CHAPTER IV THE PROJECT

CHAPTER IV. THE PROJECT

4.1. Objectives and Components of Project

4.1.1. Objectives

The Project aims to expand farm lands by reclaiming desert, swamp and inundated lands, to increase agricultural production through farm mechanization, to create employment opportunities, to introduce agro-industries, and to establish a new rural community.

4.1.2. Project Components

a. Agricultural Development Plan

(1) Irrigated agriculture	:	To introduce new farming techniques with successful water management
(2) Livestock breeding	:	To introduce to individual farmers the animal husbandry suitable to the proposed cropping pattern and land use
(3) Agro-industries	:	To introduce new agro-industries for processing sugarbeet, vegetables and animal products
(4) Supporting services	:	To provide intensified extension services
(5) Farmers' organization	:	To establish farmers' organization for water management, operation & maintenance of facilities and collective farming works

b. Land Reclamation Works

(1) Irrigation/Drainage Works	:	To construct main and secondary canals for irrigation and drainage

(2) On-farm works : To construct on-farm facilities including land levelling, farm ditches and drains and on-farm roads

(3) Road networks : To construct trunk roads and farm roads including O & M roads

c. Rural Development Plan : To formulate a plan of villages and their facilities

4.2. Proposed Land Use and Cropping Pattern

4.2.1. Proposed Land Use

The gross area covered by the Project amounts to 74,700 feddans or 31,370 ha. This area includes the existing farm lands distributed along the Bahr Saft drain on the western border of the Project area and along the existing canal on the southern border. This area also includes the farm lands with fish ponds dotted here and there about along the Bahr Baqar drain on the eastern border. These lands amount to 7,800 feddans or 3,300 ha.

The proposed land use was decided taking into consideration the better treatment of these existing farm lands and fish ponds, and alternative studies were made as to whether or not they should be included in the Project Area. Four items, that is, present land holding, on-farm work and irrigation and drainage facilities, rural development, farm organization and marketing were studied.

This study has drawn the conclusion that it is recommended to include the existing farm lands and fish ponds in the Project Area and to involve the farmers presently working there in the Project.

The land classification map shows that land unsuitable for cultivation amounts to about 5,940 feddan or about 2,495 ha. This area consists of the land with extremely poor drainability, hillrocks and depressions. This land should be used as much as possible as sites for villages, factories, irrigation and drainage canals and roads.

The proposed net cultivation area to be provided for the new settlers is 55,740 feddan or 23,410 ha, occupying 75 percent of the gross land area of 74,700 feddans.

Other land could be used as sites for villages, factories, canal and roads and terminal facilities. An area of 5,330 feddan, however, should remain as non-arable waste lands, occupying about seven percent of the gross land area.

The proposed land use is summarized as follows.

(Unit: feddan)

Item	Present		Proposed	
	(feddan)	(ha)	(feddan)	(ha)
1. Net Cultivation area	7,800 1/	3,300	55,740	23,400
2. Submerged area	27,600	11,600	-	-
3. Arable area not in use	38,900	16,300	-	-
4. Others	400 2/	200	18,960 3/	8,000
Total	74,700	31,400	74,700	31,400

Note: 1/ Include fish ponds
2/ Hill land and others
3/ Details are as below;

Item	Area	
	(feddan)	(ha)
Existing roads & canals	500	211
Non-arable waste land	5,330	2,250
Residence area	1,700	718
Factory sites	200	84
Road & canals	5,290	2,233
Terminal facility sites	5,940	2,504
Total	18,960	8,000

Note: Terminal facilities are tertiary canals, tertiary drains and field roads.

4.2.2. Cropping Plan

a. Cropping Pattern

(1) Crops Selection

The crops to be grown in the Project Area were selected taking into account the following matters.

i) Salt-resistant crops should be selected due to saline soils and saline irrigation water of about 880 ppm.

ii) The farm land consists mainly of heavy clayey soils.

iii) The crops should be selected to meet the Egyptian Government's requirement for fodder crops, industrial crops, food crops, export-oriented crops and processable crops.

iv) The selected crops should have high economic value in production.

The salt-resistant crops have been selected according to the FAO's Report, "Water Quality for Agriculture, Salt Tolerance Levels for Different Crops" (Ayers and Westcot, 1976).

The crops finally selected are as follows;

Fodder crops	:	berseem, sorghum
Industrial Crops	:	soybean, sugarbeet
Export-oriented Industrial Crops	:	tomato
Export-oriented Crops	:	Cauliflower, onion, cabbage, paddy
Processable Crops	:	Crops are selected so that processing factories can be operated as long as possible per annum in terms of working economy

On top of the above, cotton, wheat and barley were taken up additionally for an alternative study (See Table IV-1).

(2) Proposed Cropping Pattern

The proposed cropping calendar was prepared as illustrated in Figure IV-1, based on the data available from GARPAD and the Vegetable Research Division.

The proposed cropping patterns were prepared in a three-staged development to follow the soil desalinating process. The early stage will cover two to three years after starting the leaching works, and the paddy shall be cropped as summer crop and berseem as winter crop. Soil salinity in this stage is expected to be about 6 mmhos/cm. Paddy growing will have a considerably favourable effect in desalination of soils because the paddy fields will be sufficiently flooded for the growing season. In winter, highly salt-resistant berseem cropping will be most suitable. In the middle stage, soil salinity will be reduced to around 4.0 mS/cm, and the cropping pattern for this stage will last five to seven years after the early stage. The full development stage will cover those years after the middle stage and onward when the soil salinity will be 1.5 mS/cm. The cropping rotation to be recommended at the full development stage has resulted from the study on eight alternatives shown in Table IV-2.

The four crops of paddy, fodder, sugarbeet and vegetables show different farm income per feddan varying with their respective cropping ratios. The farm income to be expected from a vegetable - growing cropping pattern will be comparatively high. Patterns A, B and C are traditional ones, while pattern G is an improvement on the traditional ones with sugarbeet cropping introduced.

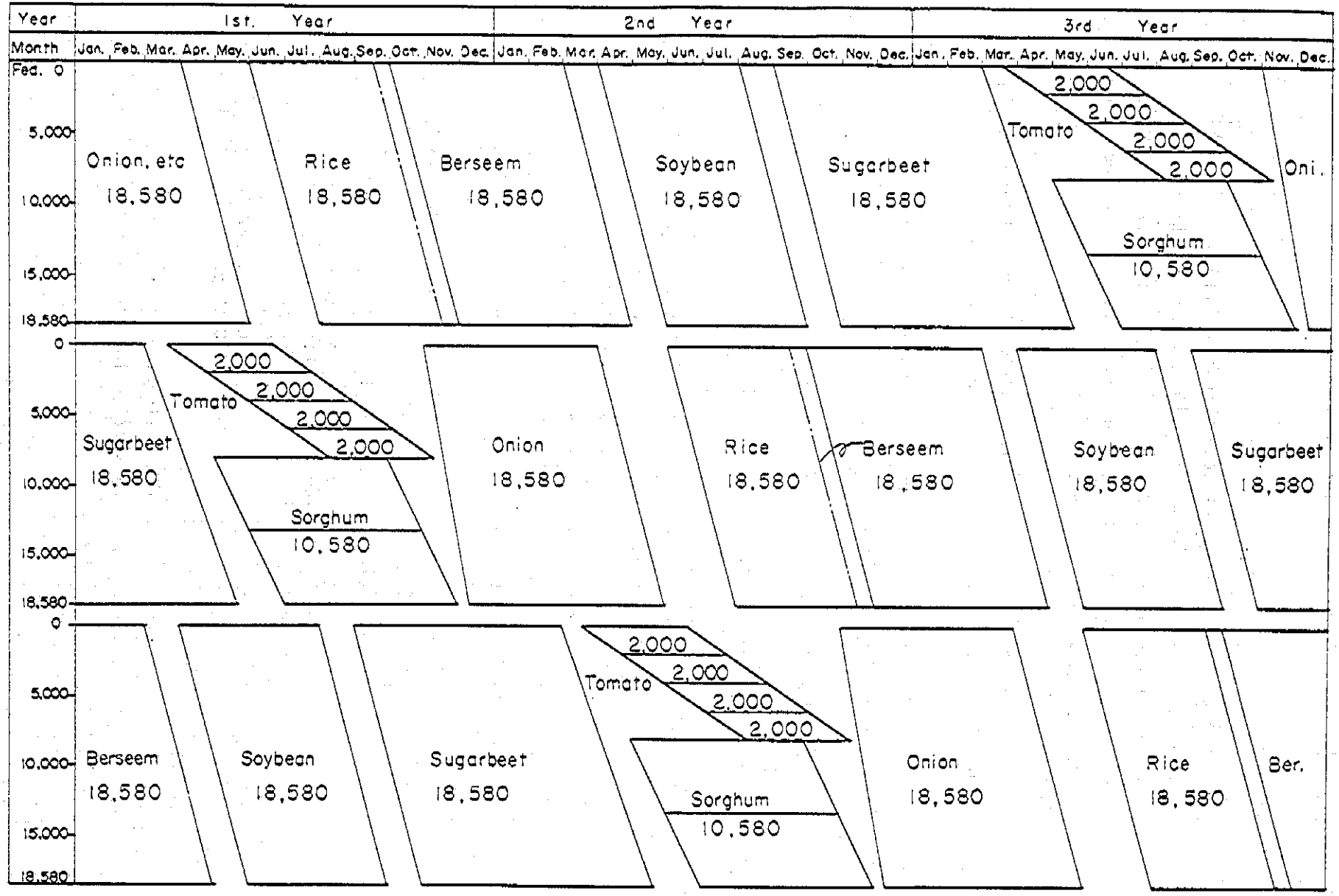
Fodder crop in pattern F is grown in the Area by one-third of those cropped for both seasons of summer and winter. Net production value from pattern F is less than that from pattern H.

Table IV-1 Crop Selection

Crops	/1 ECe-	Economy (LE/fd) Financial	Economical	Industrial Crops	Oil Seed	Fodder Crops	Tolerance Heavy Clay Soil
Rice	3.0	115	290	-	-	-	M
Barley	8.0			-	-	-	M
Cotton	7.7	236	269	0	0	-	M
Peanuts	3.2			0	0	-	L
Sorghum	4.0			-	-	0	M
Soybean	5.0	124	173	0	0	Cake	M
Sugarbeat	7.0	375	391	0	-	-	M
Wheat	6.0	49	106	-	-	-	M
Broccoli	2.8			0	-	-	M
Cabbage	1.8			0	-	-	M
Cucumber	2.5			0	-	-	M
Potato	1.7			-	-	-	L
Spinach	2.0			-	-	-	M
Sweet corn	1.7	80	95	0	-	-	M
Tomato	2.5	1,050	643	0	-	-	M
Onion, Garlic	1.2			0	-	-	M
Pepper	1.5			-	-	-	M
Sunflower	M			0	0	-	M
Berseen	1.5			-	-	0	M
Broad.Bean	1.6	179	140	-	-	-	M

Note : H: High M: Medium L: Low /1 ECe = electrical conductivity of the soil saturation extract (mmhos/cm) for a given crop appropriate to the tolerable degree of yield reduction.

Figure IV-1 3-YEAR CROP ROTATION



The gross field water requirement of sorghum is 5,000 m^3/feddan. This is larger than 4,000 m^3/feddan for tomato. Hence, in comparison of pattern F with pattern H, the latter is more desirable considering the two factors of farm income per year and water requirement in summer.

Pattern H comprises a large part of cash-crop growing, and G and H were finally brought into a comparative study.

The stage-wise development status of these two patterns are illustrated as follows;

(3) Comparison in Cropping Patterns

i) Early Stage (2 to 3 years from commencement)

	Summer Crops	Winter Crops
	Paddy	Berssem
2 years	Land classification class 2, 3	
3 years	Land classification class 4.	

ii) Middle Stage (5 to 7 years with 3-year rotation)

* Proposed Cropping Pattern (See Figure C-2 in Appendix C)

Summer Crops	Y.P.[1/]	Winter Crops	Y.P.
Paddy	90%	Berseem	90%
Sorghum	100	Beet	100
Soybean	100	Vegetables	
		Onion	90
		Caulilflower	80
		Cabbage	80

5 years Land classification class 2, 3

7 years Land classification class 4

TABLE IV-2 ALTERNATIVE CROPPING PATTERN AND NET PRODUCTION VALUE PER FEDDAN
- Full Development Stage -

	Rice + Fodder (A)	Rice + Fodder (B)	Tradi-tional (C)	Rice + Fodder + Sugarbeet (D)	Rice + Fodder + Vegetable (E)	Rice + Fodder + Vegetable + Sugarbeet (F)	Traditional + Sugarbeet (G)	Rice + Fodder + Vegetable + Sugarbeet (H)
Summer Crop	Rice 100%	Rice 50	Rice 33.4	Rice 33.4	Rice 33.4	Rice 33.4	Rice 33.4	Rice 33.4
	-	-	Maize	Maize	Soybean	Soybean	Soybean	Soybean
	-	-	33.3	33.3	33.3	33.3	33.3	33.3
	-	Sorghum	Cotton	Sorghum	Sorghum	Sorghum	Cotton	Sorghum
	-	50	33.3	33.3	16.7	33.3	33.3	16.7
	-	-	-	-	Vegetable	-	-	Vegetable
	-	-	-	-	16.7	-	-	16.7
Winter Crop	Berseem 100%	Berseem 100	Berseem 66.7	Berseem 66.7	Berseem 66.7	Berseem 33.4	Wheat 16.4	Berseem 33.3
	-	-	Wheat	Sugarbeet	Vegetable	Sugarbeet	Sugarbeet	Sugarbeet
	-	-	33.3	33.3	33.3	33.3	0.333	33.3
	-	-	-	-	-	Vegetable	Berseem	Vegetable
	-	-	-	-	-	33.3	0.333	33.3
Net Production Value per Feddan : Financial (Economic) Price						Unit : LE/Fed.		
Cow Farm	373(588)	427(571)	367(493)	453(557)	820(723)	798(780)	470(581)	940(849)
Cattle Farm	219(420)	222(350)	246(361)	306(396)	697(590)	664(636)	370(482)	820(720)
Share of Rent (Rent - NPV) : Financial Price								
Cow Farm	0.64	0.56	0.65	0.53	0.29	0.30	0.51	0.26
Cattle Farm	Negative	Negative	0.98	0.78	0.34	0.36	0.65	0.29
Labor Returns per Day, LE : Financial Price								
Cow Farm	2.3	2.9	2.2	3.1	7.8	8.1	4.1	10.4
Cattle Farm	Negative	Negative	0.2	1.5	8.3	9.0	3.2	12.1

* Traditional Cropping Pattern

Summer Crops	Y.P.	Winter Crops	Y.P.
Paddy	90%	Barley	100%
Cotton	100	Berseem	100
Maize	90	Wheat	100

Note: Y.P.: Yield Potential

iii) Full Development Stage

* Proposed Cropping Pattern (H)

Summer Crops		Winter Crops	
Paddy		Berseem	
Soybean		Sugarbeet	
Sorghum	57%	Vegetables	
Vegetables	43	Onion	70%
Tomato		Cauliflower	15
		Cabbage	15

(Refer to See Figure IV-1)

* Traditional Cropping Pattern (G)

Summer Crops	Winter Crops
Paddy	Wheat
Soybean	Sugarbeet
Cotton	Berseem

Finally, the study resulted in the recommendation that proposed cropping pattern H is applicable to the Project Area in terms of economy with higher income.

New settlers will have to purchase the reclaimed lands. The high cost of the land will put a constraint on farm economy, and the farmers will be urged to adopt a higher cropping intensity. The shares of rent of pattern H is about 1/2 or less than that of pattern G. Labor return per day in pattern H is much more profitable than that in pattern G.

Pattern H shows favourable figures for the two indicators of shares of rent and labor returns.

It is concluded that the pattern H with higher farm income is to be recommended economically.

4.3. Land Reclamation for Agricultural Use

It is obvious that drainage and leaching are two basic requirements for the successful reclamation of such saline and alkali soils as the Project Area soils. Various methods for amelioration of saline and alkali soils have been developed in the course of land reclamation projects in many countries. Up to now, however, no sole nor absolute method has been established. The success of the reclamation of saline and alkali soils depends on the adequate combination of various amelioration methods.

In Egypt as well as other countries, it has been recognized that the leaching in combination with rice growing is very useful as a means of reclaiming extremely saline soils with poor permeability.

4.3.1. Drainage Improvement

For the land reclamation in the Project Area soils, the corrections for poor drainability is of most importance. In order to improve the surface and internal drainage and to lower groundwater table, it is essential to establish the sufficient drainage system having an adequate depth, spacing, and capacity.

The drainage system in saline soils must be designed to desalinize not only the toposil but also upper subsoil and one and a half meter for the Project Area in order to control both the water and salt balances.

As regards types of drainage, the shallow horizontal drainage, about one meter deep, has been widely used. However, leaching with shallow drainage has not succeeded in a lasting improvement because it fails to eliminate secondary salinization. On the other hand, the deep horizontal drainage can lower the groundwater table to a critical depth that makes no longer secondary salinization.

As regards construction, the drainage system may be open or closed.

For the Project Area, the field drain system within a farm plots were designed to be 1.5 m deep and 25 m spacing as an open drain system at the early stage of reclamation period to secure the full capacity, and then those would be replaced by a closed drain system after leaching. Details of the design are shown in Section 4.5.

It should be noted that such field drain system cannot facilitate prosperously without improving soil permeability above and at the depth of drain. Soil permeability can be improved by physical, biological, and chemical amelioration methods.

a. Physical Amelioration

Several mechanical methods have been used to increase soil permeability for saline and alkali soils, that is, deep plowing, subsoiling, and sanding.

Deep plowing is to increase soil permeability directly by mixing fine and coarse textured layers and obtain a more uniform soil through plowing from about 40 to 150 cm deep. This is especially beneficial on stratified soils as the Project Area soils having impermeable layers lying between permeable layers.

Subsoiling is to pull chisels with a powerful tractor through the soil to open channels to improve soil permeability by breaking up impermeable layers. The beneficial effects of subsoiling usually persist for several years if an indurated horizon is broken.

Sanding is an effective means of making a fine textured, but not heavy clayey, surface soil more permeable by incorporating sands into it. But the effect is not reliable for the Project Area soils mainly consisting of heavy clay.

b. Biological Amelioration

Both alive and dead plants have beneficial effect of improvement of soil permeability as well as of soil fertility.

Incorporating large amounts of manure in the soil also improves the surface soil permeability by loosening the compacted soils in addition to improving the soil fertility.

Growing deep rooting plants such as legumes (alfalfa,berseem etc.) promotes the reclamation of sline soils lacking internal drainage by penetrating their root systems and by lowering the groundwater table, and consequently allowing the salt leaching.

In addition, the shading effect of living plants or the mulching effect of plant residue or manure lead to reduce the evaporation from the soil surface, as a result, to slower the build-up of surface salt accumulation with the upward movement of soil water.

c. Chemical Amelioration

Chemical amendments are used for reclamation of alkali soils to improve the soil permeability through to replace exchangeable sodium, which disperse clay fraction, by calcium. Known amendments are gypsum, $CaCl_2$, limestone, sulphuric acid, and sulfur. Gypsum is the most common amendments for reclamation of alkali soils in this Region.

d. Gypsum Requirement

In the Project Area, some portions, mainly in the cultivated areas where the lands had been irrigated once, the ESP values exceed 15 percent.

The Project Area soils generally contain a considerable amount of gypsum. These grypsum existing in the soils at relatively high level can play an important role as a source of Ca ion in replacing Na at the soil exchange complex and contribute to the substantial decrease in exchangeable sodium during the leaching process as below;

$$2NaX + CaSO_4 \rightleftarrows Ca\ X + Na_2SO_4$$

X: Soil exchangeable complex

However, the gypsum is considerably affected by leaching owing to its relatively greater solubility than lime. As a result, the gypsum content, especially in the surface layer is markedly decreased after leaching.

Thus, the possibility of the increasing soil, alkalinity after leaching is expected. Accordingly the addition of gypsum amendment to the soils before leaching is recommended.

The dosage of gypsum used for soil improvement can be determined by the laboratory method, and also it can be estimated by the calculation based on the theory that the dosage of gypsum must be equivalent to the quantity of exchangeable sodium to be removed. The gypsum requirement for the alkali soils can be calculated from the following formula;

$$\text{Gypsum Requirement in meq/100 g soil} = \frac{(\text{ESP} - \text{ESP final})}{100} \times \text{CEC}$$

Here, the ESP final of 10 is considered as not resulting in any noticeable peptisation of the soil.

Assuming that the surface layer in the Project Area soils weighs on average 3,900 ton/ha (bulk density averages 1.30), the total gypsum requirement for the soils in order to reduce the ESP below ten can be further calculated.

According to the calculation, the gypsum requirements range from zero to 3.9 tons/feddan and can be classified into three groups, that is, 0, 2, and 4 tons/feddan.

4.3.2. Leaching of Saline Soils

The effective leaching is entirely dependent on the elaborated designing such as water dose, time, method and procedures based on data obtained by field investigation.

The effectiveness of leaching has been confirmed by prominent works, even though there have been, numerous cases of failures due to various technical defects, insufficient case, and insufficient experience.

For determination of leaching requirement, in the USSR, L. Rozov, (1936) proposed the following empirical formula;

$$M = FC - m + n\,FC$$

where M = amount of water (cum/ha)
FC = field capacity (cum/ha)
m = water reserve in the soil before leaching (cum/ha)
n = coefficient (0.5 - 2.0 depending on the salinity and the mechanical composition of the soil)

Applying this formula for the anticipated Project Area soils after drainage improvement, the leaching water requirement is calculated.

$$M = 6{,}825 - 3{,}900 + 2 \times 6{,}825 = 16{,}575 \text{ cum/ha}$$

where		
	leaching soil depth	1.5 m
	bulk density	1.3
	field capacity	35%
	moisture content before leaching	25%

According to the US Salinity laboratory's guide, an approximation of the amount of water required for leaching 15 m depth of soil by flooding can be made as below;

Salt Removal	Depth of Water Needed
50%	750 mm
80%	1,500 mm
90%	3,000 mm

For the Project Area, for example, about 2,000 mm depth of low-salt water is needed for leaching the soils having ECe of 40 mS/cm to 6mS/cm, 85 percent of salt removal.

Based on the relation between leaching application and salinity obtained by generalization of data from many experiments, V. Kovda (1957) established the following empirical formula;

$$y = n_1 \cdot n_2 \cdot n_3 \, 400 \, x \pm 100$$

where y = depth of leaching water (mm)
x = mean salt content in the 2 m soil profile (%)
n_1 = coefficient depending on mechanical soil composition (sand = 0.5, loam = 1.0 , clay = 2.0)
n_2 = water table depth (1.5 - 2.0 m = 3.0, 2 - 5 m = 1.5, 7 - 10 m = 1.0)
n_3 = groundwater salinity (weak or medium = 1.0, strong = 2.0, very strong = 3.0

Applying this formula for the Project Area soils, the depth of leaching water is calculated below;

$$y = 2.0 \times 1.5 \times 1.5 \times 400 \times 1.25 \pm 100$$
$$= 2{,}250 \pm 100 \text{ mm}$$

Subsequently, V.R. Volobuev (1960) suggested the relation between the leaching dose and the soil salinity is not rectilinear but logarithmic. And he made the equation as follow;

$$N = k \log \left(\frac{Si}{S_o} \right) a$$

where N = leaching dose (cu.m/ha)
Si = soil salinity in 0 - 100 cm layer (%)
S_o = tolerated residual soil salinity (%)
k = coefficient of proportionality, reckoning cum/ha as equal to 10,000
a = parameter depending on soil salinity and on the proportion of chlorides in its salt

For chloride salinity type and clayey soils as the Project Area soils, the parameter "a" was considered to be 1.5. Accordingly, the leaching dose was calculated as follow;

$$N = 10{,}000 \log 1.25/0.25 \times 1.5$$
$$= 10{,}485 \text{ cum/ha for 1.0 m deep soil.}$$

For 1.5 m deep soil to be leached, the total leaching requirement was calculated below;

$$10{,}485 \times 1.5 = 15{,}728 \text{ cu.m/ha}$$
$$= 1{,}573 \text{ mm.}$$

According to the above empirical formula, the leaching requirement for the Project Area soils was estimated to be in a range from 1,570 to 2,350 mm. In practice, the requirement fluctuates depending on the degree of soil drainability, salt accumulation and quality of leaching water etc. For design of the Project, the maximum value of 2,350 mm by Kovda's formula was adopted taking for certain allowance into consideration.

Furthermore, M. Afili et al (1977) made a laboratory leaching study for the Clay Swamp (Ms) and Port Said (Ps) series, and concluded that the Clay Swamp (Ms) series showed too little percolation rate to make an efficient leaching, therefore, leaching is limited by their permeability and will be tedious unless proper amendments are applied.

Figure IV-2 shows the result of laboratory leaching experiments made during this Study period.

