Annex Q, it is predicted that every settled farmer will be able to stand on their legs within 7 years after primary leaching.

Table 7-1 (1) Summary of Farm Budget Analysis [1]

(Unit: LE)

Cropping Pattern : No. 1

	Friesian Farm			Buffalo Farm		
	Smallholder	Largeholder	Largeholder	Smallholder	Largeholder	Largeholder
Farm Size (feddan)	5.0	15.0	20.0	5.0	15.0	20.0
No. of Livestock (feeding unit)	3.0	9.1	12.1	5.0	15.1	20.1
Inflow						
Crop Income	3,898	11,716	15,614	3,898	11,716	15,614
Livestock Income	5,844	17,727	23,751	3,025	9,136	12,161
Total Inflow	9,742	29,443	39,185	6,923	20,852	27,775
Outflow						
Farm Expenditures						
– Crop Costs	996	2,994	3,989	996	2,994	3,989
– Livestock Costs	2,589	7,853	10,442	880	2,658	3,538
– Hired Labor	–	3,498	5,656	–	1,837	3,448
– Sub-Total	3,585	14,345	20,087	1,876	7,489	10,975
Annual Amortization	1,250	4,350	5,660	1,250	4,350	5,660
Water charge	110	330	440	110	330	440
Land Tax	25	75	100	25	75	100
Other Annual Charges	50	100	100	50	100	100
Cost of Living	2,040	2,400	2,400	2,040	2,400	2,400
Total Outflow	9,632	21,600	28,787	5,351	14,744	19,675
Balance	2,682	7,843	10,398	1,572	6,108	8,100

Note: [1] at the 9th year and further after primary leaching

Table 7–1 (2) Summary of Farm Budget Analysis [1] (Cont'd)

Cropping Pattern : No. 2 (Unit: LE)

	Friesian Farm			Buffalo Farm		
	Smallholder	Largeholder	Largeholder	Smallholder	Largeholder	Largeholder
Farm Size (feddan)	5.0	15.0	20.0	5.0	15.0	20.0
No. of Livestock (feeding unit)	2.6	7.7	10.2	4.2	12.7	16.9
Inflow						
Crop Income	4,759	14,289	19,048	4,759	14,289	19,048
Livestock Income	5,065	15,000	19,870	2,541	7,684	10,225
Total Inflow	9,824	29,289	38,918	7,300	21,973	29,273
Outflow						
Farm Expenditures						
– Crop Costs	1,173	3,523	4,695	1,173	3,523	4,695
– Livestock Costs	2,244	6,645	8,803	739	2,235	2,974
– Hired Labor	29	3,858	6,073	29	2,453	4,212
– Sub-Total	3,446	14,026	19,571	1,941	8,211	11,881
Annual Amortization	1,250	4,350	5,660	1,250	4,350	5,660
Water Charges	110	330	440	110	330	440
Land Tax	25	75	100	25	75	100
Other Annual Charges	50	100	100	50	100	100
Cost of Living	2,040	2,400	2,400	2,040	2,400	2,400
Total Outflow	6,291	21,281	28,271	5,416	15,466	20,581
Balance	2,903	8,008	10,647	1,884	6,507	8,692

Note: [1] at the 9th year and further after primary leaching

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