Using the result, the leaching requirements were calculated as below;

Figure IV-2 Leaching Curve of Project Area Soil(1)
(By Large Scale Experiment)

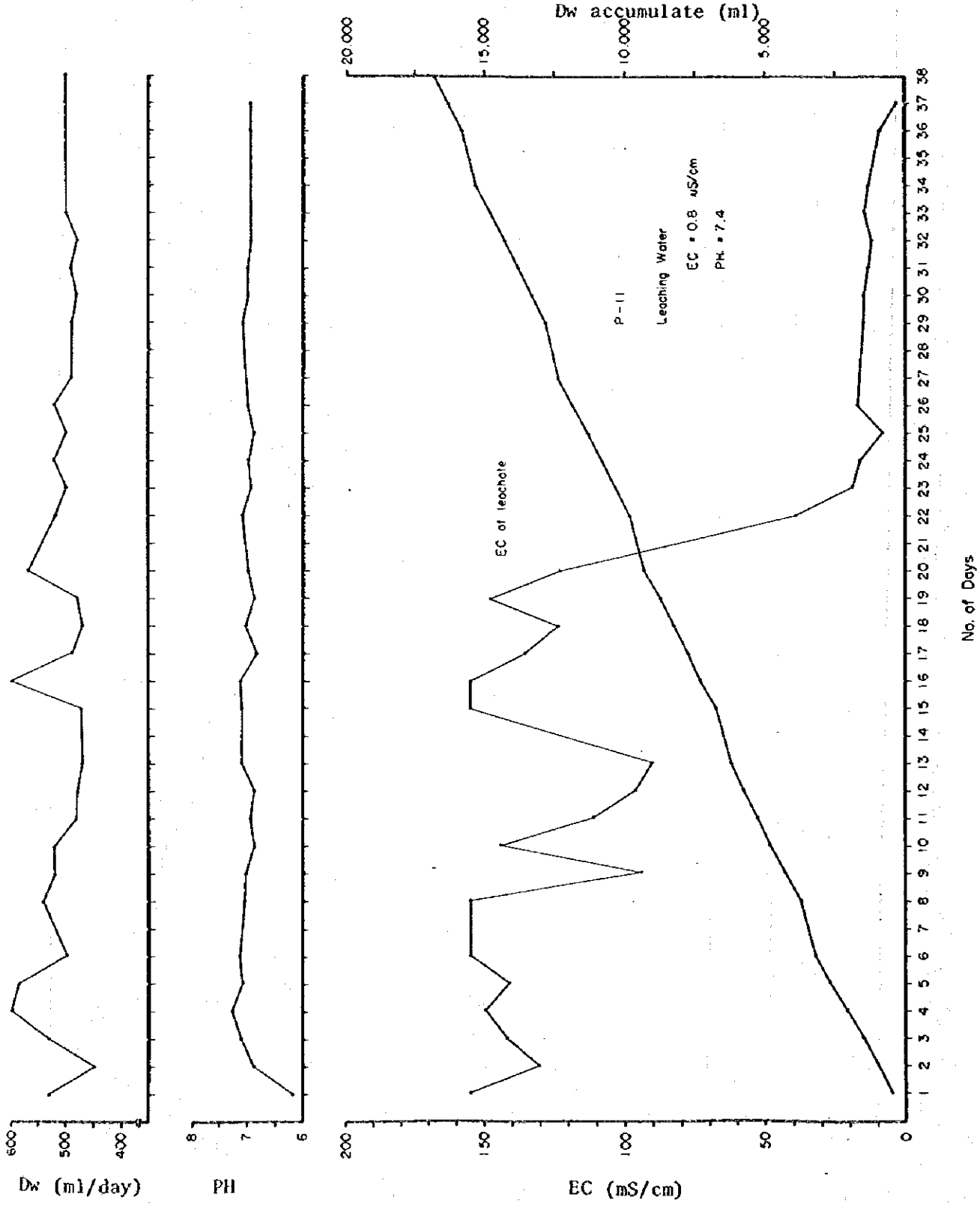
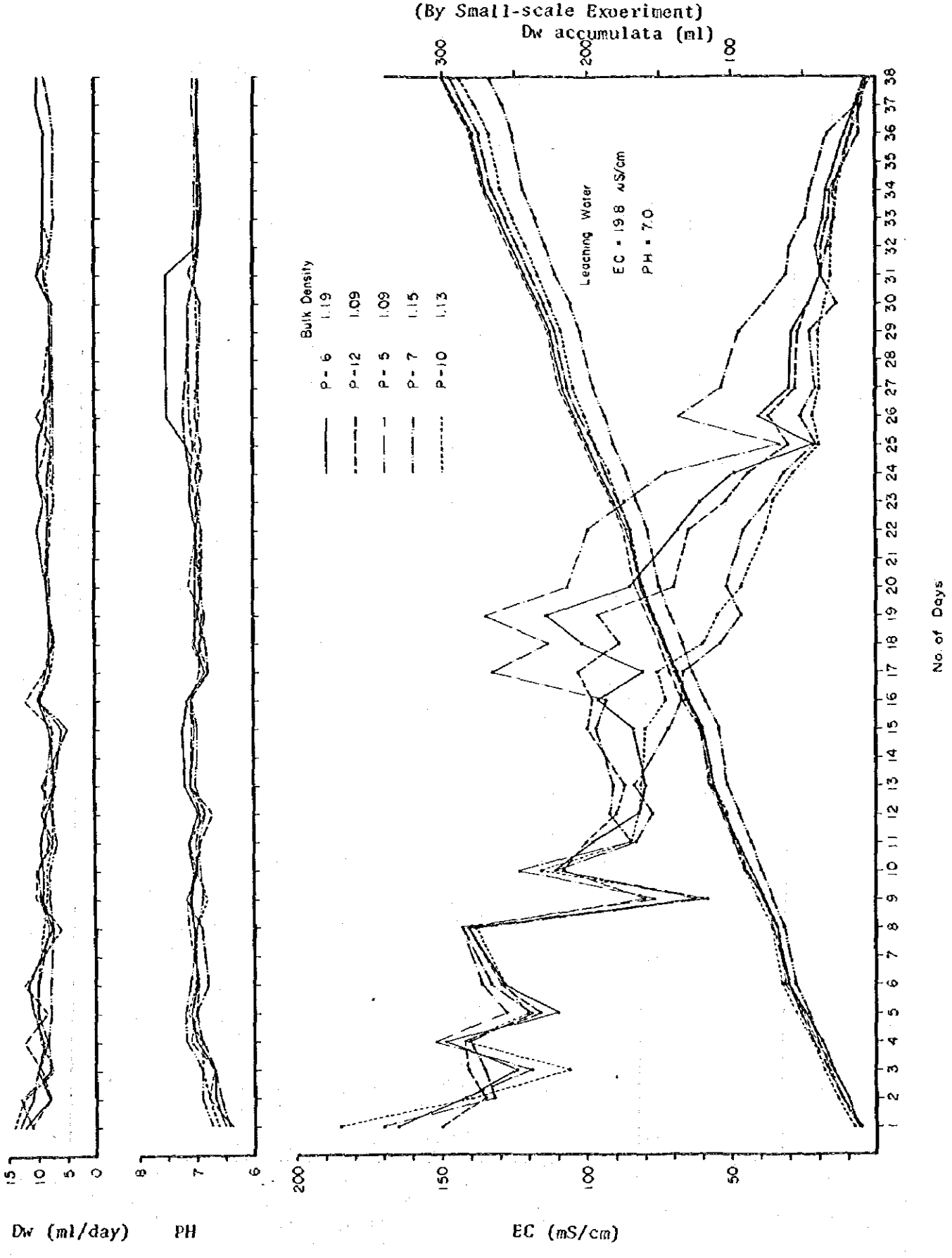


Figure IV-2 Leaching Curves of Project Area Soil(2)



Large-Scale Laboratory Leaching Experiment

Soil Sample	:	P-11
Radius of Soil Column (r)	:	7.5 cm
Thickness of Leaching Soil	:	1.5 mm
Change in ECe of Leachate	:	155 → 3 mS/cm
Amount of Leachate (Dw)	:	16,275 ml

$Dw/\pi r^2 = 16,275/176.6 = 92.2$ cm

Small-Scale Laboratory Leaching Experiment

Soil Sample	:	P-5, 6, 7, 10,12
Radius of Soil Column (r)	:	2.5 cm
Thickness of Leaching Soil	:	20 cm
Change in EC of Leachate	:	155 → 3.4 mS/cm (average)
Amount of Leachate (Dw)	:	281 ml (average)

$Dw/\pi r^2 = 281/19.6 = 14.85$ cm

In case that the thickness of leaching soil is 1.5 m, the leaching requirement is,

14.85 cm x 7.5 = 111.4 cm

According to the laboratory leaching experiments, the leaching requirements range from 922 to 1,114 mm, while the statistical analysis was impossible because of insufficient number of samples as well as lacking of replication. The laboratory experiment made the least loss, therefore, the actual requirement in the field should be obviously larger than these figures.

The adequate period for effective leaching of saline soils under the conditions prevailing in the Project Area is in late autumn to winter when the sufficient amount of water source is available and the evaporation is least.

During the summer season prior to the start of leaching, the lands are left fallow after deep plowing or subsoiling in order to dry the soils uniformly for making the infiltration of leaching water more easily and perfectly. In the next summer following the leaching, rice cultivation is started to eliminate the risk of re-salinization under the dry and hot climate.

Types of leaching can be separated into two groups; that is, continuous flooding and intermittent flooding. The former is frequently less effective per unit of water applied than is the latter. In case of leaching saline-alkali soils, alternate watering and drying is especially recommendable to maintain the soil permeability for clayey soils which crack upon drying since cracking accelerates the downward movement of water.

The following leaching procedures are recommendable for the Project Area. Before leaching, the lands are cleared of the overgrowth of halophytes shrubs, and salt crusts on the surface are removed mechanically at about 3 cm thick. Then, the lands are levelled with an accuracy of 10 cm.

Then, the fields are plowed to a depth of about 20 - 40 cm. In case that cemented layer formed at the upper subsoil, subsoiling for breaking-up it is preferable. After this, the fields are levelled again with an accuracy of 5 cm and divided into leaching plots which are separated from others by ridges. Leaching water is poured on the fields with controlling the quantity by using weir. Approximately 150 mm of water is applied at a time. The first water application is done at the rate not exceeding the deficit in field capacity (approximately 100 mm). This water spreads and soaks into

the soil having virtually no downward flow, and gradually dissolves all the soluble salts accumulated in the soil. With respect to the solubility of salts, even with the most strongly salinized soils, the water depth, as mentioned-above, is enough to fully dissolve the salts.

Subsequently (after about four days) further leaching will have to be done, with application of 150 mm, for removal of the salt solution.

During the leaching, the EC is measured regularly to check the amount of salts washed out. As the water soaks in, the easily soluble salts are gradually removed, that is, first NaCl, $MgCl_2$, and $MgSO_4$, while Na_2SO_4 remains longer particularly in cold weather.

Using leaching water of greater than 500 - 700 mm, it is difficult to complete the leaching operation in a single season in general. For the Project Area, the quantity was estimated to be about 2,350 mm in total, therefore, the leaching period will be spread over two years. After leaching, rice and berseem are grown as the first crop in crop rotation.

Fort the Project Area, the designing items of leaching are as below;

- leaching requirement : 2,350 mm
- leaching period : 2 years (except for a period from April to August)
- leaching type : intermittent flooding
- water amount per application: 15.0 mm (100 mm at the first application)

  100 mm + 150 mm x 15 times = 2,350 mm
- leaching days per application: 21 days

Average daily evaporation except for
months for April to August 4.2 mm/day

Estimated daily percolation with open
drain system 3.0 mm/day

Total: 7.2 mm/day

150 mm ÷ 7.2 mm/day = 21 days

° Drying days after leaching 4 days
total necessary days for leaching
(21 + 4) days x 16 times = 400 days (about 14 months)

With respect to the water quality for leaching, the interpretation of water quality for irrigation was quoted from FAO's guideline.

The water analysis showed that every source was evaluated the degree of increasing problem for salinity and permeability problems.

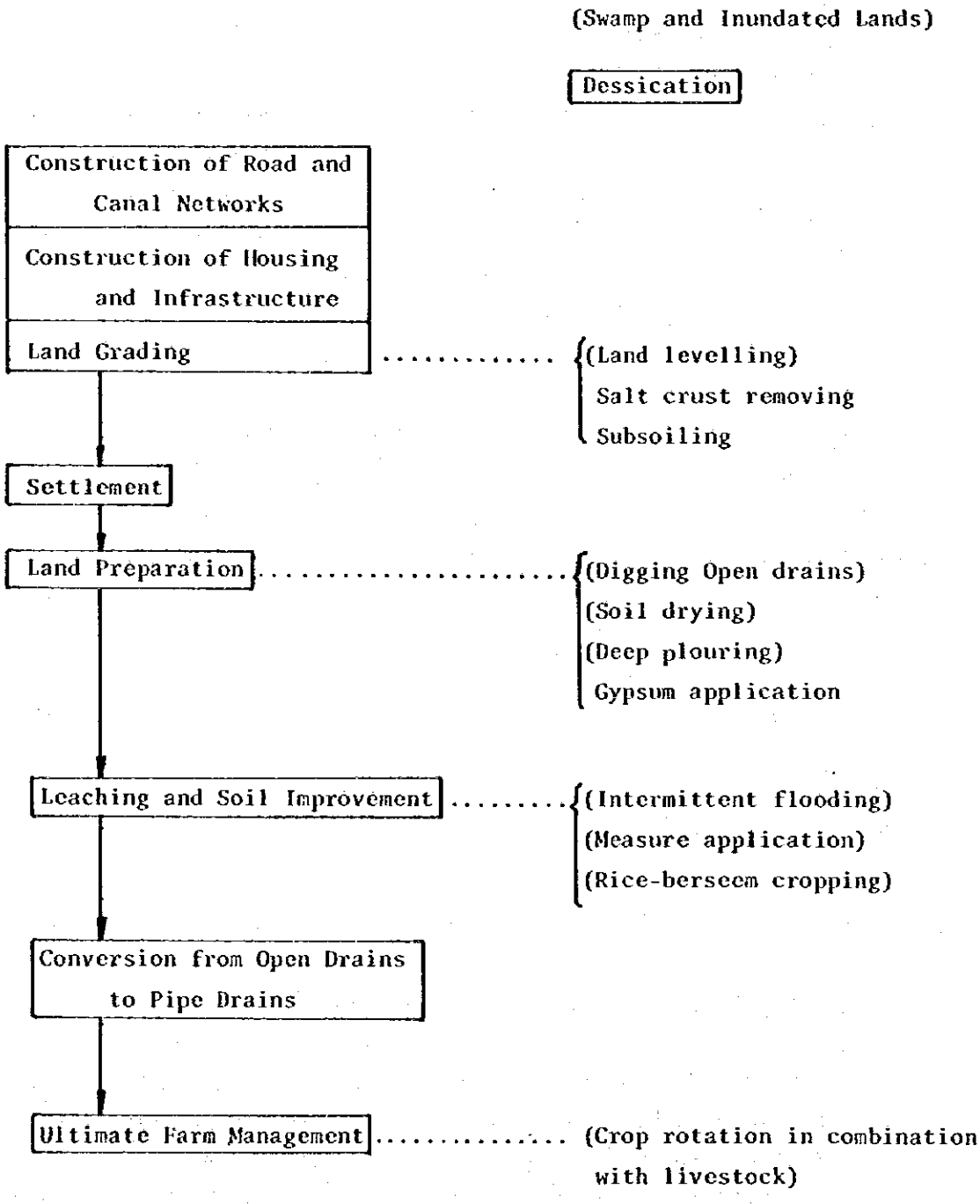
To avoid the cause of permeability problem in leaching soil, it is recommendable to use the slightly saline water for the initial leaching and then convert to the water having low salinity.

The careful water management is essential to prevent the leached soils from re-salinization (secondary salinization). Leaching requirement to maintain the water and salt balances during irrigation for the proposed crop rotation after land reclamation is discussed in Section 4.3.4.

4.3.3. Soil Improvement

The fertility of surface soils is severely degraded after heavy leaching because the leaching washed essential nutrient elements including nitrogen and phosphate etc. from the topsoil as well as excessive harmful salts.

Work Programme of Land Reclamation



( ) main works

{ } works depending on the local condition

Application of organic matter is very beneficial for improvement of both chemical and physical properties of soils. During the early stage of crop rotation after land reclamation, concentrated application of manure in combination with chemical fertilizer should be done to compensate the nutrient loss by the leaching.

The application of organic matter for the Project Area is required to be 15 - 20 tons per feddan.

For the inundated area, sulfidic materials (pyrites) were found in the substrata in the course of survey for the North Nussinia and South Port Said Project. When the sulfidic materials will be oxdized by desiccation of the inundation, they will be transformed to sulfuric acid and show strongly acid reaction (pH 4.5). This oxidation is as follow;

$$2FeS + 7O_2 + 2H_2O \rightleftarrows 2FeSO_4 + 2H_2SO_4$$

In such case, the chemical amendment to neutralize it, calcium carbonate for example, would be required.

4.3.4. Irrigation

a. Field Water Requirement

(1) Reference Crop Evapotranspiration (ETo)

Crop water requirements are expressed as equivalent depth of water over the horizontal projection of the crop growing area. In estimating crop water requirements the three methods of Blaney-Criddle, Radiation and Modified Penman, which are evaluated highly for their suitability and internationally used by the World Bank, FAO and many countries, have been applied to determination of ETo in accordance with the procedures described in the FAO Irrigation and Drainage Paper No.24.

There is no meteorological data available in the Project Area. The data observed at El Mansural were employed in the calculation of ETo because the station was located in almost the same latitude as the Project Area, the lands prevailing around the station are reclaimed ones, and the topographic and environmental conditions are similar to those of the Project Area, while, Port Said, nearest station to the Project Area, is affected by the oceanic climate and El Salhiya is situated in the middle of the desert.

As a result, the estimated values of ETo have made little difference among three calculation methods (Appendix B-1-1). The Radiation method gives lower values and the Modified Penman Method results in comparatively high values in the peak of 8.9 mm/day and in the annual total. The ETo values estimated by the Blaney-Criddle Method have been adopted for the Project Area as the moderate values and are summarized below:

Proposed ETo (mm/day)

Month	ETo	Month	ETo	Month	ETo
Jan.	2.7	May	8.2	Sep.	6.6
Feb.	3.2	Jun.	8.7	Oct.	5.4
Mar.	4.2	Jul.	7.5	Nov.	3.7
Apr.	5.7	Aug.	7.2	Dec.	2.8

(2) Crop Water Requirements (ETcrop)

To account for the effect of the crop characteristics on crop water requirements, crop coefficients (Kc) are presented to relate ETo to crop water requirements (ETcrop).

ETcrop can be found by;

$$ETcrop = Kc \times ETo$$

Factors affecting the value of Kc are mainly the crop characteristics, crop planting or sowing date, rate of crop development, length of growing season and climatic conditions. The proposed cropping patterns are determined through the study from local information and from practices in similar climatic zones. Following the procedures described in the FAO Irrigation and Drainage Paper No.24, the crop coefficients (Kc) are calculated for selected crops and Kc values are averaged for periods of different planting dates (refer to 4.4.2). The following are summary of weighted average ETcrop of the proposed crops (refer to Appendix B-1-1).

Summary of ETcrop (mm)

Crops	ETcrop	Crops	ETcrop
Rice	842	Tomato	526
Berseem	464	Cauliflower	259
Soybean	757	Onion	439
Sugarbeet	506	Cabbage	197
Sorghum	854		

(3) Additional Water for Paddy Cropping

In addition to ETcrop, paddy cropping requires additional water for land preparation and puddling, which is assumed to be 125 mm; 50 mm for flooding on the field, 30 mm for saturation of top-soil layer, 45 mm for evaporation and ten mm for percolation (Appendix B-1-1).

(4) Leaching

The leaching treatment can be roughly divided into two; initial leaching during the early stage of land reclamation, and leaching for maintenance of cropping because the salinity levels in the soil generally increase as the growing season advances. The former is discussed in 4.3.1.

The leaching requirement may be defined as the fraction of the minimum irrigation water that must pass through the root zone to control salts at a specified level. An estimation of the leaching requirement is made from a salt balance model. This model applies to a soil profile that has been irrigated over a long period to achieve a steady-state condition with regard to salt accumulation and distribution. For planning purposes, the leaching requirement (LR) may be determined from the equation;

$$LR = \frac{ECiw}{ECdw} = \frac{Ddw}{Diw}$$

where

ECiw = electric conductivity of irrigation water (mS/cm)
ECdw = electric conductivity of drainage water (mS/cm)
Ddw = depth of drainage water
Diw = depth of irrigation water

Assuming that crops respond to average root zone salinity, the following equation results and can be used to calculate appropriate ECdw values; ECdw = 5ECe - ECiw, where ECe is the average EC of the saturation extract for a given crop appropriate to the tolerable degree of yield depression. Thus, the leaching requirements can be expressed by the following equation;

$$LR = \frac{ECiw}{5ECe - ECiw}$$

The leaching requirement is not influenced by the depth of root zone, water retention characteristics of the soil, but its achievement in practice involves water supply, uniformity of water infiltration, soil permeability, and cropping pattern. In this connection, leaching tests both at laboratory and field level were planned to be carried out by GARPAD in order to facilitate the project planning. Laboratory tests are in progress; however, field

tests have not started yet. In this calculation, a leaching efficiency is assumed to be 0.5 in consideration of heavy soils in the area.

In the present situation, the leaching requirements are estimated with the equation recommended in the FAO Irrigation and Drainage paper No.24. According to the MOI's study on the El Salam Canal Project (September 1979), the salt content of irrigation water (ECiw) is estimated to vary from 824 ppm in December to 697 ppm in August. In this estimation of LR, 100 percent of potential yield are used. Other formulas to estimate LR are examined in Appendix B. The weighted average values of leaching water are summaried below;

Weighted Average Leaching Water (mm)

Crop	Leaching Water	Crop	Leaching Water
Paddy	231	Sorghum	122
Berseem	312	Onion	457
Soybeans	78	Cauliflower	65
Sugarbeet	40	Cabbage	101
Tomato	127		

(5) Irrigation Efficiency

Field Application Efficiency

Surface irrigation by means of basin and border strip has been proposed (refer to Appendix B-1-2). In principle these are the simplest of all methods of irrigation, and consequently are the ones most widely used. When properly graded, basins with checks and border strip methods allow strict control of water with high application efficiencies and uniform distribution, and efficient leaching. It is evident that crop requirements can more easily be fulfilled when the crop rotation of all farms is more or less uniform, and the number of crops simultaneously cultivated is not more than two.

In the case of basin irrigation for rice, the basins are subsequently filled with the designed quantity, and the time of delivery to each basin is in proportion to the depth of the water demand at a given time. During the peak demand period, soil moisture is high, and water is delivered through the irrigation system at the full water supply levels as designed. And, the field application efficiency of 0.75 will be used for the Project planning.

Distribution Efficiency

Distribution efficiency is defined as the ratio between water released from the headworks and that received at the field inlets. Factors affecting the distribution efficiency are, amongst others, number and types of crops requiring adjustments in the supply, canal lining and technical and managerial facilities of water control. About 44 percent of the main canals are lined with concrete; seepage losses from the remaining unlined main canals may not be more than 10 percent because of the rather low permeability of soils (in order of 10^{-4} cm/sec). Distribution losses from conveyance systems are estimated at 15 percent (or, an efficiency of 0.85)

Overall Efficiency

With land leveling, construction of on-farm works and water control facilities, and establishment of a water management the gross field water requirement is defined as a total amount of water for cropping including leaching water, irrigation application losses, and distribution losses. The gross field water requirements by crop are summarized below (refer to Appendix B-1-4):

Gross Field Water Requirements (GFR)

(Unit: mm)

Crop	GFR	Crop	GFR	Crop	GFR
Rice	1,869	Sugarbeet	852	Cauliflower	505
Berseem	1,211	Sorghum	1,523	Onion	1,399
Soybean	1,302	Tomato	1,019	Cabbage	465

b. Project Water Requirement (PWR)

A three-year cropping rotation has been proposed with a cropping intensity of 200 percent (refer to 4.2.2), based on which the total project water requirements are estimated to result in 591.3 x 10^6 cu.m for the gross project area of 74,700 feddan (or, equivalent to 7,912 cu.m/feddan/year).

Total Project Water Requirement

Crops	Cropped Area (feddan)	Total PWR (10^6 cu.m)
Rice	18,580	145.8
Berseem	18,580	94.5
Soybean	18,580	98.5
Sugarbeet	18,580	65.2
Sorghum	10,580	67.7
Tomato	8,000	33.6
Cauliflower	2,800	5.8
Onion	13,000	74.9
Cabbage	2,780	5.3
Total	111,480	591.3

The peak project water requirement shall occur in July, during land preparation and puddling periods for rice cropping, and amounts to 92.2 x 10^6 cu.m, which is equivalent to 39.8 cu.m/day/feddan for the gross area of 74,700 feddan, or 12.7 mm/day for the net cultivation area of 55,740 feddan. The monthly water requirement by crop is given in Appendix 8-1-4. The monthly project water requirement is summarized below:

Monthly Project Water Requirement

Month	10^6 cu.m	cu.m/day/fed.	Month	10^6 cu.m	cu.m/day/fed.
Jan.	45.6	79.7	Jul.	92.2	39.8
Feb.	39.4	18.8	Aug.	78.1	33.7
Mar.	38.6	16.7	Sep.	56.0	25.0
Apr.	15.2	6.8	Oct.	46.4	20.0
May	28.8	12.4	Nov.	37.0	16.5
Jun.	71.8	32.0	Dec.	42.2	18.2

c. El Salam Canal

Construction of the first stage of the El Salam Canal, the water source facility of the Project, is underway and expected to be completed in early 1986. The total gross area west of the Suez Canal and southeast of lake Manzala is estimated at 195,000 feddan.

The El Salam Canal will draw its waters from the Nile branch at Damietta. At the pumping stations of the lower Serw drain (13.50 km), about 1.5 x 10^6 cu.m/day of drain water will be mixed with the water of the El Salam Canal through the free flow from the drain. The canal will cross the Hadous drain at 48 km where a lifting and mixing station will be constructed. Downstream from the pumping station, the canal will continue until it meets the Suez Canal. The length of the El Salam is approximately 82 km. The Project Area extends from the station 49.5 km to the station 70.3 km of the El Salam Canal.

The El Salam Canal would have an ultimate capacity of 4.46 x 10^9 cu.m per year, of which half would constitute fresh water supplied from the Damietta branch of the Nile and the remainder from the Hadous and Serw drains. According to MOI calculation, the water allocation to the Project shall fall within an average of 40 cu.m/feddan/day during the summer and 20 cu.m/feddan/day during the winter, including crop requirements and leaching requirements, furthermore, the annual amount of water shall not exceed 8,000 cu.m/day/feddan.

d. Irrigation Method

Shortage of water and of labor has encouraged the introduction of techniques more efficient than surface irrigation. Sprinkler irrigation has come into use in nearly all countries for such reason. The system allows a precise application of water requirements and is economic in its use of water; however, the initial investment costs are high. The MOI does not intend to introduce the sprinkler irrigation system to the area west of the Suez Canal in consideration of soil properties and proposed crops.

Surface irrigation uses open channel flow to spread water over a field. The driving force in this system is gravity and hence the alternate term for it is gravity flooding. Surface irrigation systems generally requirement a smaller initial investment than that of other types of irrigation systems.

Surface irrigation methods of basin and border strip have been proposed to be introduced to the Project after due consideration of major factors affecting the selection of the irrigation methods, such as soil texture, salt contents of soils and irrigation water, kind of crops proposed, project economy and so on(refer to Appendix B-1-5).

e. Water Delivery and Designed Discharge

(1) Main and Secondary Irrigation Canals

Irrigation works operated on supply schedules which determine the flow in the main and lateral canals and farm ditches throughout the growing season, thus resulting in fixed quantities and periods of delivery, prevail in most irrigated areas in Egypt. Rotational supply can be considered a suitable and economic method if the crop rotation is uniform and the climate stable. Such rotation, with full supply or none at all, will guide the farmers in their operation.

According to the operation program by the MOI, canals shall be operated during the summer season on a basis of four days on and four days off. Consequently, designed discharge to determine a canal capacity shall be twice irrigation requirement; 2 x 1.47 lit./s/ha (or, 12.7 mm/day) = 2.94 lit/s/ha (or, 1.23 lit/s/feddan).

(2) Tertiary Canal

The tertiary canal, taking off from the secondary canal, governs an area of 50 feddan (21 ha) which is composed of 10 farm fields (or, 30 farm plots). This is a smallest unit for rotational irrigation and is termed the farm block. As the farm block will be irrigated in one day under the proposed rotational irrigation, the interval of irrigation day for the farm block is eight days in conformity to the canal operation by the MOI on the basis of four days on an four days off. Hence, the canal capacity of the standard tertiary canal is designed to be eight times irrigation requirement at the farm level (0.85 x 1.47 lit. /s/ha = 1.25 lit./ha); 8 x 1.25 lit./ha x 21 ha = 210 lit./s.

The project has proposed to irrigate in one day one forth of the Project Area during the summer under the rotational irrigation program. The farm blocks to be irrigated at the same day will be dispersed over the Project Area, not dividing the Project Area into equal four sub-areas, with which overload to the drainage systems shall be reasonably avoided. A sample of rotational irrigation is stated in Appendix B-1-6.

f. Gravity Irrigation and Lifting by Farmers

In and around the Project Area, water levels in the existing canals are lowered by 0.5 - 1.0 m below the ground surface in order to reduce seepage losses from the canal, and farmers lift the water from the canal with their own small scaled pumps or Sakkia, which is the traditional irrigation method prevailing in Egypt. This type of

canals may be free from the demolition of embankment in case farmers install intake facilities; however, it may result in high operation and maintenance costs. Furthermore, purchase of pumps would be a burden on farmers.

Alternative studies have been made for two options of irrigation methods of gravity irrigation and lifting by farmers, from the viewpoints of engineering and economy, taking the M2 irrigation area by way of example (Refer to Appendix B-1-6). In case of lifting by farmers, 460 of small scaled pumping stations will be installed at a coverage of 21 ha per one station. Major features of the alternatives are summarized below;

Major Features of Alternatives

- M2 Irrigation Area -

Irrigation Area: 9,670 ha

Max. Discharge: 28.43 cu.m/s

Item	Gravity	Lifting	
	Case I	Case II	Case III
Intake Water Level	EL 1.95m	EL 1.45m	EL 1.20m
Length of Canal (km)	132	132	132
Main Pumping Station			
M2 Station			
Command area (ha)	5,680	5,680	5,680
Motor output (kw)	6x75	6x75	6x75
M2-1 Relief Station			
Command area (ha)	1,165	-	-
Motor output (kw)	4x30	-	-
M2-2 Relift Station			
Command area (ha)	860	-	-
Motor output (kw)	4x45	-	-
Small Scaled Pumping Station			
Nos. of station	-	460	460
Command area (ha)	21	21	21
Engine output (PS)	-	3	3.5

The construction cost of irrigation canals for the lifting irrigation method is lower than that needed for the gravity irrigation method becaused of well balanced earth works of excavation and embankment resulting from lowering the water levels in the canals; however, the lifting irrigation method involves higher construction costs than that of the gravity irrigation method, due to a large amount of installation and procurement costs for 460 small scaled pumping stations, as summarized below;

Construction Costs

(Unit: 1,000 LE)

Item	Gravity	Lifting	
	Case I	Case II	Case III
Canal	7,089	6,026	6,141
Main Pumping Station	4,211	2,665	2,665
Small Scaled Pumping Station	-	8,255	8,619
Total	11,300	16,946	17,425

The construction costs are converted to annual costs including operation, maintenance and replacement costs on the conditions of; analysis period of 50 years, discount rate of 10 percent, and useful life of 10 years for main pumps and seven years for small pumps. As can been seen from the table below, in addition to high amortization costs, the lifting irrigation method needs high replacement costs, resulting in higher annual costs than that of the gravity irrigation method. The Project will provide on-farm works to deliver the irrigation water to each farm plot, thus, it is no longer necessary for farmers to construct intake facilities themselves. Seepage losses may be around five percent of designed discharge, owing to the low permeability of the soils. Consideration of all these leads to the conclusion that the gravity irrigation method should be employed for the Project.

Annual Costs

(Unit: 1,000 LE)

Item	Gravity	Lifting	
	Case I	Case II	Case III
Amortization	1,140	1,710	1,758
Maintenance	296	550	567
Replacement	145	675	701
Pump Operation	36	32	34
Total	1,617	2,967	3,060

4.3.5. Drainage

a. Drain Spacing

Even with the best, carefully controlled system, some water will be lost, through deep percolation, seepage and surface runoff. Deep percolation from any source causes a heightening in the water table. Three methods of transient flow method developed by USBR, the Hooghoudt formula and the Ernst formula have been examined, to discuss spacing of drains and drainage modulus under the following conditions:

- Crop: rice
- Field application efficiency: 0.75
- Depth of root zone: 0.6 m
- Depth of flow: 1.0 m
- Allowable water table: 0.4 m above drain
- Depth of barrier layer 4.0 m
- Average permeability (k): 0.22 m/day

As a result, drain spacing is calculated to be 26 m, 29 m, and 24 m, for the transient flow method, the Hooghoudt formula and the Ernst formula, respectively. Standard criteria of drain spacing are determined to be 23 m on an average and 1.3 m depth of drain invert (refer to Appendix B-2-1).

b. Drainage Modulus

As a result of the above-stated preliminary studies, a drainage modulus of 3.0 mm/day per net area would be applied to the design of drain capacities for subsurface drainage with a drain spacing of 23 m.

A drainage canal receives water from a group of drains at a different rate. The area which has been irrigated most recently will have the highest water table and the highest discharge, while the area irrigated first will have the lowest discharge.

Irrigation water that enters the Project Area (74,700 feddan gross) can only be removed through evapotranspiration or via drainage system. The peak project water requirement is 92.1×10^6 cu.m/month (or, 9.5 mm/day) in July and the evapotranspiration rate is 5.0mm/day. Minimum drainage requirement comes to 4.5 mm/day, or corresponding to 18.9 cu.m/feddan/day. The project proposes the use of the project drainage requirement of 22 cu.m/day/feddan (or, 5.5 mm/day), taking into consideration daily fluctuation of discharge and a time lag unavoidable in the operation of pumps to meet the drainage requirement.

c. Drainage Method

Drainage plans are commonly worked out for the purpose of eliminating surface runoff and removing excessive moisture in the soils. In this Project, however, the drainage plan aims mainly at removing excessive soil moisture that causes salt accumulation rather than at eliminating surface runoff which takes place very rarely because rainfall is a mere 50 mm per annum.

There are two countermeasures to be taken for solving drainage problems; one is to provide an open drain system and the other is to provide a pipe drain system. The comparison of these two systems is tabulated below.

Open Drain vs. Pipe Drain

Open Drain	Pipe Drain
1. Cost comparatively low	High initial cost
2. Land coming under the drain section is lost forever for cultivation	Being underground, no loss of land and no obstruction to agricultural operations
3. Large capacity of the drain	Small capacity of the drain
4. Suitable for removal of surface runoff	Suitable for removal of sub-soil water
5. Perpetual problem of weed growth removal	Immune from weed growth
6. Scouring of bed and sloughing of the sides have to be taken care of	
7. Open to inspection	Being underground, causes of failure hard to detect
8. Repairs economical and convenient	Repairs very costly and inconvenient
9. Can function with flatter slope	Requires steeper slope
10. Bridges and other mean of communication have to be provided at high cost	Net saving in cost on this account
11. High maintenance cost. Require frequent cleaning	Low maintenance cost

The comparison of drainage methods of the open drain and pipe drain has been made from the viewpoint of engineering and economy, for the standard farm field of 5 feddan (2.1 ha), as follows. (refer to Appendix B-2-3).

i) Open drain method

- Gross area: 2.10 ha
- Net area: 1.68 ha
- Length of drains: 9 x 85 m 765 m

ii) Pipe drain method (plastic pipe)

- Gross area: 2.1 ha
- Net area: 2.1 ha
- Length of drains: 9 x 95 m 855 m

The economic evaluation was made through the analysis of a benefit-cost ratio for the period of 20 years. In the computation, the economic benefit of 532 LE/feddan (or, 1,267 LE/ha) that included both irrigation and drainage benefits was used because of difficulty in evaluating the benefit generated from drainage improvement alone. Benefits were expressed as an annual equivalent over the period of analysis, and all costs were reduced to an equivalent annual amount by amortizing over the period, with an interest rate of 10 percent.

Summary of Economic Evaluation

(Unit: LE/2.1 ha)

Item	Open Drain	Pipe Drain
Construction Cost	3,403	5,864
Annual O & M Costs	270	30
Annual Benefits	2,129	2,661
Present Worth Value		
- Benefits (B)	9,169	11,460
- Costs (C)	5,046	5,323
Benefit Cost Ratio	1.82	2.15

The open drain method may result in a smaller B/C ratio, mainly due to high O & M costs and value for losses of arable land is the open drain. Though intangible in the economic evaluation, the open drain system that digs drains at the spacing of 23 m has obstruction to agricultural operation.

In addition to the economic evaluation, following consideration is made from the engineering viewpoint, in selecting a proposed drainage method:

i) Open drains of suitable depths and spacing are preferable in the early stages of reclamation, especially in soils of low permeability. These can be replaced later by pipe drains

ii) The continuing leaching requirement after reclamation is not the same as the initial leaching requirement. The permanent deep drainage system for irrigated lands can not be economically designed, from a drainage spacing viewpoint, to take care of the initial leaching requirement.

In due consideration of economic and engineering aspects, the Project will use the open drain system of drainage at the early stage of land reclamation, and then they should be replaced by the pipe drains. It is recommendable that pipe drains be installed at the end of a first cropping stage; four and five years after the land reclamation has started.

The differal of construction of such drains usually is necessary because of the difficulty in locating and designing them accurately before the lands are irrigated and the drainage problem becomes evident. The initial leaching requirements are larger than the leaching requirements during cropping.

In this preliminary design of pipe drains, the gravel was employed as an envelop material because it is technically reliable, while data and information whether other materials were available or not in and around the Project Area were lacking. Rice hulls seem to be of much practical use from the viewpoint of engineering and project economy. Detail investigation are recommendable to be made during the course of detailed design.

4.3.6. Land Consolidation

a. Major Factors to Determine Size and Shape of Farm Plots

The size and shape of farm plots will be determined, in general, depending upon such major factor as farming efficiency, operation efficiency of irrigation/drainage facilities, topographical conditions, farm management conditions, construction cost, and reduction rate of farm land. For the project, two alternative were studied in due consideration of these major factors.

(1) Farming Efficiency

Mechanized farming:

- The longer the length of run is, the more efficient the mechanized farming becomes, and furthermore, the larger the ratio of the length of run to width is, the higher the working efficiency becomes. Plowing works will require more than 30 m width in view of smooth turning of machines.

- Chemicals application will limit the maximum of both the length of run and width.

- The maximum of the length of run and the width will be often limited not only by mechanized barning efficiency but also by topographical conditions and efficiency of operation of irrigation/drainage facilities. And the mechanized farming efficiency is deemed as one of the major factors to limit the minimum of both the length of run and the width.

Man-power:

- According to the three-year rotational cropping pattern, an acreage of vegetable cropping occupies about 25 percent of the total cropping area. Vegetable cropping requires much more man-power by 93 percent for onion growing and 91 percent for tomato growing.

  In case of typical farm households with five feddan farm land, working hours by man-power for vegetable growing will occupy 49 percent of the total time of farming works.

- Man-power labor will not limit the width of a farm plot

- The maximum length of run will be 100 m for man-power labor

Operation of irrigation/drainage facilities:

- The longer length of run of a plot will require longer time for draining the plot. And the length of run will be determined in consideration of drainage efficiency as well as successful land levelling.

- As for irrigation/drainage facilities, the major factor to limit the length of run is the length commanded by pipe drains. Such commanded length will be determined by soil permeability and depth of drains.

The similar-natured projects experienced in Egypt suggest that the maximum length of pipe drains is as long as 100 m.

- The longer flow length requires much time to supply irrigation water and reduce the irrigation efficiency. Consequently, the maximum length will be determined by specific feature of the intake rate of objective farm land.

Topographical conditions:

- It is most economical to take the length of run in parallel with contour lines and the width in direct angle to the contour lines. Topographical dip will be a limiting factor to the width in terms of land consolidation costs.

- When the difference in surface elevation between two field is more than 30 cm, ridge slopes should be protected by certain way, and since it will be difficult to drive machines over ridges, elevation difference should be less than 30 cm.

Farm management:

- There will be little difference in such conditions of farm management as soils, irrigation, transportation, etc. among settler farmers because the newly reclaimed land in the Project will be land-consoilidated.

- About 80 percent of the total farm land will be allocated to farmers and every farm household will manage five feddan (2.1 ha) of farm land.

- According to the three-year rotational cropping pattern, the farm land owned by individual farmers will be divided into three plots (0.7 ha each) which will be grown with paddy and upland crops in rotational way.

b. Comparative Study

The comparative study on the aforesaid factors resulted in determining the length of run by 100 m in maximum based on efficiency of man-power vegetable farming and pipe drains. Therefore, the size of five feddan (2.1 ha) farm land will be 210 m x 100 m, which will be divided into three plots of 100 m x 70 m (0.7 ha) in size. There are two ways considered for layout of such farm land.

Case 1: The 210 m long side is taken along the lateral irrigation canals

Case 2: The 100 m long side is taken along the lateral irrigation canals

A comparative study was made on the above two cases in due consideration of construction plan of roads, irrigation and drainage facilities and their construction costs and reduction rate of the respective cases. (See B-3-1 of Appendix on details). The layout of roads and canals was contemplated under the following conditions.

Roads:

- Farm roads are provided along one side of the on-farm irrigation ditch.

- O & M roads are provided along one side of the on-farm drains and small farm roads along the opposite side, if necessary.

Canals:

- Every farm plot contacts with small irrigation canal/on-farm ditch or provides an intake notch.

- Every farm plot contacts with small drainage canal/on-farm irrigation ditch, or provides drainage notch.

- Small irrigation canals have a maximum length of 1.0 km.

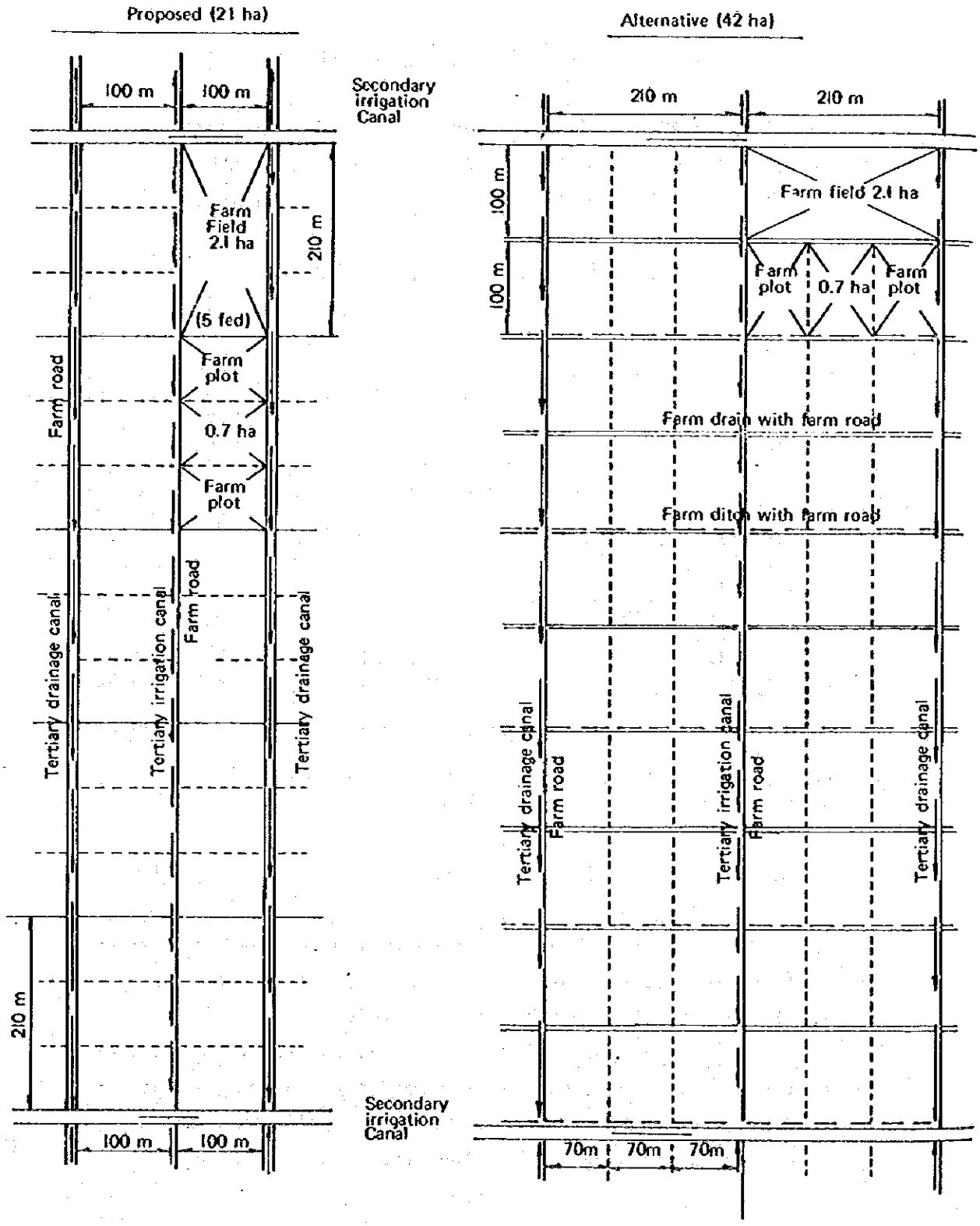
Under the above conditions, density of roads and canals, reduction rate, construction costs were studied on the respective cases to be summarized as follows;

Major Factors for Comparative Study

Items	Case I (Proposed Plan)	Case II
1. Shape of farm bloc	1,050m x 221m	1,090m x 435m
Acreage	50 feddan (21 ha)	100 feddan (42 ha)
2. Shape of farm land	210m x 100m	210m x 100m
Acreage	5 feddan (2.1 ha)	5 feddan (2.1 ha)
3. Shape of farm plots	100m x 70m	100m x 70m
Acreage	1.67 feddan (0.7 ha)	1.67 feddan (0.7 ha)
4. Density of road/ canals(m/ha)		
Farm roads	150	186
Small irri. canals	50	86
Small drain.canals	50	76
5. Acreage (ha)		
Road/canals	2.23 (9.6%)	5.46 (11.5%)
Farm land	21.00 (90.4%)	42.00 (88.5%)
Total	23.23(100.0%)	47.46(100.0%)
6. Construction cost (LE/ha)		
Earth Works	1,389	1,464
Related works	244	594
Total	1,633	2,058

As a result of the above study, Case 1, which takes the width (100 m long side) of the farm plot along the small irrigation canals, is advantageous to Case II in efficiency of facility operation and farming works, reduction rate, construction cost, etc. In other respect as well, Case I is deemed advantageous to Case II in low density of roads and canals, which will alleviate the heavy operation and maintenance works. Therefore, the layout and

Figure IV-3 Typical Layout of On-farm Works



maintenance works. Therefore, the layout of the farm plots of Case I will be employed in the Project (See Figure IV-3).

The individual farmers, holding 2.1 ha of farm land in total, will have three farm plots of 0.7 ha (100 m x 70 m), into which the surface gravity irrigation will be introduced as mentioned before.

Based on permeability of the soils of the Area and the designed water requirements, the maximum length of furrows and irrigation time were studied (See B-3-2 in Appendix). More than 100 m will be required as maximum length for either methods of basin irrigation and border irrigation. As a result, the plot size by 100 m x 70 m is considered most suitable to surface gravity irrigation of the Project.

4.4. Agricultural Development

4.4.1. Land Disposal

The land disposal in the Project will be carried out by two systems of distribution and auction. In view of implementing a land reclamation project, three categories of government, cooperative organization and private company should be taken into due consideration as executing body. According to the land reclamation plan in the Five Year Development Plan, 1982/87, the share of land by the above three categories is planned at 48 percent, 49 percent and 3.0 percent, respectively. It is considered that the Government should attempt to mobilize private capital through the latter two categories.

Implementation by the Government and the land reclamation cooperative is recommended. The main reason for using the reclamation cooperative is to mobilize idle private capital. The large size state farm will not be recommended for two reasons; one that the size of the Project Area is insufficient for it to be divided into state farms, and the other is the inefficiency of employed labor.

Allocation of the reclaimed lands will be studied using the procedures discussed in Appendix C-1. The recommended proportion of land allocation is as follows.

	Allocation to Land Reclamation Cooperatives	
	20%	30%
Allocation to auction system on land allocated to Government	30 to 40%	10 to 20%

The development of large areas by auction system is undesirable from the social point of view that the speculative tendency is accelerated by land deals and the creation of employment opportunities. In conclusion, allocation of 30 percent to the Land Reclamation Cooperative with 20 percent to auction system is recommended. This is a moderate proportion in which private capital available for the Land Reclamation Cooperative is more than the infrastructure costs in the local currency.

The land distribution to the new settlers can be shown as follows, resulting from alternative study on the basis of the budget which can be referred to in Appendix C-1.

Small holders ..... 5 feddans
Graduates
Agricultural secondary school ..... 15 feddans
University ..... 20 feddans

The appropriate land allocation between small holders and large holders was estimated by taking such procedure as studied in Appendix C-1. The reasonable proportion is available through alternative study of the demand and supply of farming labor as calculated in Appendix C-1.

The number of settlers, the population, the net farm income and necessary credit also are key social economic factors in deciding the proper proportion.

In conclusion, the proposed proportion is 80 percent for small holders and 20 percent for large holders.

The number of new settlers was estimated by using the proportion as follows.

	Government	Land Reclamation Cooperative	Total
Small holder			
5 fd.	4,992	2,844	7,836
Large holder			
15 fd.	562	100	662
20 fd.	281	50	331
Total	5,835	2,994	8,829

4.4.2. Agricultural Production

a. Cropping Pattern

Proposed farm is divided into a strip of land of 210 m long and 100 m wide (5 feddan). Open drains will be installed perpendicular to the length of land strip in order to enhance the effectiveness of leaching. After completion of the initial stage of leaching, the open drains will be replaced by the pipe drains and the cropping area will increase to 55,740 feddan from 44,600 feddan. Table IV-3 shows the cropping area by irrigation block and land class. the cropping area by crop is as follows;

Cropping Area

Crop	Feddan	ha	Crop Season
Paddy	18,580	7,803	Summer Crop
Saybean	18,580	7,803	"
Sorghum	10,580	4,444	"
Berseem	18,580	7,803	Winter Crop
Sugarbeet	18,580	7,803	"
Onion	13,000	5,460	"
Tomato	8,000	3,360	Summer Crop
Cauliflower	2,800	1,176	Winter Crop
Cabbage	2,780	1,168	"
Total	111,480	46,820	

Table IV-3. Cropping Area by Irrigation Block and by Land Class

(Unit: Feddan)

Irrigation Block	Land Class 2 . 3	Land Class 4	Total
M 1	2,430 (1,944)	13,400 (10,722)	15,830 (12,666) 1/
M 2	15,100 (12,082)	7,920 (6,337)	23,020 (18,419)
M 3	7,350 (5,881)	9,540 (7,634)	16,890 (13,515)
Total	24,880 (19,907)	30,860 (24,693)	55,740 (44,600)

1/ ( ): With open drain

b. Farming Method

(1) Paddy

Paddy will be directly sown (broadcasting method) in the early stage of development and then, transplanting method will be introduced in the course of establishing the three-year rotational cropping system. Sowing will be practised in May or June, while the nursery period will last about 2 to 3 weeks, and agri-chemicals will be applied at least once during this periods.

The gestation period will take about 60 days from June to July, and the harvesting season will last for about 60 days from October to November. The irrigation water supply will be stopped about two weeks before the harvesting season begins.

(2) Berseem

Berseem will be sown by the broadcasting method about two weeks prior to paddy harvesting. The first cutting of berseem will be carried out about 60 days after sowing, and the second cutting and onward will be practised every one month after the last cutting. When the fourth cutting is over, the plants should be plowed into soils. Fertilization shall be carried out after every cutting. Part of the harvested berseem will be dried and stored.

(3) Soybean

The sowing season of soybean will cover a period of about 60 days from April through May. The ridge width for soybean cropping shall be about 60 cm and sowing intervals shall be in a range between 20 cm and 30 cm. The harvesting season will last from August to September and be about four months after sowing.

(4) Sugarbeet

Beet shall be sown as a second crop of soybean for 60 days from September to October, and ridges should be formed as wide as about 50 cm and sowing intervals should be about 20 cm. Harvesting will be made for about 80 days in March through May. Harvested sugarbeet shall be directly sent to factories for processing.

(5) Sorghum

Sorghum is grown to enrich the soil twice or three times a year. Sowing, by the broadcasting method, will be carried out in May through July.

Harvesting as first cutting, will be made, about two months after sowing and then the second and the third cutting will be made at 1.5-month intervals after the first cutting.

(6) Vegetables

Tomato for processing should be grown as summer crops with four plantings a year to harvest for about 170 days from the end of June through early November. The seedlings for the first planting shall be grown in vinyl-sheet-covered nursery beds so as to protect the young seedlings from the cold weather.

In winter, about 70 percent of the farm lands in the Project Area will be cropped with onion and the remainder with 15 percent each of broccoli and cabbage. These winter crops will be marketed both for domestic consumption and for export fresh.

The proposed cropping calendar and related acreage are shown in Figure IV-1.

Paddy Seedling Plan

Seedling will be sown by rice transplanter and thus seedling facilities will be provided in each village. Necessary facilities per paddy field of 42 feddan (100 ha) are listed below and their installation and operation and maintenance will be taken care by the extension service center.

Summary of paddy seedling plan is as follows:

° Required period
  About 15 days Seedling height 15 cm

° Required area
  700 m^2

° Required Machinery

Seed Box	26,000
Seed Machine	1
Earth Mesh	1
Conveyor	1
Spray	2
Germination Case	1
Shelf	55
Porous Sheet	13,000 sheets

° Required Labor

16 man-days

° Machinery Cost

¥22,862,000 (79,380 LE)

° Facilities will be covered with nets to prevent the damage from birds and animals. The roof will be made of bamboo blind to avoid the sunshine.

(7) Nursery

There are five crops such as paddy, tomato, onion, cauliflower and cabbage, which require nursery works to secure the health of the seedlings. The areas required for nursery beds per feddan for the respective crop are as follows:

Acreages of Nursery Beds

(Per feddan)

Paddy	17 m^2		
Tomato	0.01 fed.	Cauliflower	0.01
Onion	0.06 fed.	Cabbage	0.01

It is recommended that these crops are treated collectively at the nursing stage for the following seasons.

- Control of crop varieties can be easily made to secure high quality products for better marketability,
- Farming management can be carried out easily and effectively,
- Labour power and input materials to be required can be reduced considerably,
- Intensive guidance will be available for successful nursing to grow healthy seedlings, and
- The nursery sites can be selected easily.

c. Crop Production

(1) Agricultural Production

The agricultural production plan at the full development stage is shown below. The production by year is given in Appendix-C.

Table IV-4. Agricultural Production

Crop	Area (feddan)	Yield (t/feddan)	Production (t)	Planting Ratio (%)
Paddy	18,580	3	55,740	100
Soybean	18,580	1.2	21,630	97
Sorghum	10,580	18	190,440	100
Berseem	18,580	25	464,500	100
Sugarbeet	18,580	25	455,210	98
Tomato	8,000	20	156,800	98
Onion	13,000	10	127,400	98
Cauliflower	2,800	5	13,720	98
Cabbage	2,780	20	54,490	98
Total	111,480			

Vegetable Production and Uses

(Unit: ton)

	Tomato	Onion	Cauliflower	Cabbage
Production	156,800	127,400	13,720	54,490
Processing	141,000	-	-	-
Export	-	115,000	12,400	49,000
Consumption	15,800	12,400	1,320	5,490

Table IV-5. Proposed Time Schedule to Build-up Full Scale Development

(Unit: ton/Feddan)

Crop	First Stage		Second Stage					Full Dept. Stage	
	1	2	3	4	5	6	7	8	9
Paddy	1.2	1.5	1.8	2.1	2.4	2.5	2.6	2.7	3.0
Berssem	10	13	15	18	20	23	25	25	25
Soybeen	-	-	0.7	0.8	0.9	0.9	1.0	1.0	1.2
Sorghum	-	-	13	14	16	18	10	18	18
Sugarbeet	-	-	16	18	18	20	21	23	25
Tomato	-	-	14	16	18	20	20	20	20
Cauliflower	-	-	3	3	4	5	5	5	5
Cabbage	-	-	14	16	18	20	20	20	20
Onion	-	-	5	5	6	7	8	9	10

(2) Agricultural Input Materials by Crops per Feddan

Crops	Seed (kg)	Urea (kg)	S.P. (kg)	Pesticide
Rice	60	100	95	Minozan Ordran 0.1 kg 2.5 kg
Berseem	25		200	MEP 2.25 lit.
Berseem (Seed)			230	
Sugarbeet	7			Endrin Lannats 0.5 kg 0.3 kg
Soybean	36	60	100	
Sorghum	12	120	120	
Tomato	0.2	130	300	Tamaron 3.6 lit.
Onion	3.5	180	260	Aphioe 3 lit.
Cauliflower	0.5	87	180	Rubigan 24 Marason 1.2 lit.
Cabbage	0.5	110	200	Tameron 1.2 lit. Marason 1.2 lit.
Cotton	60	76	100	MEP 1 lit.
Wheat	75	110	50	MEP 1 lit.

4.4.3. Farming Machinery

a. Farm Mechanization

The proposed cropping intensity of the Project Area is 200 percent, which will cause a shortage in the labour force in the future. Under the circumstances, introduction of farming machinery is a prerequisite to successfully advancing agricultural development in the Project Area.

Farming block in the Project Area will be 100 m long and 70 m wide or 0.7 ha in size, which has been determined by 1) proposed pipe drains for leaching the soil salinity, 2) production of mainly vegetables by manual labor, and 3) land distribution and three-year crop rotation. Introduction of large-scale mechanization will not be suitable to the block of this size.

The soils of the Project Area, consisting mainly of heavy clay, become hardened in dry condition, but are extremely soft when wet.

Large tractors shall be employed for plowing and to break up the soil in dry soil conditions. Medium and/or small tractors shall be used for land leveling and puddling for paddy fields, and medium size combines shall be mobilized for harvesting. Medium and/or small tractors shall also be used for ridging, fertilizing, sowing, and other farming works for upland cropping, while bean harvesters shall be employed for soybean harvesting and beet harvesters for beet harvesting.

Ownership and operation/maintenance works of the large medium machines shall belong to the agricultural cooperatives to be established in the Project Area, whereas those of small machines shall belong to individual farmers. An operation schedule for farming machinery shall be prepared by cooperatives under the guidance of the agri-extension staff.

Operation charges of the large/medium machines shall be collected by cooperatives.

For upland farming, small machines owned by individual farmers shall be used.

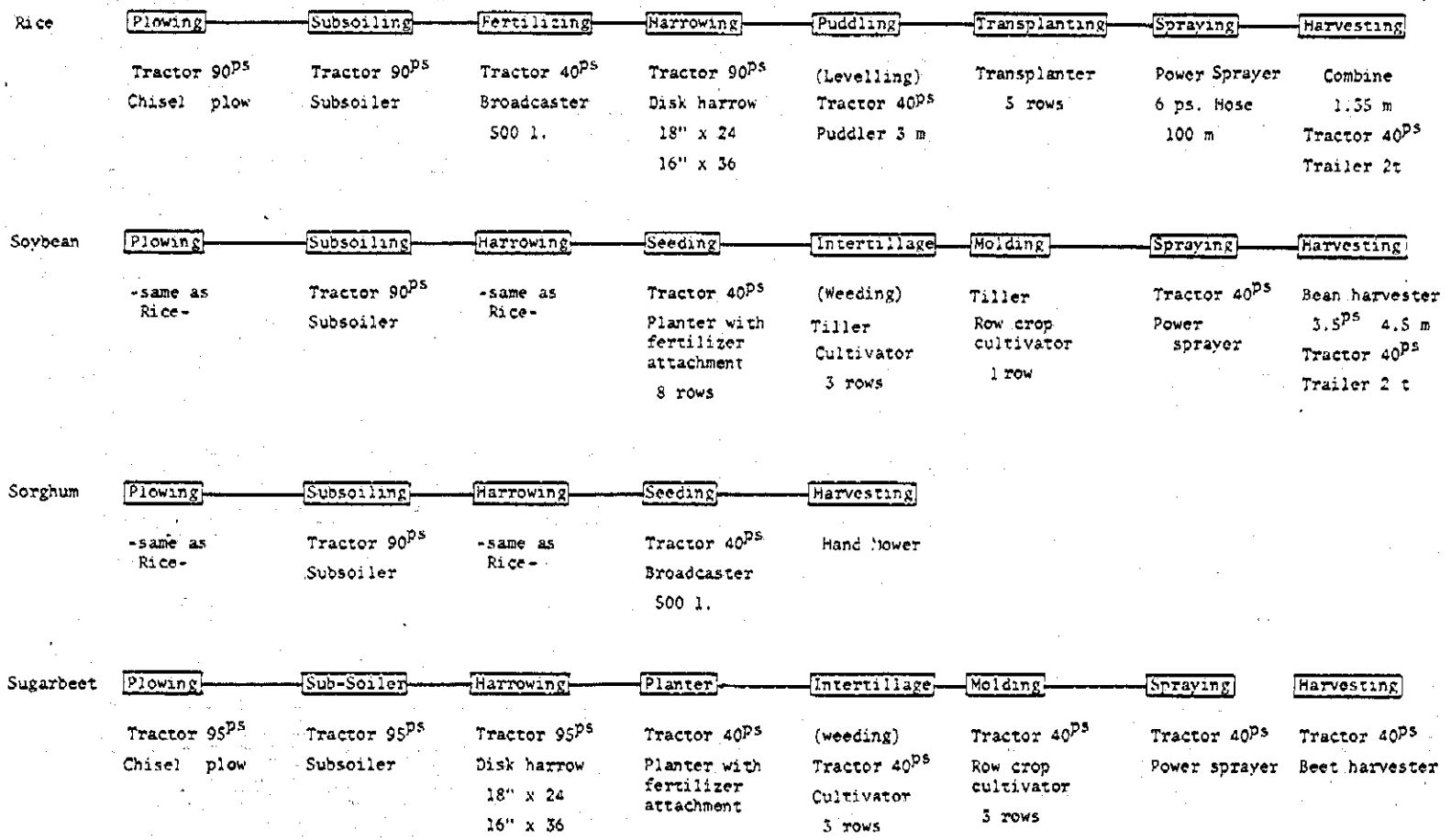
Following Figure IV-4 illustrates the proposed farm operation system under mechanization for growing paddy, soybean, sorghum and sugarbeet (See Appendix C-1, C-2).

Listed below is the proposed farming machinery. All the settlers will be members either of the general agricultural cooperative or of the agricultural cooperative for reclamation. It is desirable that the proposed farming machinery be operated and maintained by the machinery section to be set up in each cooperative. The machinery is allocated between the two cooperatives as follows.

Proposed Farming Machinery

Machinery	Capacity	Gen.Agri. Coop.	Agri.Coop. for Recla.	Total
Tractor	90 PS	125	64	189
	40 PS	87	45	132
Chisel Plow	3 m	27	14	41
Disk Harrow	18"x24	28	14	42
Puddler	3 m	19	10	29
Transplanter	5 rows	50	26	76
Combine	135 cm	16	8	24
Planter	8 rows	24	12	36
Sprayer	14 m	9	4	13
Sub-soiler	1.2 m	17	9	26
Bean Harvester	4.5 m	13	6	19
Beet Harvester	2 rows	52	27	79
Broadcaster	500 lit.	7	4	11
Trailer	4 t	27	13	40
Workshop		1	1	2
Total		502	257	759

Figure IV-4 Operation System of Farm Machinery



Small Farm Machinery

Each farm household will require the following machinery primarily for vegetable production.

Machineries	Capacity	Use	Price (Yen)	Price (LE)
Tiller	7Ps Diesel		567,000	(1,969)
Rotary	55 cm	Harrowing	176,000	(611)
Caltivator	3 rows	Furrowing, Cultivating	124,000	(431)
Ridger	1 row	Transportation of Materials & Harvests	11	(38)
Trailer	500 kg		231	(802)
Sprayer	18 lit.		32	(111)
Hand Mower	24.1 cc	Mowing	55	(191)
Total			1,196,000	(4,153)

b. Labor Requirement

The introduction of farming machinery will substantially save the farm labor requirement and the small holder will no longer employ hired labor. On the other hand, farmers with a middle-sized farm of 10 to 15 feddan will require one or two hired labor during the busy period of December to July. The following table presents the labor requirement by crop. Monthly labor requirement by crop for small holders is given in the Appendix C (See Table C-15).

Crop	Labor Requirement (hr/feddan)	Machinery Requirement (hr/feddan)
Paddy	86.7	9.1
Soybean	69.7	4.9
Sugarbeet	166.2	8.4
Sorghum	88.7	8.2
Berseem	121.1	15.1
Tomato	886.5	77.2
Onion	321.7	23.3

4.4.4. Farm Management

The settler farmers in the Project Area shall be invited from every part of the country to conduct the new farm management. Establishment of farmers' organizations in the Area will be required to successfully carry out such new farming works. The following shows one of the examples to meet the Project requirements.

a. Agricultural Cooperatives

As mentioned above, the agricultural cooperatives will be established by settlers as soon as they settle in the Project Area. The agricultural cooperatives will carry out the following works:

- Agricultural loan;
- Purchasing of agricultural input materials, and selling (distributing) them to farm households;
- Marketing of agricultural products;
- Management and maintenance of heavy and medium-size farm machinery, especially operation of the machinery on contract basis for farmers;
- Management, operation and maintenance of workshops for farm machinery.

b. Irrigators' Groups

Irrigators' groups will be organized by settlers under the guidance of the Ministry of Irrigation as soon as they come to the Project Area. The groups will be responsible for the following;

- Initial leaching;
- Terminal water management;
- Operation and maintenance of terminal irrigation and drainage canals, etc.

c. Vegetable Growers' Groups

Vegetable growers' groups will be established under the assistance of the agricultural cooperatives. The groups will carry out the following works;

- Formulation of yearly cropping and marketing plans for the group members under the cooperation of the extension office, agricultural cooperatives and irrigators' group;
- Extension of new cultivation methods to the group members under the guidance of extension workers.

d. Alternative Farming Systems

The cropping pattern proposed for the Project is characterized by the three-year rotational cropping. Accordingly, the farm lands shall be divided into three blocks. The following three alternatives are considered for this purpose. It is most desirable that the settlers themselves will select a suitable way in the initial stage of settlement under the guidance of the Government.

Alternative 1.

Each farm household will divide the allocated farm land into three blocks (See Figure IV-5).

Alternative 2.

The farm land owned by 10 farm households will be divided into three blocks for group farming (See Figure IV-6).

Alternative 3.

The farm land owned by 15 farm households will be divided into three blocks for group farming (See Figure IV-7).

Figure IV-5 Individual Farming

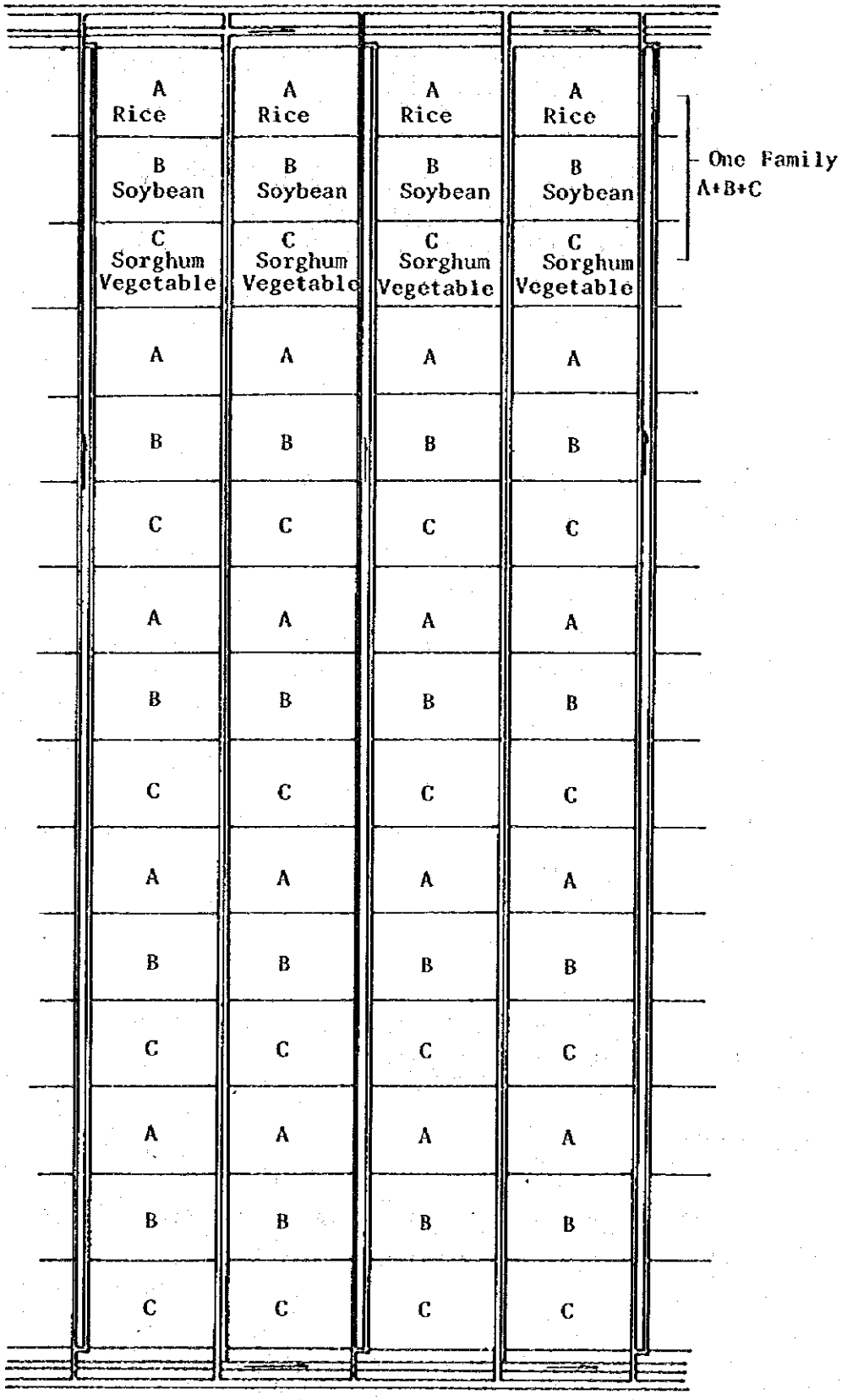


Figure IV-6 Group Farming(10 Farmers)

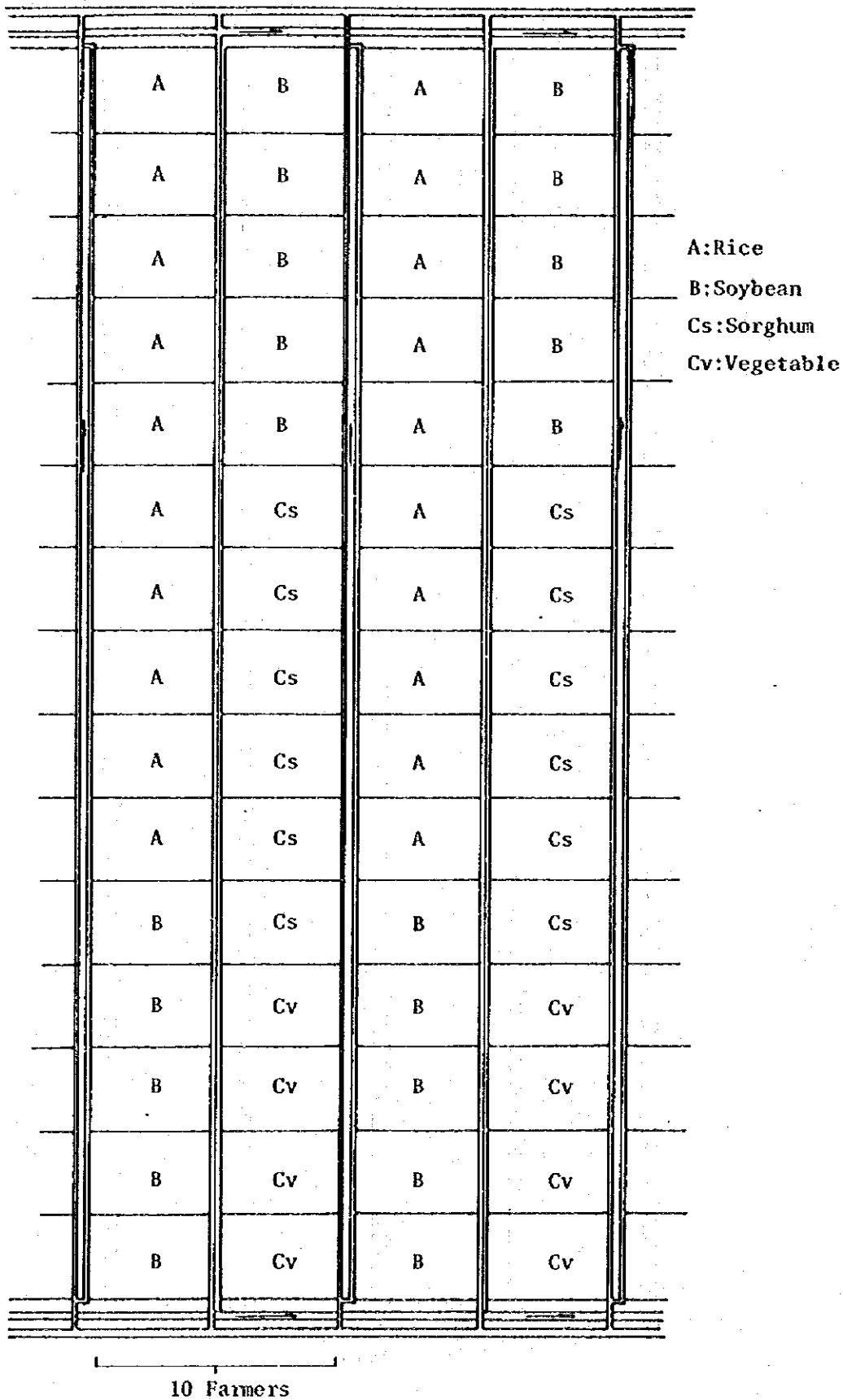
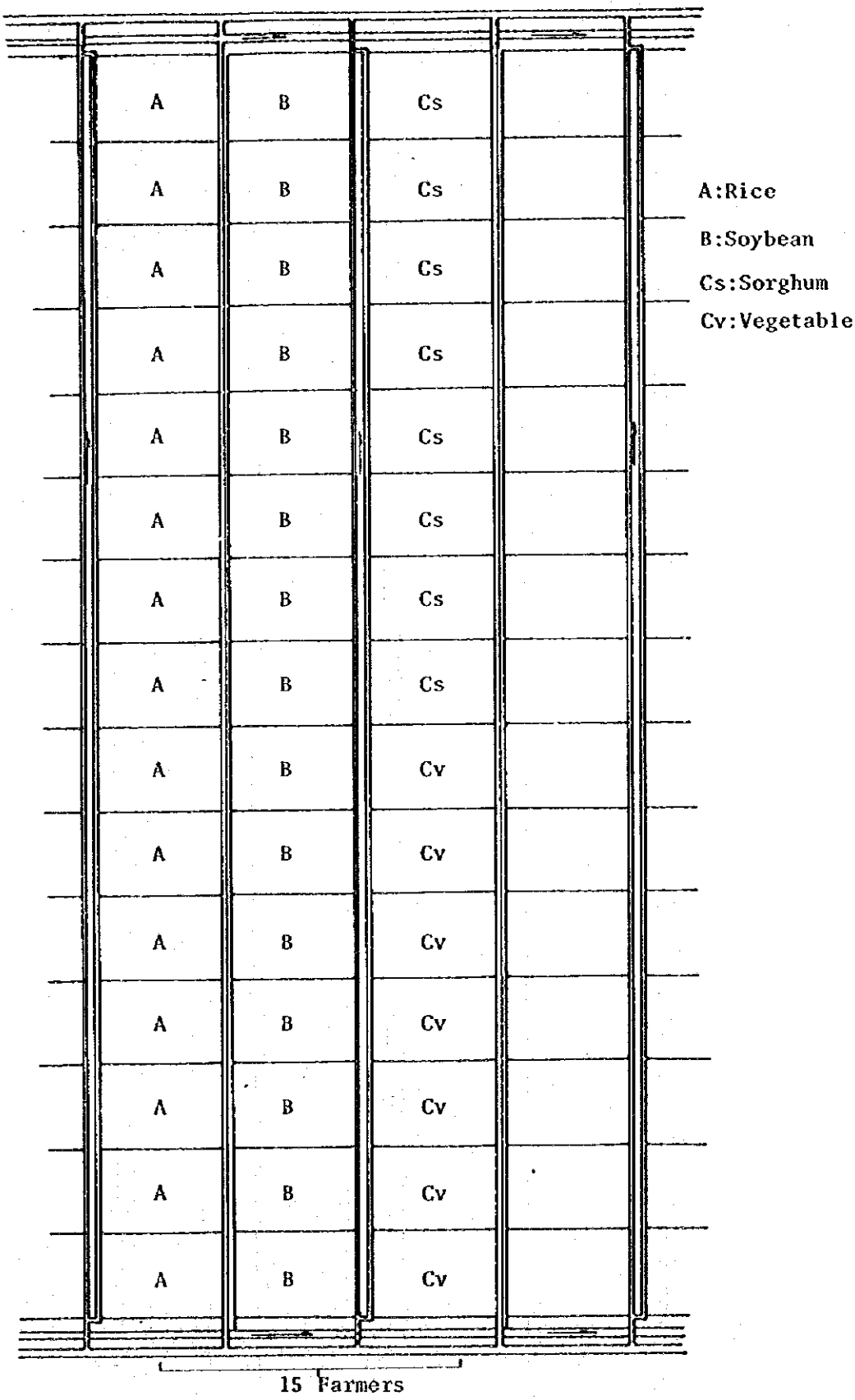


Figure IV-7 Group Farming(15 Farmers)



4.4.5. Livestock

a. Breed Selection

Annual per capita consumption of meat is still rising with resultant drastic increases in meat import in recent years. Particularly beef imports have increased tremendously as have imports of the dairy products (See Appendix C Table C-23).

Under these circumstances, consideration would be given to the introduction into the Project Area of a fine breed of cattle capable of producing a large quantity of milk and meat.

Performance of each cattle which have been bred in Egypt is shown below.

	Buffalo	Brown Swiss	Friesian	Baladi
Weight (kg)	550	600	500 - 600	350 - 380
Milk Production (kg)	1,200-2,000	3,000-4,000	4,000-4,500	1,200
Meat (weight bone - kg)	275	312	260 - 312	190 - 205
Milk Fat (%)	6-8	4	3.6-3.8	4.5-5.0
Calving Interval (month)	18.2	14	14	16

In the governorate of Sharkia where the Project Area is located, Baladi accounts for 53 percent among the cattle listed above and then follows water buffalo.

In addition to the major cattle breed of Baladi and water buffalo in Egypt, Brown Swiss and Friesian have been introduced and crossbred with Baladi to improve their performances in some large-scale farms.

Since the breeding of water buffalo requires a large quantity of water especially in the summer, it is not desirable to increase the number of water buffalo in the Project Area where the reclamation is proposed and, therefore, the water resources are limited. Moreover, the water buffalo, though in spite of it milk of a high fat content, produces poor quality meat with little milk production and a low delivery rate.

The buffalo is the major dairy cow but produces less milk than Friesian as mentioned above. There exists a large difference in production and net income as shown in Tables C-35 and C-36 in Appendix C. These tables show Friesian is more beneficial than buffals for the farmers.

Brown Swiss, on the other hand, have been raised for the dual purpose of milk and meat production, but its milk production and meat quality is slightly lower than those of Friesian.

Friesians have a slightly lower milk fat ratio, but produce a large quantity of milk and their meat quality is the highest of the dairy cows.

In actual more than 7,000 head of Friesian have already been brought to Egypt and farmers have experiences in breeding Friesian cow and introduction of Friesian would have contributed a great deal to breed improvement of local cattle.

The sheep can be bred by stubble grazing and bring income as shown in Table C-37 in Appendix. The sheep will be allocated with about five percent of berseem production based on utilization rate of pasture loads.

Considering all the above, the breed selected for introduction to the Project Area are Friesian, Baladi, and sheep.

However, it must be studied that the necessary number of Friesian could not be imported due to the foreign exchange situation in Egypt or export capabilities from supplying country.

Therefore some case studies as shown below are carried out including buffalo.

Case	Friesian	Baladi	Buffalo
Original	30%	70%	-
Case - 1	40	60	-
Case - 2	-	55	45%
Case - 3	15	70	15
Case - 4	15	45	40

Note: In each case five percent of Berseem production are applied for sheep breeding.

b. Fundamentals of Livestock Plan

Fundamental issues necessary for formulation of livestock plan, especially the salient features of proposed livestock and others, have been discussed with CARPAD, Animal Production Research Institute, fattening farm, and dairy farm.

Details of this discussion are presented in Appendix C Table C-31. In the selection of feedable number of cattle consideration would be duly given to these issues together with feeding standard for proposed cattles as mentioned above and nutrient component table.

c. Feedable Number of Livestock

(1) Forage Production Plan

Of the proposed crops, those that can be fed to the livestock are berseem, sorghum, rice straw, soybean cake, and beet pulp and the respective production is shown in Table IV-6 .

The nutrient production obtainable from these crops and fed to the livestock are estimated at, as given in Table IV-7, 80,533 tons of SE (Starch Equivalent) and 15,041 tons of DCP (Digestible Crude Protein) per year.

The SE and DCP contents in each crop are presented in Appendix Table C-34. All these data have been provided by the Animal Production Research Institute. Of the total berseem production of 464,500 tons, five percent of 23,225 tons will be fed to the sheep.

The composition of animal forage would be berseem during the winter (Nov. - Apr.) and sorghum, berseem hay, and rice straw during the summer (May - Oct.) and the concentrated forage would be used as production forage throughout the year.

(2) Feed Requirement

Feeding standard employed in Egypt is SE and DCP. The Animal Production Research Institute provides this standard as shown in Appendix Tables C-32 and C-33 on which the feedable number of livestock in the Project Area is estimated.

(3) Feedable Number of Livestock

In addition to the feeding standard, the nutrient production as noted previously has been taken into account in estimation of feedable number of proposed livestock in the Project Area.

Table IV-6 Annual Forage Production

Item	Yield (t/fed)	Area (fed)	Production (t)	Remarks
Berseem	25	18,580	464,500	
Sorghum	18	10,580	190,440	
Rice Straw	3	18,580	55,740	
Soybean Cake	0.9	18,580	16,722	75% of yield
Beet Pulp	1.17	18,580	21,738	4.7% of yield

Table IV-7 Nutrients Production

Item	Production(t)	Nutrients Content(%)		Nutrients Production(t)	
		SE	DCP	SE	DCP
Berseem	353,020	7.9	1.9	27,888	6,707
Sorghum	152,350	11.1	0.4	16,910	609
Rice Straw	55,740	21.7	-	12,095	-
Soybean Cake	16,722	71.7	38.4	11,989	6,421
Beet Pulp	21,738	53.6	6.0	11,651	1,304
Total				80,533	15,041

Note: 80% of utility rate was applied to berseem and sorghum
SE : Starch Equivalent
DCP : Digestible Crude Protein

The feedable number of livestock for original plan as estimated by the nutrient production together with the feeding standard is 26,460 heads of Baladi, 11,340 head of Friesian, and 10,180 head of cows and yearings and lands. Detail and feedable number in each cases are shown in Table IV-8 .

(4) Feeding Plan

The yearly feeding plan is formulated from the proposed cropping pattern and is shown in Appendix Table C-38.

Residual berseem and rice straw in winter will be fed in the form of hay to the livestock in summer. Fresh berseem of 60,670 tons would be processed into hay for the summer season feeding.

(5) Livestock Introduction Plan

The feedable number of cattle by year will be determined by the forage production. According to the proposed cropping pattern, cultivation of paddy and berseem will start in 1990. Thus the livestock introduction plan should be carried out in accordance with the forage production.

Maximum number of feedable cattle in terms of adult cow by year is estimated from the crop production plan as follows:

Number of Cattle (Original Plan)

Year	Baladi	Friesian
1990	4,800	2,060
1991	8,240	3,530
1992	13,730	5,890
1993	17,800	7,630
1994	19,410	8,320
1995	22,440	9,620
1996	24,870	10,660
1997	26,460	11,340
	.	.
	.	.
	.	.

According to the construction schedule, settlement in the Project Area as well as cultivation of paddy and berseem starts at the beginning of 1990 and, therefore, the introduction of cattle will also start in the same period.

Since more than 250,000 head of the Baladi cow are bred in the governorate of Sharkia where the Project Area is located, it is expected to be easy to procure this variety for the Project Area.

In the case of Friesian, however, only 2,000 head are currently bred in Sharkia. Forage production allows the importation of following head of Friesian cow in each year.

Year	Adult Cow (head)	Heifer (head)
1990	2,060	640
1991	830	170
1992	2,040	800
1993	3,480	800
1994	3,390	930
1995	3,970	1,000
1996	4,100	1,040
1997	2,580	470
1999	1,210	-

d. Types of Livestock Management

Since the farm size of each household is rather small in the Project Area, feeding method employed will be soiling instead of grazing method. Each household will not engage in full-time livestock farming but mixed farming with animals.

Types of livestock management to be practiced are fattening farming, dairy farming, and breeding farming.

Friesian bull calves will be raised for six months and sold when their weight reaches about 200 kg to the fattening farm as a stock cattle. The fattening farm, then, raises Baladi and Friesian bull calves for twelve months until they weigh 350 kg and 500 kg, respectively.

Table IV-8 Number of Feedable Livestock

	Original		Case-1		Case-2		Case-3			Case-4		
	Friesian	Baladi	Friesian	Baladi	Buffalo	Baladi	Friesian	Baladi	Buffalo	Friesian	Baladi	Buffalo
	30%	70%	40%	60%	45%	55%	15%	70%	15%	15%	45%	40%
Adult Cow(head)	11,340	26,460	14,340	21,630	20,050	24,510	6,090	28,430	6,090	6,150	18,450	16,400
Heifer(head)	3,500	7,940	4,440	6,490	6,620	7,350	1,890	8,530	2,010	1,910	5,540	5,410
Fattening Cattle (head)	4,760	9,790	6,020	8,000	8,620	9,070	2,560	10,520	1,830	2,580	6,830	4,920
Sheep(head)	10,180		10,180		10,180		10,180			10,180		

Note: Number of ewes,yearlings and lambs are included in 10,180 head of sheep.

Table IV-9 Animal Products Production

	Original	Case-1	Case-2	Case-3	Case-4
Beef	4,130	4,100	5,060	4,440	4,480
Milk	63,830	70,590	33,530	50,270	48,400
Mutton&Lamb	53	53	53	53	53
Wool	13	13	13	13	13

e. Production Plan of Animal Products

As stated elsewhere, it is estimated that 11,340 head of Friesian and 26,460 head of Baladi will be feedable in the Project Area and that these cattle will annually produce 63,830 tons of milk and 4,130 tons of beef.

Sheep will produce about 53 tons of land and mutton and 13 tons of wool. Of the total milk production of 63,830 tons, 59,200 tons will be sent for processing while the remaining will be consumed by settling households and fed to calves.

Raw milk would be processed into UHT milk, white cheese, butter, yoghurt, and ice cream taking into account the taste of Egyptians.

Amount of animal products in each case is shown in Table IV-9 .

f. Plan of Facilities

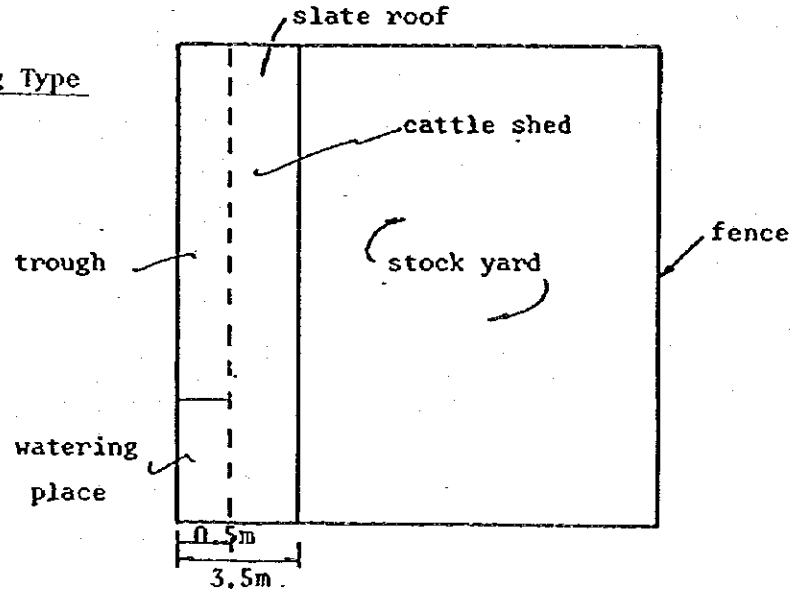
(1) Cattle Shed

As mentioned above, an open cattle shed is recommended which is popular in rural Egypt. This type requires a space of 20 square meters per cow cattle. The general floor plan of a cattle shed is shown on the following page.

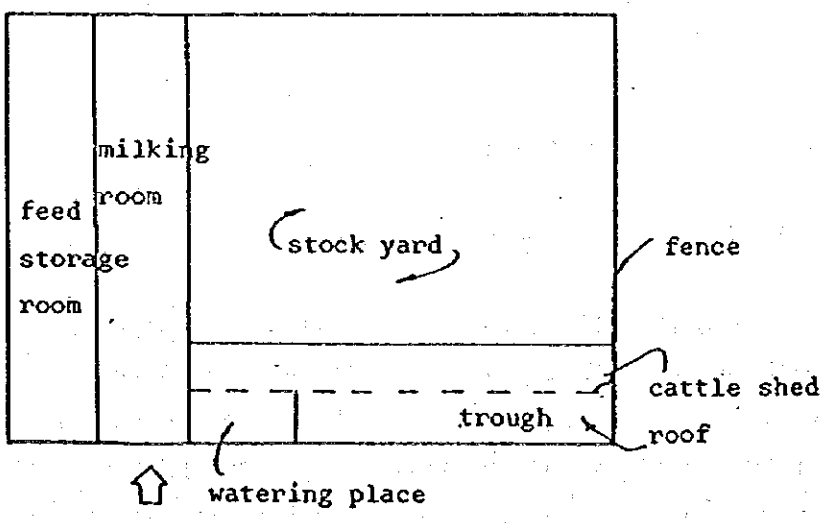
(2) Milk Collecting Center .

A milk collecting center will be established in each village. Milk produced in the village will be hauled to the milk collecting center by each farmer. The milk collecting center should be managed by the agricultural cooperatives and equipped with bulk coolers to keep milk at a low temperature so that it will not be spoiled. Inspections of pH, freshness, specific gravity and milk fat shall be carried out at this center.

Fattening Type



Milking Type



A milk collecting center will be established in 29 villages and each center should be equipped with two units of bulk coolers of 2.5 m^3 capacity per unit. Dimensions of the center are given below:

Item	
Capacity of Bulk Cooler	5 m^3 (bulk cooler 2.5 m^3 x 2 units)
Staff Requirement	5 persons
Building Lot	0.02 feddan (84 m^2)
Lot Requirement	0.1 feddan(420 m^2)

(3) Milk Processing Plant

Milk production in South Hussinia is estimated at 63,830 tons per year, of which 59,200 tons will be processed into UHT Milk, white cheese, butter, yoghurt, and ice cream. Assuming a plant is operated 365 days a year, the daily processing capacity required is about 162 tons.

Considering the production management at the plant, it is advisable to construct one plant each in North and South Hussinia. Details will be discussed in the section on the Processing of Animal Products.

(4) Slaughterhouse

In South Hussinia, 19,280 head of cattle and 2,160 head of sheep will be slaughtered annually.

Therefore, assuming that a slaughterhouse is operated 300 days a year, the number of cattle and sheep to be slaughtered a day is about 70 and 7, respectively. This number can be easily slaughtered and dressed in the existing slaughterhouse in Ismailia which has a capacity of 500 head/day.

In North Hussinia, however, it is desirable to construct one slaughterhouse, considering that 32,400 head of cattle will be slaughtered there annually.

Floor plan map of the slaughterhouse is given in Appendix D for reference.

(5) Breeding Center

The Egyptian government has been endorsing the quality improvement of the native cattle variety by crossbreeding Baladi with Friesian and Brown Swiss.

It is estimated that South Hussinia is capable of raising 11,340 head of Friesian and 26,460 head of Baladi together with their raising and fattening cattle.

For the quality improvement of these cattle, the establishment of a breeding center equipped with the production facilities for frozen semen is recommended.

This breeding center will raise superior breeding cattle of Friesian and Baladi whose semen is frozen and artificially inseminaned into cows. This experiment is expected to enhance the beef and milk producing capacity of the native cattle.

Dimensions of the center will be as follows:

Item		
No. of Bulls		Baladi 6 head
Staffs		Friesian 2 head
Building Lot	Office	0.05 feddan (210 m^2)
	Cattle Shed	0.2 feddan (840 m^2)
Lot Requirement		0.75 (3,150 m^2)

4.4.6. Agri-Supporting Organization

The settlers in the Project Area will be invited from every part of the country and some of these settlers will have a considerably deep knowledge and experience in farming on heavily clayey soils. The cultivable farmlands of the Project Area are estimated at 48,500 feddan, and the soils of the Project Area have particular features of saline soils in addition to heavy clay. Besides the commonly grown crops of paddy, berseem, and sorghum, soybean, beet and some other vegetables will be introduced as export-oriented fresh or processed crops, although not so popular in Sharkia Governorate.

On the other hand, milk cows and beef cattle and sheep will be bred in the Project. A powerful supporting organization is essential for successful execution of such farming works. The better extension service system should be established through joint activities with the extension staff covering the adjacent areas of North Hussinia and South Port Said (about 100,000 feddan in total acreage) so that comprehensive services can be rendered successfully and effectively.

The rural development plan of the Project has made up the following general layout of the rural community, and it is recommended that the agricultural extension program shall be designed to meet the requirements of the aforesaid plan.

Proposed Rural Layout

Region	Central Vill.[1/]	Service Vill.[2/]	Satellite Vill[3/]
South Hussinia	2	6	21
North Hussinia	3	7	42

1/ No. of Farm households: 285 Farmland Acreage: 1,225 feddan
2/ " : 315 " : 1,750 "
3/ " : 315 " : 1,750 "

The extension offices in charge shall be responsible for the following services for effective extension works;

° about 10 percent of the best farmers shall be selected from each village and appointed as local leaders, and then, intensive guidance shall be given to these selected local leaders, so that they can render extension services to improve individual farmers' techniques

° Some demonstration farms shall be selected and given guidances preponderantly to bring up a farmer's volition for agricultural production.

° Several farmers shall be selected to carry out the seed multiplication and renewal works in their own fields for paddy, berseem and soybean.

° The agri-extension staff shall do their best to give guidance and technical advice on fattening and breeding of cattle.

° Training of farmers

The new settlers in the Project Area will total about 8,800 farm households of which the households of 15 - 20 feddan farm number 1,000 or 11.4 percent. Since these new settlers have limited experience in the modern farming technique, it will be necessary to introduce a training program for the settlers in the initial two to three years of the first development stage. Training should preferably be conducted at a newly constructed training center.

4.4.7. Agro-Industry

a. General

Major agricultural products to be supplied for the proposed agro-industry are sugarbeet, soybean, tomato, milk and other dairy products. Tomato paste processed from tomatoes is for export and other processed products will be for local market. Agricultural products from farm households are collected through the agricultural cooperatives and then forwarded to the factories. The factories will be designed as follows laying emphasis on their economic aspects.

Sugarbeet Factory	To be constructed in the Project Area Part of sugarbeet will be supplied from North Hussinia
Tomato Factory	To be constructed in the Project Area Daily Processing Capacity of 810 ton
Soybean Oil Factory	Construction is planned by the Government
Milk Processing Factory	To be constructed in the Project Area Daily Processing Capacity of 162 ton
Slaughterhouse	Existing slaughterhouse in Ismailia

Production of major farm products as well as their processed products in the full development stage is summarized below;

Farm Product	Full Development Year	Production (ton)	Processed Product	(ton)
Sugarbeet	2001	455,210	White Sugar	67,803
			Pulp	3,187
Tomato	2005	141,000	Paste	17,907
Soybean	2001	21,630	Soybean Oil	4,011
Milk	1997	59,200	Butter	440
			White Cheese	5,920
Beef Cattle	1997	19,280	Dressed Caracass	4,130
			Dressed Caracass	45.1
Sheep	1997	1,980	Wool	11.4

b. Sugarbeet Processing

(1) General

A beet factory normally produces white sugar directly from sugarbeet in a single integrated manufacturing process and molasses and beet pulp can be obtained as the principal by-products. There are two major alternatives to increase sugar yield, viz: by reprocessing the molasses, and by extending the annual operating period through storage of the partially processed products taken off after evaporation of the thick juice stages and completing the processing later.

(2) Factory Capacity

The capacity of the proposed beet sugar factory has been designed at 6,000 tons/day of washed beet sliced prior to the extraction stage. The sugar content of the material-beet has been taken at 15 percent and the thickness juice purity after evaporation at 90°C.

At full development stage, 67,803 tons of beet sugar will be produced. Production in each years is shown in following tables.

(3) Factory Analysis and Financial Analysis

A practical factory layout is normally fixed after taking into consideration the location of incoming roads and services, the prevailing wind, site gradients etc. The layout of a typical beet sugar factory and financial analysis and capital cost are shown in Appendix D. Economic evaluation is made in Chapter 6. Financial internal rate of return is estimated at 32.5 percent.

Production of Sugarbeet and Beetsugar by Year

Year	Sugarbeet (ton)	White Sugar (ton)	Beet Pulp (ton)
1992	12,701	1,892	89
1993	163,233	24,313	1,143
1994	261,662	38,974	1,832
1995	323,088	48,124	2,262
1996	348,733	51,943	2,441
1997	369,606	55,052	2,587
1998	401,033	59,733	2,807
1999	432,744	64,457	3,029
2000	448,953	66,871	3,143
2001	455,210	67,803	3,187

c. Soybean Processing

Soybean production at the full development stage is estimated at 21,630 tons per year. Soybean oil and by products of soybean cakes will be produced 4,110 tons and 16,223 tons, respectively.

Soybean will be collected after havesting by agriculture cooperative and transported to the factory which is established by the government.

Soybean and Soybean Cake Production by Year

Year	Production (ton)	Soybean Oil (ton)	Soybean Cake (ton)
1992	550	105	413
1993	7,078	1,345	5,309
1994	8,624	1,639	6,468
1995	15,098	2,869	11,324
1996	15,990	3,038	11,993
1997	17,219	3,272	12,914
1998	17,696	3,362	13,272
1999	19,847	3,771	14,885
2000	21,109	4,011	15,832
2001	21,630	4,110	16,223

d. Tomato Paste Processing

Tomato production starts in 1997 and reaches the full development stage in 2005. Harvesting period ranges from the end of June to the beginning of November. Of the total tomato production, 90 percent is forwarded for processing and this corresponds to 141,000 ton at the full development stage. Annual tomato production forwarded to the processing factory and tomato paste production are shown in Table IV-10 below.

Tomato paste processing factory will be constructed in the Project Area with one production line in the initial stage and some more lines added in the subsequent period. Tomato paste production in the full development will be 17,907 ton per annum.

Appendix D Agro-Industry presents construction cost, result of financial analysis, and production process.

Table IV-10. Annual Tomato Production for Processing and Paste Production

Year	Tomato (ton)	Tomato Paste (ton)
1997	4,300	546
1998	31,630	4,017
1999	49,070	8,232
2000	79,100	10,046
2001	102,200	12,979
2002	126,400	16,053
2003	134,300	17,056
2004	138,700	17,615
2005	141,000	17,907

e. Processing of Animal Products

(1) Dairy Products

The number of milk cows feedable in South Hussinia, as estimated in the section on Livestock Plan, is 11,340 head of Friesian and 26,460 head of Baladi. Considering their milk delivery rate, the annual milk production from these cows is estimated at 63,830 tons. Of this total production, 59,200 tons are processed into various milk products while the remaining is either consumed by the settling farmers or fed to calves. The milk products to be manufactured, taking into account the Egyptian's taste, are white cheese, table butter, market milk, yoghurt and ice cream. Market milk is the long life milk type capable of being preserved for a long period.

Assuming a milk processing plant is operated 365 days per annum, the daily processing capacity required is 162 tons.

However, since it is not economic to construct a plant of this capacity from the beginning, the plant capacity would be expanded gradually corresponding to an increase in milk production.

Considering the production management of the plant, it is desirable to construct one plant each in North and South Hussinia. The plant is scheduled to start its operation in 1990 along with the proposed cropping pattern and is expected to reach the target capacity of 162 tons per day in 1997.

As a result of financial analysis, financial internal rate of return was estimated at 33 percent. Construction cost and detail studies on financial analysis and the floor plan of the proposed plant are given in Appendix D.

(2) Slaughterhouse

The number of cattle and sheep to be slaughtered in South Hussinia is estimated at about 19,280 head and 2,160 head per year respectively. Assuming that a slaughterhouse is operated 365 days a year, the above number can be processed by slaughtering 60 head per day. These cattles are to be slaughtered and dressed at the existing slaughterhouse in Ismailia which has a capacity of 500 head a day.

In North Hussinia, however, since the number to be slaughtered is as large as 32,400 head, it is proposed to build a slaughterhouse there.

Plane map and dimensions of the slaughterhouse are given in Appendix D for reference.

4.4.8. Marketing

a. The marketing of agricultural products in the Project Area will be made through the marketing system or marketing channels which are presently predominant in Egypt. There are two marketing systems that is, the cooperative marketing system and the free village market system. The marketing system in the Project Area would be projected to take the cooperative marketing system as far as possible. The recommended marketing channels for vegetables and milk and dairy products are illustrated in Appendix C.

b. Vegetables produced in the Project Area would be expected to be available for processing and export as much as possible. In the year 2000, the demand for vegetables in Sharkia Governorate could be locally met by their supply from the present cropping area, if per capita consumption remains at 115 kilograms as reported by FAO, 1980. However, with a larger consumption per capita, vegetable production in the present cropping areas will be insufficient to meet the demand, and some products in the Project Area should be shared to meet the demand.

c. Cabbages, cauliflower and dry onions produced in the Project Area would be expected to be exported in parallel with supply to domestic market. According to the Food Balance Sheet, FAO, it is considered that Germany F.R. is the most hopeful market for three crops mentioned above. The Netherland shall be a good market for cauliflower and onions and France, U.K. and Italy for dry onions. Germany F.R. imported cabbages of 114,000 tons, cauliflower of 128,000 tons and dry onions of 263,000 tons on the average from 1975 to 1977. These volume accounts for 19 percent, 63 percent and 95 percent of total domestic consumption, respectively.

d. Almost all quantities of tomato produced in the summer season would be processed by the factories to be established in the Project Area. Tomatoes canned or preserved are marketable to Arab countries. According to the trade statistics, preserved vegetables exported to Saudi Arabia, Lebanon, Kuwait, Bahrain, UAE and Oman were about 1,060 tons in 1980 and 940 tons in 1981. For example, the CIF price of begetables frozen or in temporary preservative which Kuwait imported from Egypt was 0.31 Kuwait Dinar per kg in 1980.

The CIF price of frozen vegetables imported into Kuwait from USA, UK, Netherlands, Canada and Poland were 0.42, 0.51, 0.52, 0.26 and 0.26 Kuwait Dinar respectively. Egypt's goods prices competitiveness in the Kuwait market seems to be strong. However the competitive position of Egyptian fruit and vegetable juice is not strong yet. About 15,250 tons of fruit and vegetable juice ware imported in 1980. The proportion of quantities imported from main exporters were 31.5 percent from Taiwan, 19.5 percent from Japan, 8.6 percent from Denmark, 7.6 percent from USA and 5.7 percent from Singapore. Egypt exported only 150 tons, or 1.0 percent. The CIF price of Egyptian juice was 0.36 Kuwait Dinar per kg. The price of juice imported from other main exporters, that is, Taiwan, Japan, Denmark, USA and Singapore were 0.17, 0.20, 0.20, 0.28 and 0.21 Kuwait Dinar per kg, prespectively. Egyptian juice was imported to Kuwait market at the highest CIF price. The production cost and the quantities exported affect its competitiveness.

e. Sugarbeet produced in the winter season would be processed by the factory established in the Project Area. Beet sugar and cane sugar in solid have been imported at the rate of 202,700 tons in 1979, 232,900 tons in 1980 and 370,600 tons in 1981. On the other hand, exports for three years were only 28,000, 8,800 and 22,300 tons respectively. Beet sugar produced in the factory in the Project Area would be marketed for domestic consumption as a substitute for imported sugar.

f. The annual production of milk and beef in the full development stage in projected at 63,830 tons and 4,130 tons, respectively. These products will be hauled to the milk processing factory to be established in the Project Area and sent to the existing saughter-house at Ismailia though the products in North Hussinia Valley and Port Said South Project Area shall be slaughtered in the Project Area.

Processed produce is marketable for domestic consumption instead of imported goods. The demand for meat has been increased because of the high growth rate of the population. According to the trade statistics in 1981, about 200,000 tons of meat and poultry were imported. Imports of milk and cream preserved or concentrated or sweetened, butter and cheese were about 46,000, 43,700 and 16,800 tons respectively. According to the forecasting study on the demand an supply of meat and chicken, and cheese and butter until the year 2,000, about 600,000 tons of meat and chicken and about 129,000 tons of cheese and butter are expected to be imported. Hence, the produce in the Project Area is marketable in the future.

g. Fresh tomatoes are exported to Arab countries. The price is not always cheap. In Kuwait market, Egyptian tomatoes shows the highest CIF price. To keep the international marketing standardization is vitally important in order to develop the export. These standards requirements are shown in Table C-51 in Appendix C.

h. The major determinants of consumer's demand consist of an increase in population, changes in consumption patterns and uprising of income. The demand for meat, vegetables and fruit shows a high income elasticity. In future, household income will increase, and will be followed by an increase in food expenditure. Hence, market demand will expand, and consumption patterns will be diversified.

i. The prepackaging measures which should be taken in the field of fruits and vegetables on three levels-regulatory, economic and information could make it possible to give a complete service to the consumer.

4.5. Rural Development

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) Trunk and village roads
  - c) Potable water
  - d) Sewage and refuse treatment
  - e) Electric power
  - f) Telecommunications

4.5.1. Settlement

a. Outline of Settlement Plan

The settlement plan in the Project is included as part of the comprehensive development plan covering about 240,000 feddan of wide land areas composed of the North Hussinia and the South Port Said, and about 230,000 people will settle in this wide area in the future. This being the case, social and technical services shall be appropriately rendered to improve the life of the new settlers.

Various facilities should be provided for rendering appropriate social and technical services to the inhabitants within the proposed activity sphere so as to meet their living standards.

Successful execution of this plan will require the establishment of an elementary settlement, a primary activity sphere and a secondary activity sphere with the local activity zone to be set up as a wide area local administration entity within the aforesaid comprehensive development areas. The secondary activity sphere means for the individual project areas. Towns will be developed functioning as cores of the wide-area local administration entity, being located in the center of the North Hussinia (the site at the crossing of El Salam Canal and Bahr El Baqar).

The respective activity spheres should provide their own settlements to form such local rural communities. The settlements shall be established in groups of inhabitants by their farming level and social activities so that the social and technical services can be rendered more effectively and efficiently. Under the conditions, the Project will provide satellite villages as elementary settlements, and the service village will be set as cores of the primary activity sphere. Moreover the service villages will be established in the center of the secondary sphere.

On the other hand, the social function of the communities should be maintained by limiting the size of the communities to 300 households and a population of 2,000. Consequently, the size of the satellite settlements shall meet the requirements mentioned above.

The scattered villages will be advantageous for farming management, whereas they will have some demerits in rendering efficient public services. The Project, therefore, will employ the clustered villages in the community planning.

b. Alignment of Villages

The settlements shall be located along irrigation canals and in the areas of unsuitable lands for farming so far as the areal conditions can allow. The 12,000 settler families in the Project will be accommodated in 29 villages. The settlements will be arranged in a hierarchy consisting of three types of settlement; they are 21 satellite village, each having 315 farm households with appropriate social and community facilities, six service villages, and two central villages. For every three to four satellite villages one service villages, and for every three service villages one central village will be founded.

4.5.2. Housing

About 60,000 persons are expected to reside permanently in the Project Area in its full development stage. Therefore, 12,000 houses will be built and six house types (farmer's house, owner's house, technical laborer's house, assistant director's house, director's house and apartment houses) will be intermixed to promote social integration.

Land holding farmers will be provided with a starter house comprising two rooms and a plot of 200 sq.m or 500 sq.m. The plot will be used for expansion and development as the need arises, such as living rooms, storeroom and livestock barn, etc.

4.5.3. Infrastructures

a. Village Facilities Plan

The satellite villages, service villages and central villages will be equipped with necessary village facilities so that each village can function as planned. A village area will be divided

into three zones; that is, service zone, farmers house zone and owners house zone. The major village facilities are planned for the following services and activities;

Education: A combined school will be built in each service village and central village. In a central village, a secondary high school and a nursery school will be built.

Health : A medical treatment unit for settlers' health will be built in each service and central village. A central village will be provided with a hospital with about 20 beds.

Commercial: In satellite villages small stores will be built for the daily necessities of the villagers such as bakeries, groceries, and drug stores, etc. More space will be allocated necessary for those of the central and service villages to reflect the high level commercial activities thereabout.

Access: Villages will be linked with each other by paved roads. Streets in villages will have an effective width of ten meters, being provided with a footpath of three meters wide on both sides. The main streets in villages will be paved.

Utilities: Potable water and electric power will be supplied to all houses in the villages. In addition, some communal standpipes with washing facilities will be installed so that no villagers have to use irrigation water for drinking or other domestic purposes. Telephone services will be made available through town exchange.

Mosque: Mosques are usually provided by the Government Their sites have been allocated in each village, small sites for mosques without towers in satellite villages and large sites for those with towers in service and central villages, respectively. Lands for cemeteries will also have to be alloted near villages.

Others: The principal public service facilities such as a police station, fire station, post office, bank, telephone office, etc. will be established in a central village.

b. Trunk and Village Roads

Two trunk roads, having 12 m effective width and running through the heart of the Project Area will be constructed to connect the existing roads and the O/M road of the El Salam Canal, with a total length of 51 km. Village roads will connect villages with each other, having a ten meter effective width and a total length of 82 km.

c. Potable Water

The Nile water has been taken as a source for drinking water supply to villages in the wide area (South Hussinia, North Hussinia and South Port Said). Potable water will be distributed, as a result, to all settlements.

The beneficiaries have been computed to be 68,000 persons in due consideration of a future increase in population in the Project Area.

Water requirements in the Project Area are estimated at 150 lit/day/person and 70 lit/day/head or 13,000 cu.m/day (0.15 cu.m/sec). One unit of water filtration facilities will be installed near the Town (North Hussinia Project Area) to meet the daily maximum water requirement of 50,000 cu.m/day. The water clarification facilities will be connected with pipelines to all villages.

The trunk pipeline will be about 28 km long in total whereas the branch pipeline will be about 100 km long.

d. Sewage and Refuse Treatment

In this farm village development plan all houses exclusive of farmers houses will be provided with flush toilet. Waste will be flushed through pipelines to treatment tanks (aerobic tank system).

Waste from farmers' houses will be hauled from their pit latrines to Oxidation Ditch system by vacuum-car, and wasterwater from communal taps will be taken into the treatment system through drains. Each village will have one unit of the Oxidation Ditch system.

The Oxidation Ditch tank system; Air and sewage are mixed in open ditch. Oxygen-using (aerobic) bacteria grow, digest sewage, liquefy most solids. Liquid discharges to canals after disinfection.

Trucks will be used to collect refuse. Refuse will be gathered at designated pits, and buried to be resolved in soils.

e. Electric Power

The existing high voltage line of 220 KV running along the Suez Canal will be the power source for the Wide-Area. The No.1 sub-station will be set at the crossing point of the Suez Canal and the El Salam Canal. And there, the voltage will be drawn down from 220 KV to 66 KV. A high voltage transmission line (66 KV) will be constructed along the El Salam Canal from the No.1 sub-station to the No.2 sub-station planned at the crossing point of the El Salam Canal and the Bahr El Baqar Drain. The voltage will be drawn down from 66 KV to 11 KV at the No.2 sub-station.

From the No.2 sub-station a 11 KV line will be branched off to each village, pumping station and filtration plant, etc., along the major roads.

Villages and various facilities which will require power will be provided with transformers in order to obtain an appropriate voltage.

f. Telecommunication

Telephone networks are essential for keeping communities in newly developed areas in good conditions. At present it is not necessary to provide all houses with a telephone, but it will be so in the near future. In the Project it will be essential to have smooth communication for social services or among operation and maintenance units, pump station and headquarters to ensure satisfactory operation of the irrigation systems.

The communication networks among villages and outside communities are also necessary to ensure the optimum use of social services to be provided.

4.6. Project Works

4.6.1. Irrigation

a. Irrigation System

The Project Area is divided into three irrigation systems of M1, M2 and M3 in consideration of the topographic conditions (refer to Figure B-4). The major features of the irrigation systems are summarized as follow;

Major Features of Irrigation System

Item	M1	M2	M3
Irrigation Area (ha)	6,650	9,670	7,090
Length of Canal (m)	89,900	131,770	101,420
Intake Water Level (EL. m)	2.50	1.95	1.58
Max. Discharge (cu.m/s)	19.55	28.43	20.84

b. Slope of Main Canal and Gravity Irrigation

Farm lands of 570 ha in the M2 irrigation system and 1,190 ha in the M3 irrigation system are higher in elevation than the designed intake water levels of the El Salam Canal. The installation of pumping stations shall be needed for a considerable area, when considered water head looses in the canals. Generally, the steeper the canal slope is, the lower the cost is, to some extent depending on the topography; however, in the area where lifting is needed, the steeper slope shall reduces the commandable area by gravity and increases pump capacities required. The comparison of annual costs was made of four alternatives that have different slopes of main canals; 1/10,000, 1/15,000, 1/20,000 and 1/25,000 (refer to Appendix B-4-1).

Major Features of Alternatives

Item	1/10,000	1/15,000	1/20,000	1/25,000
M1 (6,650 ha)				
Gravity irrigation area (ha)	4,470	4,700	6,650	6,650
Pumping irrigation area (ha)	2,180	1,950	-	-
M2 (9,670 ha)				
Gravity irrigation area (ha)	2,995	3,570	3,990	4,170
Pumping irrigation area (ha)	6,675	6,100	5,680	5,500
M3 (7,090 ha)				
Gravity irrigation area (ha)	2,340	3,390	4,390	4,590
Pumping irrigation area (ha)	4,750	3,700	2,700	2,500

The estimated costs of the construction, operation, maintenance and replacement were converted to an equivalent annual amount by amortizing over the period of 50 years on condition that a discount rate was 10 percent and durable life were 10 years for pumping plant. Results of comparison are discussed below.

Construction Cost and Annual Cost - M1

(Unit: 1,000 LE)

	1/10,000	1/15,000	1/20,000	1/25,000
1. Construction Cost				
- Canal	5,543	5,775	5,917	5,953
- Pumping Station	1,015	790	-	-
Total	6,558	6,565	5,917	5,953
2. Annual Cost				
- Amortization	662	662	597	601
Maintenance	139	138	118	119
- Replacement	35	27	-	-
- Electric Charge	10	7	-	-
Total	846	834	715	720

For the M1 irrigation area, the whole area (6,650 ha) can be irrigated by gravity with the designed water level of the El Salam Canal when the canal slope is 1/20,000, the annual cost of which is lowest among the alternatives. The ground elevations of upper reaches of the M1 canal are relatively low as the topography is in reverse, and in any case the design water levels are 1 - 2.5 m above the ground surface. In order to strengthen the stability of canal embankment, the Project plans to line the M1 canal (16,350 m) with 10 cm thick concrete. The alternative to the lining canal will be discussed in the following section of 4-6-1, c.

Construction Cost and Annual Cost - M2

(Unit: 1,000 LE)

	1/10,000	1/15,000	1/20,000	1/25,000
1. Construction Cost				
- Canal	7,208	7,230	7,350	7,356
- Pumping Station	5,190	4,431	3,897	3,799
Total	12,398	11,661	11,247	11,155
2. Annual Cost				
- Amortization	1,251	1,177	1,135	1,126
- Maintenance	285	265	252	250
- Replacement	175	149	130	127
- Electric Charge	45	32	23	21
Total	1,756	1,623	1,540	1,524

The M2 irrigation area needs inevitably to install pumping stations because its highest elevation is 2.5 m, while the designed water level of the El Salam Canal is 1.95 m. In addition to a main pumping station on the main canal, two relift pumping stations on the secondary canals have to be installed, due to the complicated topography of the area. The commandable area by gravity increases, as the canal slope becomes gentle; however, the rate of increase in gravity irrigation area is limited, because of its topography, when the canal slope is more gentle than 1/20,000.

The annual cost (158 LE/ha) of 1/25,000 is lower than that (159 LE/ha) of 1/20,000; however, the difference is insignificant. Under the situation considerations have been given to the engineering accuracy of earth works for such gentle slope canal and higher velocity (min. 035 m/s) than that (0.28 m/s) of 1/25,000, and have led to employ the canal slope of 1/20,000.

Construction Cost and Annual Cost - M3

1. Construction Cost	1/10,000	1/15,000	1/20,000	1/25,000
- Canal	5,427	5,340	5,428	5,430
- Pumping Station	3,257	2,547	1,677	1,492
Total	8,684	7,887	7,105	6,922
2. Annual Cost				
- Amortization	876	796	717	698
- Maintenance	199	177	156	150
- Replacement	112	88	58	51
- Electric Charge	48	36	22	19
Total	1,235	1,097	953	918

Being higher in elevation than the designed water level of the El Salam Canal, the M2 irrigation area needs also to install a pumping station on the main canal. The annual cost of 1/25,000 is 129 LE/ha, which is lower than 134 LE/ha of 1/20,000; however, the difference might be insignificant. The proposed slope of the main canal is designed to be 1/20,000 for the same reason as the M2 irrigation area. The upper reach (700 m) of the main canal shall be lined with 10 cm thick concrete because the canal bed shall be elevated.

c. Lining of M1 Main Canal vs. Lifting by Farmers

As stated previously, the M1 main irrigation canal will be lined with concrete. For saving the cost incurred by concrete lining, the possible alternative is to lower the water levels in the canals; however, lifting by farmers shall be necessary. The

topography of the area varies from 0 - 1.0 m in elevation, while the designed water level of 1.00 m resulted in lowest construction cost of the canals due to well balanced earth works of excavation and embankment. The alternative needs installing 325 small scaled pumping stations. The construction costs of the alternative with the intake water level of 1.00 m was compared with the costs including canal lining.

Comparison of Construction Costs in 1,000 LE

Item	Gravity Irrigation (Lining Canal)	Lifting Irrigation (Earth Canal)
Canal	8,212	4,652
Small Pumping Station	-	7,123
Total	8,212	11,775

When the intake water level is lowered by 1.50 m, the cost required for the construction of canals is reduced to a great extent. However, the total construction costs for the gravity irrigation is cheaper than that required for the alternative, because the installation cost of 325 small scaled pumping stations exceeded the costs to be saved in the construction of canals. The construction costs were converted to the annual costs by amortizing over the period of 50 years on the same condition stated in f. of 4.3.4. As summarized below, the gravity irrigation is economical by far more than the lifting irrigation. Therefore, the gravity irrigation that line the main canal with concrete has been proposed.

Comparison of Annual Costs in 1,000 LE

Item	Gravity Irrigation (Lining Canal)	Lifting Irrigation (Earth Canal)
Amortization	829	1,188
Maintenance	82	378
Replacement	-	501
Pump Operation	-	13
Total	911	2,080

d. Irrigation Canal and Appurtenant Structures

(1) Hydraulic Formula

The Manning formula was applied to the hydraulic computation of canals with the roughness coefficient (n) of 0.025 for earth canal and 0.015 for concrete lining canal. Usually a side slope of 1.5 : 1 was used. The empirical equation commonly used in Egypt was adopted for computing the ratio of bed width to water depth;

when water depth (d) is more than 1.62 m,

$$d = 0.1\ (S/2 + 4)\ \sqrt{b}$$

when water depth is less than 1.62 m,

$$d = [0.0025\ (S + 8)^2\ b]\ /\ 1.62$$

where b = bed width

S = canal slope (cm/km)

(2) Canal

The total length of the proposed irrigation canals amounts to 323,090 m as dense as 13.8 m/ha. Out of 38,600 m of main canals, 44 percent (or, 17,050 m) are lined with concrete. The designed capacity of canals is 2.94 lit./s/ha, twice the proposed irrigation requirement of 1.47 lit./s/ha, in accordance with the operation rule of the canals of four days on and four days off. Major dimensions of the canals are summarized below (Detail are presented in Appendix B-4-2.

Major Dimensions of Irrigation Canals

Item	Length (m)	Capacity (cu.m/s)	Structure
Main Canal; M1	16,350	79.55 - 6.41	Concrete lining
M2	9,250	9.67 - 5.68	Earth canal
M3	700	7.09	Concrete lining
M3	12,300	6.89 - 3.70	Earth canal
Total	38,600		
Secondary Canal			
M1	73,550	7.23 - 0.10	Earth canal
M2	122,520	8.67 - 0.13	- do -
M3	88,420	4.56 - 0.16	- do -
Total	284,490		
Grand Total	323,090		

(3) Appurtenant Structures

For better water management, each irrigation canal is connected with the drainage canal through the fail escape canal. The total length of the fail escape canals is 14,500 m; 4,250 m, 6,550 m and 3,700 m for the M1, M2 and M3 irrigation areas, respectively.

The slide gate is installed at the off-take of the secondary canal to regulate the flow rate. When compared with the fixed quantity diversion that maintain the water level in the main canal, the diversion with slide gate is unstable, however, this has the advantage of low construction cost and flexibility in operation.

The Parshall flume is installed as a water measurement device in the canal. This is best suited to the Project Area that provides the earth canals with the gentle slope, having comparatively large discharge of flow (refer to Appendix B-4-2).

The check is provided for maintaining a water surface at a required elevation for turnout deliveries upstream with partial flows in the canal. By partially closing the inlet with the gate, the canal water surface can be controlled to the desired elevation. This structure can also serve a shut off point in the canal. When

water delivery downstream from the inlet is not required, complete closure of the inlet with diversion to a wasteway could isolate the appropriate canal reach.

The road crossing is of a culvert structure to save the construction cost, having the design capacity not obstructing the flow in the canal.

e. Irrigation Pumping Station

In order to introduce the gravity irrigation at the farm level, the pumping stations are installed; two main stations at the tail of the M2 and M3 main irrigation canals, and two relift stations on the secondary canals of the S-N-2 and S-M in the M2 irrigation system. The commandable area and designed discharge of the pumping station are given below;

Pumping Station	Commandable Area (ha)	Discharge (cu.m/s)	Actual Head (m)
M2 Main Station	5,680	16.70	0.50
M2-1 Relift Station	1,165	3.43	0.50
M2-2 Relift Station	860	2.53	2.40
M3 Main Station	2,700	7.94	2.00

The number of pump units is three for the discharge of less than five cu.m/s and five for the discharge of more than five cu.m/s. In addition, each station shall have one standby unit. The proposed pumps are the vertical axial flow type as the operating head hardly fluctuates. The bore diameter is determined by the following standard;

Discharge and Bore Diameter

Discharge (cu.m/min)	Diameter (mm)	Discharge (cu.m/min)	Diameter (mm)
36 - 50	600	90 - 115	900
50 - 75	700	115 - 150	1,000
75 - 90	800	150 - 200	1,200

The pumping stations shall be operated through the year. the electric motor is used to drive the irrigation pump, the advantages of which are easy operation and stable supply of power. The size of power unit required to drive the pump is computed by the following equation:

$$\text{Output work (KW)} = \frac{0.163 \times Q \times H}{0.80} \times 1.2$$

where Q = discharge flow rate (cu.m/min)
H = total dynamic head (m)

Major dimensions of pump plant are given in the following table;

Major Dimensions of Pump Plant

Pumping Station	Nos. of Pump Unit	Bore Dia-meter(mm)	Discharge per Unit (cu.m/min)	Total Head(m)	Motor Output (KW)
M2 Main Station	6	1,200	200	1.5	75
M2-1 Relift Station	4	700	69	1.5	30
M2-2 Relift Station	4	700	51	3.4	45
M3 Main Station	6	900	95	3.0	75

f. Borrow-pit

The canals were designed for the gravity irrigation to maintain the water levels as high as possible, and a large amount of embankment is required. The quantity of borrowed soils for embankment would amount to about 3.7 million cu.m as given below:

Earth Work Balance of Irrigation Canal

(Unit: 1,000 cu.m)

Canal	Length(m)	Excavation	Embankment	Borrowed
Main	38,600	805	1,574	961
Secondary	284,490	913	3,678	2,765
Total	323,090	1,718	5,252	3,726

The side borrow is recommendable as the borrow-pit for the construction of irrigation canals that spread over the Project Area. The soils are excavated by bulldozers at the land along the both sides of the canal. The width of the borrow-pit (one side of the canal) is about 15 m for the main canal and five m for the secondary canal on an average, and the total area of the borrow-pit may reach about 400 ha. After the completion of the construction works, the borrow-pit shall be filled in the utilize farm lands.

4.6.2. Drainage Facilities

a. Drainage Canals

The drainage canal networks, consisting of the main and lateral canals and on-farm drains, will be designed aiming at underground drainage by on-farm drains with invert placed 1.3 m deep from field surface. Due to relatively low designed drainage water level against high outer water level, runoff in the Project Area will have to be drained out of the Area by pumping system. Drainage of runoff in the Area will be available only to Beqar drainage canal that is the eastern boundary of the Area. The main drainage canal should be laid out along El Salam canal running through the low-lying land of the Area for draining runoff water in the Project Area.

The elemental hydraulic design factors of the drainage canals are 0.025 for roughness coefficient, 1/20,000 for main canal slope, 1/10,000 for lateral canal slope and the Manning's formula was used for computation. The 8.0 m wide farm roads will be constructed along one side of the banks of the main drainage canal, while the 5.0 m wide berm along the other side of the banks as O & M roads. Along the lateral drainage canals, small farm roads with 6.0 m in width will be constructed. The total length of canals will be 295,550 m (12.6 m/ha).

Major Dimensions of Drainage Canals

Kind of Canal	Length (m)	Capacity (cu.m)	Structure
Main Drainage Canal	44,250	2.09 - 12.09	Earth canal
Lateral Drainage Canal	251,200	0.05 - 1.59	Earth canal
Total	295,550		

b. Drainage Pumping Stations

A drainage pumping station will be provided near the crossing point of El Salam Canal and the existing Beqar drainage canal. The drainage capacity is 14.18 cu.m/s at maximum and 2.41 cu.m/s at minimum. The flood water level at Beqar drainage canal is EL 1.00 m, while the designed water level at the drainage pumping station is EL -3.50 m at the highest and EL -4.70 m at the lowest. The drainage pump units will be operated constantly throughout the year. There will be six units of pump, including one stand-by unit, provided, having a borehole diameter of 1,200 mm, respectively. A vertical mixed flow type is adopted in due consideration of considerably large lift of 8.0 m at maximum. Horizontal type pumps may cause cavitation. Electric motors are the prime mover in the same season of stability and easiness in operation as explained for the irrigation pump prime mover. Pumping capacity per unit is 170 co m/min and power output is 260 KW.

c. Treatment of Residual Earth Materials

Due to designed low water level for subsurface drainage, there will be a volume of residual earth materials lift by drainage canal construction works as shown below.

Balance of Earth Work Volume of Drainage Canal

(Unit: 1,000)

kind of Canals	Length	Excavation	Embankment	Residual Materials
Main canal (1)	15,420	1,427	216	1,211
Main canal (2)	28,930	1,460	405	1,005
Lateral	251,200	3,667	3,014	922
Total	295,550	6,554	3,635	3,188

The residual earth materials will be treated in the following way: The residual earth materials brought about from the construction works of the main drainage canal (15,420 m) along El Salam Canal will be used in 30 m-wide embankment lying between El Salam canal and the said main drainage canal. Such space in embankment between two canals will be necessary for preventing the water from intruding into the drainage canal from El Salam canal. For other main drainage canals, the residual earth materials will be used to construct 6.0 m-wide embankment at one side of the canal banks and the same treatment will be made for the lateral drainage canals. Such a space will be used for planting shade trees.

d. Land Reclamation

When the study was carried out, about 12,000 ha of land area were found inundated by 0.5 m below water surface on an average, and the inundation water was estimated at 6,000,000 cu.m in its amount. Such inundation is caused by adverse flow into the said area from Manzala Lake through several openings of El Salam canal. Completion of El Salam canal in early 1986 will enable to prevent the adverse flow from intruding into the area and to largely reduce the amount of water inundated in the area by heavy annual evaporation of over 2,000 mm.

Prior to land consolidation works, the drainage pumping station should be constructed and the drainage canal between the station and the inundated areas should be roughly excavated. This will eliminate the surface inundation and promote drying up the land. The lateral drainage canals should be excavated while the land reclamation is progressed. Completion of the drainage canals should be executed when the soil conditions are stabilized by dry-up and weathering

The standard penetration tests carried out at 10 points in this study revealed that N value by 2.0 m below the ground surface ranges from 4.0 to 18 and 8.0 on an average. Implementation of the construction works will require further detailed tests. The march type or ordinary type construction machinary is operative on the land with bearability in such extent as above.

Unless the ground surface, however, is sufficiently dried up, the slip-free measures should be taken with the construction machines.

4.6.3 Land Consolidation

Land holding per one common farm household is five feddan (2.1 ha) in size by 210 m x 100 m. As discussed in paragraph 4.3.6, the typical plot layout in the farm land consolidation will be made by providing five farm plots along the both sides of the small irrigation canals with 1,050 m length, and the acreage of these plots is 21 ha in total. Physical planning of the land consolidation is made for these typical farm plots and work volume for 21 ha was estimated as follows:

Facilities per 21 ha

Small irri. canal & farm road (4 m width on one side of canals)		1,050 m
Small drainage canal & small farm road (3 m width on both sides of canals)		1,050 m
Pipe drain: (9 x 85 m x 10)		7,650 m
Appurtenant Structures:	Lateral diversion	1 site
	Inlet	30 sites
	Road crossing	15 sites
	Outlet	1 site

4.6.4. Agro-industries

a. Milk Processing Plant and Slaughter House

The milk production in South Hussinia is estimated at 63,830 tons per year, of which 59,200 tons are to be processed into various milk products, such as UHT milk, white cheese, butter, yoghurt, and ice cream, while the remaining is either consumed by the settling farmers or fed to calves.

Daily capacity for processing is estimated at 162 tons. It is recommended to establish one factory for the South Hussinia Project Area and one for the North Hussinia Project Area taking into consideration efficient operation and maintenance of the plant.

Operation of the plant will begin in 1990 when the proposed cropping pattern starts and daily capacity will reach 162 tons in 1997. Financial analysis for the milk processing plant and floor plan are shown in Appendix D.

As for slaughterhouse, the North Hussinia, the number of cattle to be slaughtered is as large as 32,400 head, and thus construction of a slaughterhouse is proposed there. However, about 53 head of cattle to be slaughtered in the South Hussinia Project Area will be transported to the existing slaughterhouse in Ismailia with 500 head capacity per day.

Floor plan map and dimensions of the slaughterhouse are given in Appendix D for reference.

b. Sugarbeet Processing Factory

Sugarbeet processing factory would be constructed from 1989 to 1992. The capacity of the factory is designed at 6,000 tons/day of washed sliced beet Main plant. Main plant consists of diffusion and ancillary plant, pulp processing and bagging, juice purification, evaporators and heaters, sugar end plant, sugar drying, bagging and storage, boiler house and power generator, etc. Number of staff and labour totals about 250 persons. Housing and other living facilities will also be constructed.

c. Tomato processing Factory

Raw tomatoes to be supplied for processing in the year 2005 would be projected at 141,000 tons.

A tomato paste processing factory with a capacity of 450 ton per day and three lines in one shift is established. A factory with 810 tons will be processed daily in two shifts. In 1997, processing building, warehouse, laboratory, office and processing plant of one line (150 tons per day) are constructed. Other lines would be added in the year of 1999 and 2001. The operation of factory would be enlarged to two shifts from the year 2001. The processing plant is equipped with facilities concerned to each process of juice

preparation line, juice concentration and paste sterilization, canning, seaming and cooling.

4.6.5. Housing and Infrastructures

a. Housing

Houses	Satellite Village	Service Village	Central Village	Project Area
Director's	-	1	8	22
Ass't Director's	-	1	8	22
Technical Laborer's	8	20	60	408
Apartment	2	3	9	78
Owner's	35	37	18	993
Farmer's	280	250	228	7,836
Total	325	312	331	9,359

b. Infrastructures

(1) Village Facilities

(i) Satellite Village

Buildings	Building Area	Number of Buildings	Number of Families	Population
Agri. Administration Office	500 sq.m	1	15	75
Group of Shops	300	1	20	100
Mosque	100	1	3	15
Technical Laborer's House	58	8	8	40
Apartment house	300	2	(40)	-
Owner's House	60	35	35	175
Farmer's House	54	280	280	1,400
Total			361	1,805

(ii) Service Village

Buildings	Building Area	Number of Buildings	Number of Families	Population
Village Development	75 sq.m	1	20	100
Combined School (Primary & Preparatory)	1,600	1	18	90
Medical Treatment Unit	212	1	5	25
Mosque	181	1	3	15
Auto-Service	180	1	10	50
Market with Bakery	717	1	15	75
Director's House	200	1	2	10
Asst. Director's House	153	1	2	10
Technical Laborer's House	58	20	20	100
Apartment	300	3	-	-
Owner's House	60	37	37	185
Farmer's House	54	250	250	1,350
Total			382	1,910

(iii) Central Village

Buildings	Building Area	Number of Buildings	Number of Families	Population
Village Development Office	800 sq.m	1	20	100
Administration Office	1,600	1	40	200
Artificial Insemination Center	1,025	1	12	60
Nursery School	500	2	20	100
Combined School	3,200	1	30	150
High School (General, Agriculture and Commerce)	3,200	1	30	150
Hospital (20 beds)	500	1	30	150
Medical Treatment Unit	212	1	50	25
Mosque	181	2	6	30
Police Station	568	1	8	40

Buildings	Building Area	Number of Buildings	Number of Families	Population
Post Office	170 sq.m	1	15	75
Fire Station	230	1	6	30
Store	1,000	1	8	40
Village Bank (Incl. insurance)	250	1	10	50
Workshop	1,000	1	20	100
Auto Service Station	180	1	10	50
Market with Bakery	717	2	30	150
Group of Shops	258	8	24	120
Separated Bakery	180	1	6	30
Rest House for Employees	1,200	1	6	30
Club	500	1	4	20
Cinema/Theatre House	710	1	10	50
Director's House	200	8	8	40
Asst. Director's	153	8	8	40
Technical Laborer's House	58	60	60	300
Apartment house	300	9	-	-
Owners House	60	18	18	90
Farmers House	54	228	228	1,140
Total			672	3,360

(2) Trunk and Village Road

Roads	Length (km)	Width Total (m)	Width Passing (m)	Pavement
Trunk Roads	51	12	6	Asphalt
Village Roads	82	10	4	- do -
Total	133			

(3) Water Supply Facilities

Water requirements:	13,000 cu.m/day
Trunk pipeline:	28 km
Branch pipeline:	100 km
(Water clarification facility:	1 unit)

(4) Sewage Treatment

Aerobic tank system:	29 units

(5) Electric Facilities

Village electric equipment:	18,000 KW
Irrigation and drainage pumps:	3,000
Agro-industrial electric equipment:	5,000 KW
220 KV/66 KV sub-station:	1 unit
66 KV sub-station:	1 unit
66 KV distribution line:	10 km
11 KV distribution line:	130 km
Low voltage distribution works:	36 units

(6) Telecommunication Facilities

Trunk cable to connect with the national networks:	20 km
Lines within the Project Area:	180 km
Central exchange:	1 set
Total capacity of telephone lines:	400 lines 1/
Telex facilities	2 sets 2/

Note: 1/ Five lines per satellite village
16 lines per service village
100 lines per central village

2/ Telex system will be made available at the central villages

4.7. Project Implementation

The MLR, GARPAD in particular, will be responsible for preparing detailed designs and the execution of on-farm development works, including tertiary canals, and necessary social infrastructures in conjunction with the authorities concerned, while the MOI will be responsible for the main irrigation and drainage works, including the pumping stations.

Construction works will be executed on the contract basis in close coordination with the agencies concerned. It will be the most practical way to make a contract with the respective Ministry-related construction companies.

The Project area covers 48,500 feddan (or, 20,370 ha) of irrigable areas comprising three blocks; M1 of 13,790 feddan (or, 5,790 ha), M2 of 20,000 feddan (or, 8,410 ha) and M3 of 14,690 feddan (or, 6,170 ha). The construction works shall be implemented on the block-by-block basis from the upstream block (M1) to M2 and M3 in order.

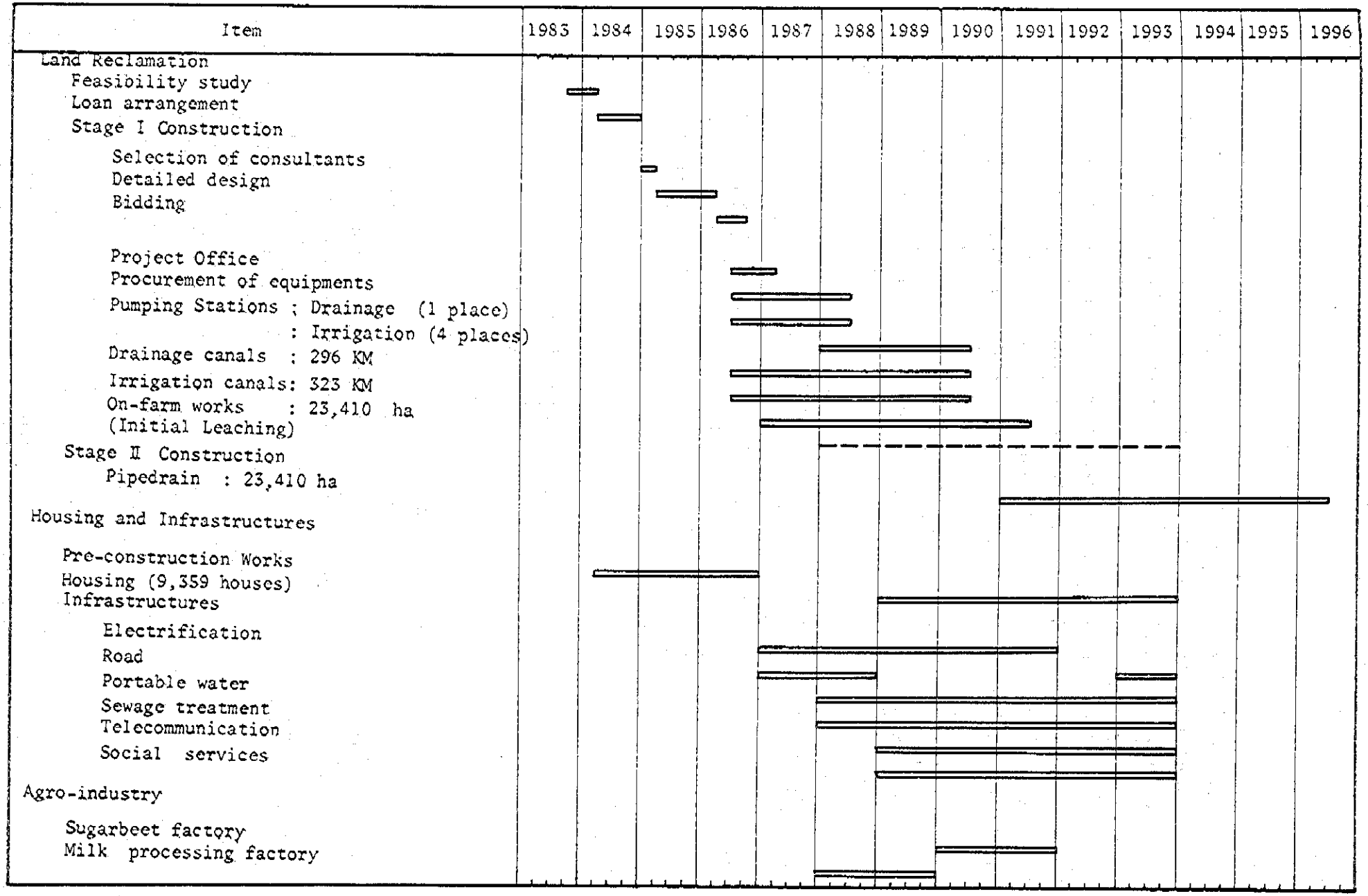
The Project will be implemented over six years starting in 1986 when the construction of the El Salam is to be completed. Prior to the start of construction works, two years will be needed for financial preparation and detail design works (See Table IV-11).

4.8. Cost Estimate

4.8.1. Basis of Cost Estimate

a. Unit Costs

The basic data employed in construction cost estimate of the proposed facilities in the Project, such as labor wages, the unit prices of construction materials, etc. have been taken from various


Item
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
Land Reclamation
Feasibility study
Loan arrangement
Stage I Construction
Selection of consultants
Detailed design
Bidding
Project Office
Procurement of equipments
Pumping Stations ; Drainage (1 place)
: Irrigation (4 places)
Drainage canals : 296 KM
Irrigation canals: 323 KM
On-farm works : 23,410 ha
(Initial Leaching)
Stage II Construction
Pipedrain : 23,410 ha
Housing and Infrastructures
Pre-construction Works
Housing (9,359 houses)
Infrastructures
Electrification
Road
Portable water
Sewage treatment
Telecommunication
Social services
Agro-industry
Sugarbeet factory
Milk processing factory

related data available by GARPAD through discussions between the Government officials in charge and the Team members, the unit prices as of 1983 have been employed in this cost estimate.

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

The unit costs of labor and construction materials are shown in Table IV-12.

b. Necessary Units of Construction Equipment

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

(1) Working Days in a Year

The annual working days excluding holidays in each week, the national holidays, and Ramadan are about 265 days a year, in other words, 22 day/month.

(2) Actual Working Hours in a Working Day

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

Table IV-12. Unit Cost of Labor and Materials

Description	Unit Cost (L.E.)
Common laborer for earth work	7.0
Skilled laborer for earth works	9.0
Common laborer for building works	8.0
Skilled laborer for building works	9.0
Driver for light equipment	5.0
Driver for heavy equipment	13.0
Bricklayer	12.0
Welder	10.0
Carpenter	12.0
Piling driver	11.0
Reinforced bar tender	7.0
Surveyor	15.0
Asist. Surveyor	9.0
Mechanic	10.0
Portland cement	32.0
Sulfate resisting portland cement	78.0
Plain bar	300.0
Shape steel	330.0
Stone rip rap	16.0
Broken stone at site	12.0
Washed gravel at site	12.0
Sand at site	8.0
Timber	280.0
Regular gasoline	0.15
Diesel oil	0.03
Grease	1.2

4.8.2. Construction Cost

Basic data employed in construction cost estimates such as labor wages, unit prices of construction materials, etc., domestically available have been selected from various related data obtained in ARE through discussions made with the GARPAD.

The overall project costs in 1983 are estimated at LE 849.2 million(or, US$ 1,036 million) for land reclamation, housing and infrastructures and agro-industry (Table IV-13).

The total project costs for the land reclamation project are estimated at LE 404.4 million(or, US$ 493.2 million) with a foreign exchange component of LE 86.7 million. Physical contingencies of ten percent have been added to all civil works costs. Estimated price increases were derived by applying annual rates of price escalation of 12 percent for local exchange component and five percent for foreign exchange component (Table IV-14). Table IV-15 gives the total project costs ot the housing and infrastructure project.

4.8.3. Operation and Maintenance Costs

The operation and maintenance for facilities constructed would be carried out by the Government authorities after completion of works (Detail is described in Chapter V).

The operation and maintenance cost of facilities in future consist of cost for the Government offices, electric charge for drainage and irrigation pumping station and cost for main, secondary and tertiary canal and pipe drain. Annual operation and maintenance cost would be estimated at follows.

1.	Salary and Wages	770 Million LE
2.	Electric Power Charge	311
3.	Repairing Cost	228
4.	Terminal Facilities Cost	747
5.	Grand Total	2,056

Unit cost is calculated at 36.9 LE/feddan (87.8LE/ha)(See Appendix).

Table IV-13 Cost Summary - Overall Project

(Million L.E.)

Item	Local	Foreign	Total
1. Land Reclamation			
Base Costs	116.7	57.4	174.1
Contingencies	201.0	29.3	230.3
Total(1)	317.7	86.7	404.4
2. Housing and Infrastruture			
Base Costs	76.5	40.0	116.5
Contingencies	123.8	24.6	148.4
Total(2)	200.3	64.6	264.9
3. Agro-Industry			
Base Costs	24.3	67.3	91.6
Contingencies	52.2	36.1	88.3
Total(3)	76.5	103.4	179.9
Grand Total(1 - 3)	594.5	254.7	849.2

Table IV-14 - Cost Summary
- Land Reclamation -

(Unit: '000 LE)

Item	Local	Foreign	Total	Foreign (%)
Stage I Project				
1. Civil work	41,372	30,898	72,270	43
2. Equipment	990	8,873	9,863	90
3. Project facilities	610	-	610	-
4. Consulting services	660	2,318	2,978	78
5. Engineering & administration	9,381	-	9,381	-
Base cost (1 to 5)	53,013	42,089	95,102	44
6. Physical contingencies	5,303	4,210	9,513	44
7. Price escalation	42,891	13,124	56,015	23
Sub-Total (6 to 7)	48,194	17,334	65,528	26
Total	101,207	59,423	160,630	37
Stage II Project				
1. Pipe drain	58,991	14,183	73,174	19
2. Engineering & administration	4,781	1,134	5,852	19
Base cost (1 to 2)	63,709	15,317	79,026	19
3. Physical contingencies	6,370	1,531	7,901	19
4. Price escalation	146,390	10,450	156,840	7
Sub-Total (3 to 4)	152,760	11,981	164,741	7
Total	216,469	27,298	243,767	11
Grand Total	317,676	86,721	404,397	21

Cost Estimate Summary
- Land Reclamation -

Stage I

(Unit: '000 LE)

Item	Local	Foreign	Total	Foreign (%)
1. Civil works				
1-1. Pump station				
Drainage - 1 station	605	449	1,054	43
Irrigation - 4 stations	1,353	1,106	2,459	45
1-2. Irrigation canal - 337 km	12,030	9,601	21,631	44
1-3. Drainage canal - 295 km	4,748	4,153	8,901	47
1-4. On-farm development	22,636	15,589	38,225	41
Sub-Total	41,372	30,898	72,270	43
2. Equipment				
2-1. Pump and motor	654	5,882	6,536	
2-2. O & M equipment	336	2,991	3,327	
Sub-Total (2)	990	8,873	9,863	90
3. Project facilities	610	-	610	
4. Consulting services	660	2,318	2,978	
5. Engineering & administration	9,381	-	9,381	
Base Cost (1 to 5)	53,013	42,089	95,102	44
6. Physical contingencies	5,303	4,210	9,513	
7. Price escalation	42,891	13,124	56,015	
Sub-Total (6 to 7)	48,194	17,334	65,528	
Total Cost	101,207	59,423	160,630	

Note: Base Cost $95,102 \times 10^3$ LE/55,740 feddan
= 1,706 LE/feddan
= 4.954 US$/ha

Table IV-15 Cost Summary - Housing and Infrastruture

(1,000 L.E.)

Item	Local	Foreign	Total
1. Housing - 9,353 houses	24,129	3,290	27,419
2. Infrastructure			
Electrification	4,638	3,092	7,730
Public Road - 133 km	5,920	3,946	9,866
Potable Water - 128 km	11,320	11,317	22,637
Sewage Treatment - 29	10,915	10,915	21,830
Telecommunication - 200 km	316	947	1,263
Village Facilities	7,806	2,495	10,301
Total (2)	40,915	32,712	73,627
3. Engineering and Administration	11,502	4,040	15,542
Base Cost (1 - 3)	76,546	40,042	116,588
4. Physical Contingencies	14,743	7,741	22,484
5. Price Escalation	109,075	16,901	125,976
Total (4 - 5)	123,818	24,642	148,460
Grand Total (1 - 5)	200,364	64,684	265,048

Table IV-16 Schedule of Expenditures (Million L.E.)

Item	1985	1986	1987	1988	1989	1990	1991	1992	1993
1. Land Reclamation									
Base Cost	4.6	1.7	17.1	26.2	25.9	14.2	7.7	21.0	24.3
Contingency	1.3	0.7	8.6	16.2	19.7	13.1	9.1	34.6	47.4
Total (1)	5.9	2.4	25.7	42.4	45.6	27.3	16.8	55.6	71.7
2. Housing and Infrastructure									
Base Cost	2.6	2.6	8.4	12.3	22.1	22.7	17.4	9.8	18.6
Contingency	0.3	0.5	5.6	9.9	22.4	28.3	26.1	16.7	38.7
Total (2)	2.9	3.1	14.0	22.2	44.5	51.0	43.5	26.5	57.3
3. Agro-Industry									
Base Cost	-	-	-	4.7	8.6	23.9	32.2	17.6	-
Contingency	-	-	-	3.0	5.5	18.0	28.7	18.4	-
Total (3)	-	-	-	7.7	14.1	41.9	60.9	36.0	-
Total (1 - 3)	8.8	5.5	39.7	72.3	104.2	120.2	121.2	118.1	129.0

Item	1994	1995	1996	1997	1998	1999	2000	2001	Total
1. Land Reclamation									
Base Cost	14.4	12.5	4.5	-	-	-	-	-	174.1
Contingency	32.8	33.0	13.8	-	-	-	-	-	230.3
Total (1)	47.2	45.5	18.3						404.4
2. Housing and Infrastructure									
Base Cost	-	-	-	-	-	-	-	-	116.5
Contingency	-	-	-	-	-	-	-	-	148.5
Total (2)	-	-	-	-	-	-	-	-	265.0
3. Agro-Industry									
Base Cost	-	-	-	2.5	0.1	1.0	-	1.0	91.6
Contingency	-	-	-	8.5	0.3	2.7	-	3.2	88.3
Total (3)	-	-	-	11.0	0.4	3.7	-	4.2	179.9
Total (1 - 3)	47.2	45.5	18.3	11.0	0.4	3.7	-	4.2	849.3

CHAPTER V ORGANIZATION AND MAINTENANCE

CHAPTER V. ORGANIZATION AND MAINTENANCE

5.1. Project Organization

5.1.1. Executing Body

The Project is an integrated development project comprising land reclamation, on-farm development and irrigation and drainage works as well as social infrastructure for settlers. Many government agencies will be involved in the implementation of the Project.

The Ministry of Land Reclamation (MLR) will be responsible for overall planning and coordination. An executive committee will be established for effective implementation, operation and maintenance of the Project and will be composed of the representative of the three Ministries of the MLR, MOI, and MOA (See Figure V-1).

5.2. Operation and Maintenance

The responsibility for the O & M of the project facilities shall be transferred to the Government agencies concerned after the completion of the Project. At present the provincial government office at Zagazig has taken charge of local administration whereas the regional office of the central Government has been directly responsible for the O & M of irrigation and drainage systems.

The establishment of an Irrigation System Office has been proposed for effective O & M of the Project. This office will be open for activities and services not only of the MLR but also of the MOI and MOA. Three field offices, as sub-organization of the proposed Irrigation System Office will be established in consideration of the importance of water management (See Figure V-2).

Furthermore, the responsibility for water management on the on-farm level will be gradually transferred to farmers' organization proposed for the Project under the control of the proposed field office. Water management on the on-farm level should be carried out with the participation of all farmers so that they might fully recognize the necessity and importance of water management. In this sense, the MLR and MOI should make continuous effort to educate farmers in water management.

The Irrigation System Office will have the O & M section, engineering section, and administration section. The field office whose routine work will be water management, will be under the control of the O & M section.

Figure V-1 Organization Chart for Project Implementation

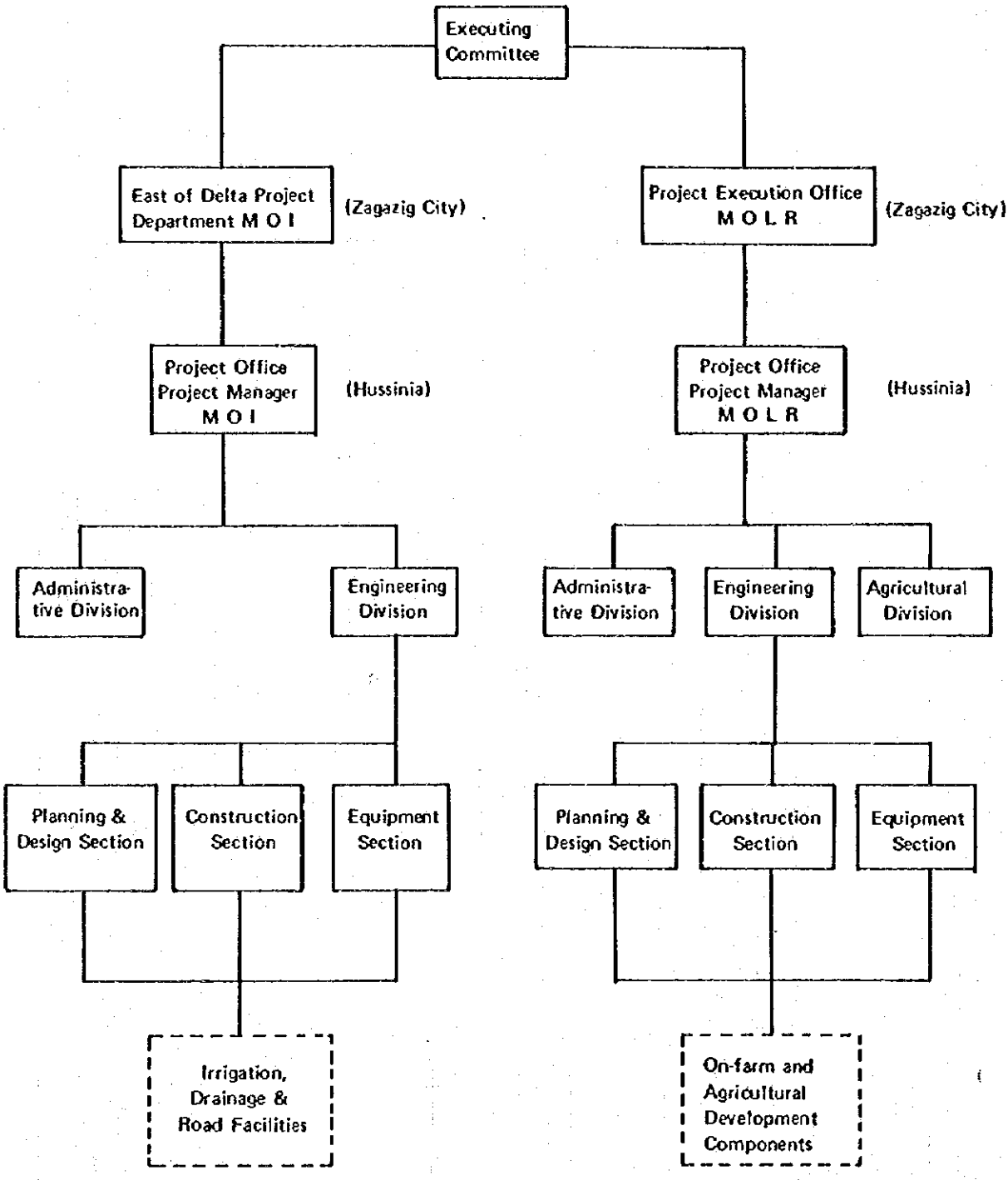
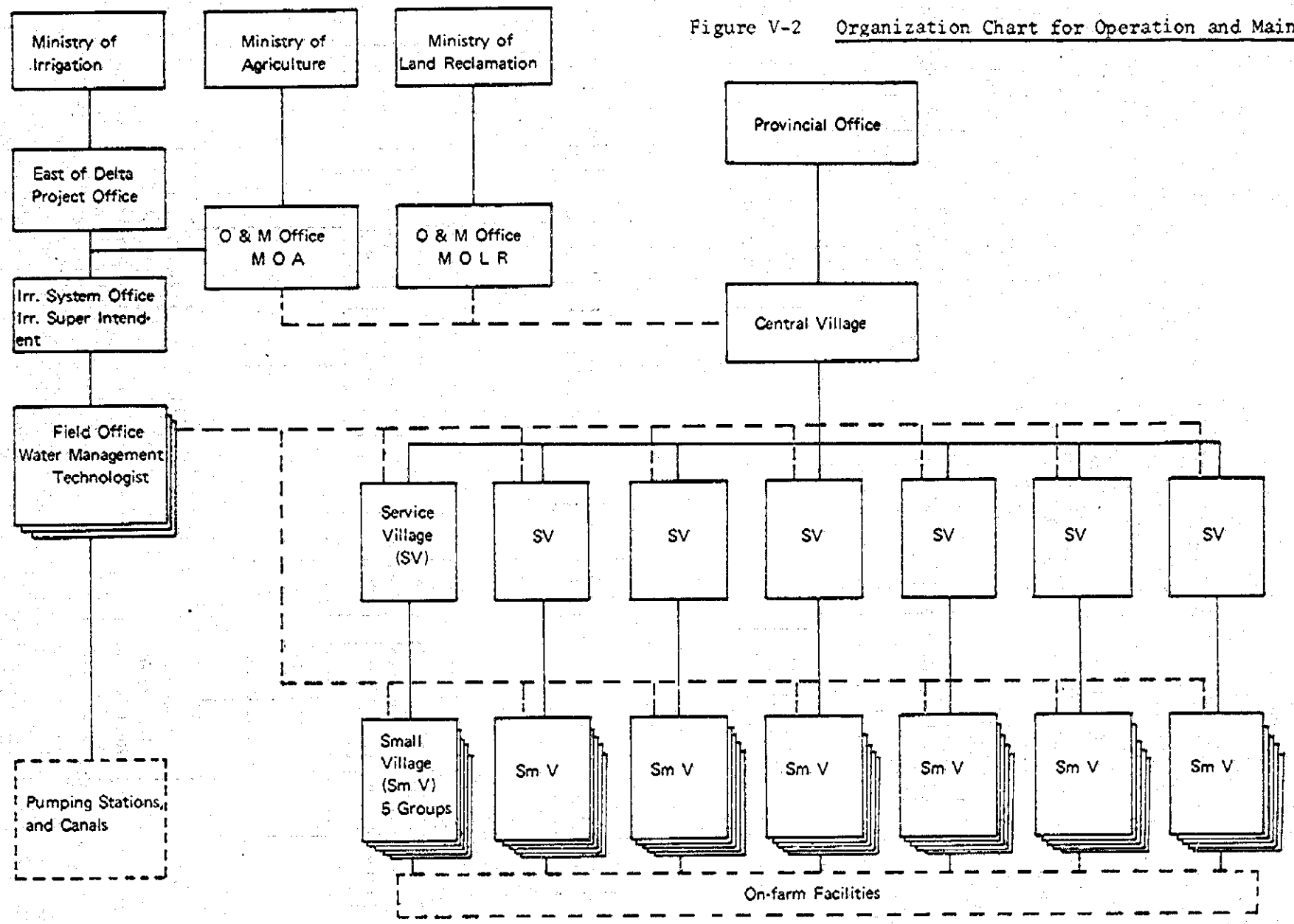


Figure V-2 Organization Chart for Operation and Maintennace



CHAPTER VI PROJECT JUSTIFICATION

CHAPTER VI PROJECT JUSTIFICATION

6.1. 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 74,700 feddan or 31,400 ha. The net cultivated area is projected at 55,740 feddan. The farmlands will be cultivated by newly settled farmers of about 8,800 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 percent of this land is actually under cultivation and possibly as little as 35 percent 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. Failures of this kind will not be repeated in the implementation of this Project.

6.2. Method of Economic Evaluation

a. The measurable economic benefits and costs are expressed in monetary terms and both streams of benefits and costs on the annual basis over the evaluation period are converted into the respective present worth values. The economic internal rate of return (EIRR)

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

is used as the main indicator for the economic justification of the Project.

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

b. Project life

The Project Life should not be more than 50 years, because of the great uncertainties involved and the negligible present worth value of the future benefits and costs beyond 50 (or even 30) years. The life of the land reclamation project is assumed at 50 years, because major investment consists of permanent facilities such as canals. The life of pump and operation & maintenance facilities are assumed at 15 and 10 years, respectively. Their costs are listed as the replacement cost.

The life of the houses and social infrastructure is assumed at 50 years. Although the technical life of the major investment in the agro-processing project is quite long, the economic life is expected to be much shorter because of obsolescence. However, it is assumed that the major investment does not become obsolete over a medium-term period of twenty to twenty-five years.

The economic evaluation of the comprehensive Project consisting of three projects of land reclamation, houses & social infrastructure and agro-processing would be estimated using the project life of 50 years. The major investment in the agro-processing project is considered as the replacement cost.

6.3. Economic Evaluation of Land Reclamation Plan

6.3.1. Commodity Prices

a. The exchange rate of Egyptian Pound(L.E.) has two rates. The first is the official rate and the second is the privilege rate. The official rate is L.E. 0.7 per US$ which has been constant since 1979. The prevailing rate which the F/S team exchanged during the study period at Bank MISR was on average L.E. 0.819 per US$. It is considered that the privilege rate indicates the real rate. Hence the exchange rate is estimated at L.E. 0.82 per US$(LE. 1.0 = US$ 1.22). This value corresponds to that used in the South Hussinia Agricultural Project Identification Mission Report, July, 1983.

b. The exchange rate of Japanese Yen per US$ is estimated at ¥236, an average for the last three months of September to November, 1983. Hence, L.E. 1.0 is equivalent to ¥288.

c. Annual price escalation rate to be used in estimation of the Project cost consists of two rates; one for foreign cost and the other for local cost. The escalation rate for foreign cost is projected at 5 percent based on the rate projected by OECF, JAPAN. Whereas the rate for local cost is projected at 12 percent considering the trends of wholesale prices over the recent years.

d. According to the World Bank Report titled Agricultural Price Management in Egypt, 1980, some 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.

On the other hand, the World Bank reported SCF of 0.965, and this SCF will be used in the sensitivity analysis.

e. The conversion factor of rural unskilled labor is 0.22 according to the World Bank Report. The market wage rate is L.E. 5.00 in the Project Area. Using the results of labor balance study, shadow wage rate is estimated at L.E. 2.5.

f. At present Egypt is a net importer of fertilizer. Although there is sufficient planned investment in capacity expansion to achieve self-sufficiency, fertilizer is treated as an import in this Report.

g. Following table shows the financial and economic prices of main commodities

Table VI-1. Farm Gate Prices of Main Commodities

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

6.3.2. Evaluation of Project Benefits

a. Stage Development of Benefits

Project benefits would be generated from production of crops and livestock breeding. Growing of benefits is scheduled considering three factors, viz, implementation schedule, land classification and stage development of cropping pattern as shown in the following table.

Table VI-2. Schedule of Benefit Growing

Year	M1 BLock		M2 Block		M3 Block	
	Class 2&3 (2,430 fed)	Class 4 (13,400 fed)	Class 2&3 (15,100 fed)	Class 4 (6,337 fed)	Class 2&3 (7,350 fed)	Class 4 (9,540 fed)
1988	Leaching	Leaching				
1989	Leaching	Leaching	Leaching	Leaching		
1990	1st Stage	1st Stage	Leaching	Leacning	Leaching	Leaching
1991	- do -	- do -	1st Stage	1st Stage	Leaching	Leaching
1992	2nd Stage	- do -	- do -	- do -	1st Stage	1st Stage
1993	- do -	2nd Stage	2nd Stage	- do -	- do -	- do -
1994	- do -	- do -	- do -	2nd Stage	2nd Stage	- do -
1995	- do -	- do -	- do -	- do -	- do -	2nd Stage
1996	- do -	- do -	- do -	- do -	- do -	- do -
1997	Full Deve	- do -	- do -	- do -	- do -	- do -
1998	- do -	- do -	Full Deve	- do -	- do -	- do -
1999	- do -	- do -	- do -	- do -	Full Deve	- do -
2000	- do -	Full Deve	- do -	- do -	- do -	- do -
2001	- do -	- do -	- do -	Full Deve	- do -	- do -
2002	- do -	- do -	- do -	- do -	- do -	Full Deve

Note: Full Deve: Full Development Stage

Construction of intake facilities and main irrigation canals are scheduled in the order of M1, M2, and M3 block. Farmlands of each block are classified into two groups of Classes 2 & 3 and Class 4. After two years of leaching at the initial stage, the necessary years to reduce the salinity of soil for land Class 4 are planned as three years in the 1st stage and seven years in the 2nd stage in comparison with two years and five years for land Classes 2 and 3. The whole area shall reach the full development stage by the year 2002 starting in 1990.

Drainages system in the field is planned to be canal drain in the 1st stage and converted to pipe drain in the 2nd stage.

b. Cropped area with Project

Open drain system to be operated during the 1st stage shall be converted to pipe drain system in the 2nd stage. Consequently, the cultivation area shall increase by 20 percent after the completion of pipe drain works.

Table VI-3. Cultivated Area
(Unit:Feddan)

	1990	1993	1996	2000	2002
Summer crops					
Rice	12,666	30,162	18,580	18,580	18,580
Soybean	-	10,309	18,579	18,579	18,579
Sorghum	-	10,311	18,581	15,016	10,580
Tomato	-	-	-	3,565	8,001
Sub-total	12,666	50,782	55,740	55,740	55,740
Winter crops					
Berseem	12,666	30,162	18,580	18,580	18,580
Sugarbeet	-	10,309	18,579	18,579	18,579
Onion	-	7,218	13,015	13,015	13,015
Cauliflower	-	1,556	2,800	2,800	2,800
Cabbage	-	1,537	2,766	2,766	2,766
Sub-total	12,666	50,782	55,740	55,740	55,740
Total	25,332	101,564	111,480	111,480	111,480

c. Production of Crops with Project

Production of crops excluding fodder crops is shown in the following table. Rice will reach its target yield of 3.0 tons per feddan in seven years. Soybean, sugarbeet and vegetables will take five years to reach their target yield. Hence, production of crops will reach the full development stage by the year 2005. It will take a total of 16 years from 1990.

Table VI-4. Crop Production

(Unit: 1,000 tons)

	Rice	Soybean	Tomato	Sugarbeet	Onion	Cauliflower	Cabbage
1990	32.3	-	-	-	-	-	-
1991	18.9	-	-	-	-	-	-
1992	61.2	0.6	-	12.7	2.5	0.3	1.3
1993	46.7	7.1	-	163.2	31.8	3.7	17.1
1994	39.4	8.6	-	261.7	48.0	5.6	25.6
1995	37.1	15.1	-	323.1	64.2	7.9	36.6
1996	40.3	15.9	-	348.7	73.8	8.4	40.7
1997	42.7	17.2	4.8	369.6	85.7	10.7	43.1
1998	45.9	17.7	35.1	401.0	100.4	11.8	46.8
1999	50.1	19.8	54.5	432.7	113.2	12.2	48.2
2000	53.3	21.1	87.9	448.9	121.6	12.9	50.8
2001	54.8	21.6	113.5	455.2	125.4	13.3	52.4
2002	55.7	21.6	140.5	455.2	127.4	13.7	54.5
2003	55.7	21.6	149.1	455.2	127.4	13.7	54.5
2004	55.7	21.6	154.1	455.2	127.4	13.7	54.5
2005	55.7	21.6	156.8	455.2	127.4	13.7	54.5

d. Number of Livestock and Produce

Number of cows and cattle is projected at 37,800 head and 14,500 head, respectively. 4,130 ton of beat and 63,830 ton of milk will be produced per year in 1998. Sheep is projected at 9,360 head in 1998.

Table VI-5. Production of Livestock

	No. of Fattening Cattle	Tons of Beef	No. of Milking Cows	Tons of Milk	No. of Sheep	Sheep Meat	Wool
	Head	ton	Head	ton	Head	ton	ton
1990	2,650	750	6,860	11,580	2,770	14.4	2.3
1991	4,530	1,300	11,770	19,870	7,640	39.8	10.0
1992	7,550	2,150	19,620	33,140	9,830	50.4	12.9
1993	9,790	2,790	25,430	42,940	8,670	45.1	11.4
1994	10,670	3,040	27,730	46,830	7,380	38.5	9.7
1995	12,340	3,510	32,060	54,140	6,850	35.6	9.0
1996	13,680	3,890	35,530	59,990	7,850	40.8	10.2
1997	14,550	4,130	37,800	63,830	8,690	45.1	11.4
1998	14,550	4,130	37,800	63,830	9,360	48.7	12.3

e. Production Cost

Production cost by crop is estimated using cost items of seed, fertilizer, agricultural chemical, agricultural machinery, fuel, labor and miscellaneous. Cost items for breeding of friesian, baladi and sheep consist of fodder, labor, medicine and others.

f. Crop Budget

Net Production Value by crop and livestock would be estimated as follows.

Table VI-6 N.P.V. With Project

(Unit: L.E./per feddan & feeding unit)

	Rice	Soybean	Tomato	Sugarbeet	Onion
G.P.V.	546	274	1,190	750	800
P.C.	223	154	590	325	420
N.P.V.	323	120	600	425	380

	Cauliflower	Cabbage	Friesian	Baladi	Sheep
G.P.V.	588	1,200	1,191	625	61
P.C.	358	400	707	297	38
N.P.V.	230	800	484	328	23

g. Net Production Without the Project

The existing field is cultivated with rice, cotton, wheat and vegetables. Annual N.P.V. is estimated as follows. This value is assumed to be constant in the future.

Table VI-7. N.P.V. Without Project

(Unit: 1,000 L.E.)

	Paddy	Cotton	Wheat	Vegetables	Total
G.P.	1,030	576	258	112	1,976
P.C.	730	382	174	63	1,349
N.P.V.	300	194	84	49	627

h. Net Production Value with Project

Net Production Value with Project is N.P.V. of crops plus that of livestock.

Table VI-8. N.P.V. with the Project

(Unit: Million L.E.)

	Crop			Livestock	Total
	G.P.V.	P.C.	N.P.V.	N.P.V.	N.P.V.
1990	2.75	1.98	0.77	3.63	4.40
1993	18.60	11.74	6.86	13.44	20.30
1996	30.79	17.87	12.92	18.69	31.61
2000	48.46	23.41	25.05	19.91	44.96
2002	53.67	24.95	28.72	19.91	48.63
2005	54.82	25.18	29.64	19.91	49.55

i. Incremental N.P.V.

Incremental N.P.V. is estimated by subtracting N.P.V. without Project from N.P.V. with Project as shown in the following table.

Table VI-9. Incremental N.P.V.

(Unit: Million L.E.)

	N.P.V. with Project	N.P.V. without Project	Incremental N.P.V.
1990	4.40	0.63	3.77
1993	20.30	0.65	20.95
1996	31.61	0.67	32.28
2000	44.96	0.70	44.26
2002	48.63	0.71	47.92
2005	49.55	0.73	48.82

6.3.3. Evaluation of Project Cost

The direct costs employed for estimating the internal rate of return consist of those of engineering design, property and construction of the Project, but exclude the interests to be incurred during the construction period.

Both interest and tax are considered as transfer payments, and so, are not included in the economic costs. The Project cost includes a depreciation cost of the construction equipment.

The local currency costs are converted into the border prices using the standard conversion factor.

The financial project cost excluding the escalation factor was estimated at 191,542 L.E. x 10^3 as shown in Table VI-10. The economic cost used for evaluating the internal rate of return was estimated at 165,863 L.E. x 10^3.

Main works excluding the pipe drain works would be implemented from 1985 to 1991. The pipe drain works on 55,740 feddans (23,410 ha) are scheduled to start in 1991 as end of implementation period of main works and to be completed in 1996. Overall period amounts to 12 years. The pipe drain works should be started at the earliest from the beginning in the 2nd stage of cropping pattern in order to estimate the foregin currency consisting of two components of main works and pipe drain works. As a result, the land reclamation project cost will expand and the construction shall take a long time.

Total land reclamation project cost is divided into Stage I cost of main works and Stage II cost of pipe drain works. Financial cost is converted into the border prices using the standard conversion factor.

Both flows of financial cost and economic cost excluding price escalation are estimated as follows.

Table VI-10. Financial and Economic Land Reclamation Project Cost

(unit: million L.E.)

	Financial Cost			Economic Cost		
	Stage I	Stage II	Total	Stage I	Stage II	Total
1985	5.04	-	5.04	4.20	-	4.20
1986	1.91	-	1.91	1.65	-	1.65
1987	18.76	-	18.76	16.48	-	16.48
1988	28.87	-	28.87	25.79	-	25.79
1989	28.48	-	28.48	25.50	-	25.50
1990	15.61	-	15.61	13.99	-	13.99
1991	5.94	2.53	8.47	5.34	2.12	7.46
1992	-	23.05	23.05	-	19.33	19.33
1993	-	26.79	26.79	-	22.47	22.47
1994	-	15.88	15.88	-	13.32	13.32
1995	-	13.73	13.73	-	11.52	11.52
1996	-	4.96	4.96	-	4.16	4.16
Total	104.62	86.93	191.55	92.95	72.91	165.86

Note: Stage II pipe drain works.
Price escalation is excluded.

Operation and maintenance cost of facilities consist of electric charge for pumping station, repair cost, salary and wage and O & M cost of main, secondary, tertially and pipe drain canals.

O & M costs per feddan are estimated at 36.9 L.E. of financial cost and 34.2 L.E. of economic cost.

O & M cost of conveyance from the Nile to South Hussinia is added to the Project's O & M cost in the estimation of IRR. According to the South Hussinia Agricultural Project Identification Mission Report, 1983, World Band, the costs to be allocated are estimated at 25,234 thousand L.E.

6.3.4. Internal Rate of Return

The economic internal rate of return was computed by using the linear interpolation method. The incremental benefit was estimated by subtracting the project cost from the benefits for each project year. The project cost consists of initial capital, operation and maintenance cost and replacement cost. The project economic life was set at 50 years.

IRR of the Land Reclamation Project jointed by Stage I and Stage II is estimated at 13%, El Salam Canal costs to be allocated is invested in the 1st year. IRR of the Project without El Salam Canal costs allocated is estimated at 15.4 percent. According to the suggestion of the Economist, GARPAD, the marginal capital interest is 10 to 12 percent. The marginal productivity of capital at border prices is 10 percent based on the accounting ratios evaluated in the World Bank Staff Working Paper No.521.

This project, therefore, is economically justifiable.

6.3.5. Sensitivity Analysis

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

EIRR in Sensitivity Analysis
- Land Reclamation Project -

Item	IERR
1. Original	13.0%
(Case without El Salam Canal costs allocated.)	(15.4%)
2. 10% decline in prices of products:	10.7%
3. 10% decline in target yield of products:	10.7%
4. 10% increase in production cost:	11.7%

6.4. Economic Evaluation of Agro-Industries

6.4.1. Sugarbeet Processing

Sugarbeet processing factory would be constructed from 1989 to 1992 and its operation starts in 1993 corresponding to the annual supply of raw sugarbeet. The financial project cost excluding price escalation amounts to 89.5 million L.E. and the economic project cost is estimated at 85.4 million L.E.

The gross production income would be gained as follows in 9th years after the onset of operation of factory.

- Gross Production Value (2001) -

Products	Quantity (1,000 tons)	Financial G.P.V. (1,000 tons)	Economic G.P.V. (1,000 L.E.)
White sugar	71.55	28,620	34,400
Dry molasses & beet pulp	9.90	990	990
Dry non-molasses & beet pulp	24.42	3,663	3,663
Molasses	26.47	3,970	3,970
Total	132.34	37,243	43,023

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 2001 is estimated using raw beet price of L.E. 30 per ton as follows.

- Production Cost -

Items	Financial (1,000 L.E.)	Economic (1,000 L.E.)
Raw material cost	9,610	14,415
Variable Cost	5,889	5,952
Fixed Cost	1,425	1,425
Total	16,924	21,792

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 Band 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	17.6%	22.5%
30 LE/ton	13.0%	19.0%

6.4.2. Milk Processing

Milk processing factory would be constructed from 1988 to 1989 and begin an operation in 1990. The financial project cost including processing facilities, buildings, transportations vehicles and refrigerator but excluding price escalation amounts to 6.3 million L.E. The economic project cost is 5.6 million L.E.

The gross production income in the 8th year (1997) after the onset of operation of factory would be projected as follows.

- Gross Production Value (1997 years) -

Products	Quantity (tons)	Financial G.P.V (1,000 LE)	Economic G.P.V. (1,000 LE)
UHT Milk	23,680	9,472	9,169
Butter	440	1,320	1,278
White Cheese	5,920	8,880	8,596
Total		19,672	19,043

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 1997 is estimated as follows.

- Production Cost (1997) -

Items		Financial (1,000 LE)	Economic (1,000 LE)
Raw Milk Cost			
0.30 LE/kg	(X)	17,760	17,190
0.25 LE/kg	(Y)	14,800	14,320
0.20 LE/kg	(Z)	11,840	11,460
Other Variable Cost		1,438	1,364
Fixed Cost		1,165	994
Total	(X)	20,368	19,548
	(Y)	17,408	16,678
	(Z)	14,448	13,818

IRR is calculated using project life of 25 years.

	FIRR (%)	EIRR (%)
Raw Milk Cost		
0.30 LE/kg (X)	-1	-1
0.25 LE/kg (Y)	13.1	16.5
0.20 LE/kg (Z)	33.5	37.5

6.4.3. Tomato Processing

According to the projection of tomato production, quantity of tomatoes supplied for processing in the full development stage of 2005 would be expected at 141,000 tons. Capacity of factory capable of processing 141,000 tons of raw tomatoes shall be planned at 800 ton per day based on a working period of 174 days.

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

One line plant is implemented in 1997, 1999 and 2000 respectively. Initial costs are as follows.

	Financial Cost	Economic Cost
	- Million LE -	
Base Cost	4.55	4.17
Physical Contingency	0.45	0.41
Sub-total	5.00	4.58
Price Escalation Value	16.62	
Total	21.62	

The economic gross production value of tomato paste ;in the year 2005 is assumed as the same value with the financial gross production value of 21.49 million LE. The production cost consists of raw material, other materials and fixed cost items. The processing cost in the year 2005 under two shift is estimated at 16.72 million LE in financial terms and 16.53 million LE in economic terms.

Internal rate of return is calculated as follows.

Financial	Economic
32.5%	37.6%

6.5. Economic Evaluation of Housing and Infrastructures

The components of rural development project are houses, road, water supply, sewerage, electricity, communication and village facilities. The financial basic cost of these components accounts

for 27, 10, 23, 22, 8 and 10 percent of total basic cost, respectively. Though an economic justification of these investments is difficult to make in manetary terms, study is possible by use of some methods. Particularly, the social and economic justification of investment in village water supply and rural electrification projects are attempted in the World Bank Paper (Refer to Village Water Supply, Mar. 1976 and Rural Electrification, Oct. 1975).

6.5.1. Water Supply Project

In the Project Area, if the investment in village water supply is not made, the settlers should look for alternative supply system, that is, to use irrigation water or to purchase drinking water from outside town. The quality of irrigation water is 800 ppm. Hence the irrigation water to be used in the Project Area is unsuitable for drinking purpose. Another alternative is to purchase drinking water of 12,650 tons per day. This huge quantity in every day shall be impossible to be supplied from outside. Satisfactory alternative does not exist in this Project Area. This is similar to the case where there are no satisfactory alternatives to a public system in most urban areas. Revenues from water changes in urban systems are sufficient to meet all costs and provide a reasonable rate of return. These revenues can be used as a minimum approximation of economic benefits.

Cairo water supply council approved the raising of water charge from 1.2 piaster per ton to 2.0 piaster per ton in July, 1983. It is reported that the desirable water charge is 10 piaster per ton consisting of 5.5 piaster of water production cost and 4.5 piaster of repayment cost of facilities. The prime cost of drinking water in this Project Area shall be higher than that in Cairo City because of conveyance from the Nile River.

Annual benefit is expected at 0.46 million LE using 10 piaster per ton in order to derive the moderate benefit.

6.5.2. Electric Facilities

There is normally a substitute for publicly supplied electricity in the form of diesel engines. The net advantage of electricity over the substitutes is counted as benefits.

Total electric power requirement amounts to about 65.8 million KWH as follows.

Irrigation Pumping Stations	2,320,500 KWH
Drainage Pumping Stations	6,942,000 "
Rural Village Facilities	56,600,000 "
Total	65,862,500 "

The electric charge is lower than the fuel cost of operating diesel engines. The difference is assumed as annual benefit. The conversion factor of electricity is 3.321 based on the World Bank Papers No.521. In order to estimate a moderate benefit, the conversion factor of fuel is 1.01 of crude oil. Annual economic benefit is estimated at 0.8 milion LE as compared with financial benefit of 4.6 million L.E.

6.6. Economic Evaluation of Comprehensive Project

The comprehensive project comprising of agricultural land reclamation, houses and social infrastructure and agricultural processing is economically justified as follows.

a. Agricultural land reclamation project only 13%

Cost flow includes the cost of El Salam Canal Phase I to be allocated to the Project and operation & maintenance cost of canal from the Nile to the Project Area.

b. Project comprising of agricultural land reclamation, houses and social infrastructure.

(1) Case with benefit of water supply and electricity 7.3%

(2) Case without benefit of water supply and electricity 7.2%

c. Project comprising of agricultural land reclamation, houses & social infrastructure and agricultural processing.

- Cost of Raw Material Processing -

	Beet 20 LE/t Milk 0.2 LE/kg - (%)	Beet 20 LE/t Milk 0.2 LE/kg Tomato 80 LE/t (%)	Beet 30 LE/t Milk 0.3 LE/kg - (%)	Beet 30 LE/t Milk 0.3 LE/kg Tomato 80 LE/t (%)
(1) Case with benefit of water supply and electricity	10.7	10.9	9.1	9.4
(2) Case without benefit of water supply and electricity	10.5	10.7	8.9	9.2

6.7. Financial Analysis

6.7.1. Farm Budget Analysis

Farm budget study is carried out for three types of farmers, i.e., 5.0 feddan, 15.0 feddan, and 20.0 feddan holders as shown in Table VI-10. Each item is calculated under the hypothesis that output and input excluding labor cost are valued in proportion to farm size. Labor balance, however, is different between small and large holders. Labor balance of 15.0 feddan and 20.0 feddan holders is in deficit by 207 days and 433 days per year, respectively, while it is in surplus for 5.0 feddan holder. Annual amortization was

estimated as follows. Two cases of grace period, i.e., three (3) years and five (5) years are calculated assuming no interest during the both periods.

	5 Feddan	15 and 30 Feddan
- Cost of Reclaimed Land	LE 5,000	LE 5,000
- Cost of Settler's House	2,500	8,000
- Repayment Period	25 years	25 years
- Grace Period	3 & 5 years	3 & 5 years
- Interest	None	1%

According to the cropping pattern, fodder cropped in Stage I is berseem while it is berseem and sorghum in Stage II. It is assumed that Baladi is raised in Stage I while Friesian is raised in Stage II. The purchasing cost of animal is estimated using interest of six (6) percent deducting the subsidy of seven (7) percent from 13 percent which is the loan condition of the Agricultural Development Project. The grace period is not applied.

Water charge is estimated using annual operation and maintenance cost of LE 37 per feddan. Berseem and sorghum are the self-sufficient fodder and included in the production cost. The present food cost per farm household is roughly estimated at LE 60 per month or LE 720 per year. The forecasted living cost of farm household settled in 1990 is estimated at LE 2,040 using Engel co-efficient of 60 percent and annual average growth rate of 5.7 percent (annual GDP growth rate per capita based on the Five Year Plan for Economic and Social Development).

It is concluded that 5.0 feddan farmer will gain about LE 1,200 to LE 1,300 of net farm income in the full development stage while 15.0 feddan and 20.0 feddan farmers will earn enough profit for re-investment or saving, i.e., LE 6,500 to LE 6,900 and LE 8,700 to LE 9,200, respectively (Table VI-11).

Table VI-11. Farm Budget at the Full Development Stage

		Unit	Small Holder	Large Holder	
1. Size of Farm		Feddan	5.0	15.0	20.0
2. Net Cultivated Land		- do -	5.0	15.0	20.0
3. Cropped Area					
Summer :	Rice	- do -	1.66	4.98	6.64
	Soybean	- do -	1.62	4.86	6.48
	Sorghum	- do -	0.95	2.85	3.80
	Tomato	- do -	0.70	2.10	2.80
Winter :	Berseem	- do -	1.66	4.98	6.64
	Sugarbeet	- do -	1.63	4.89	6.52
	Onion	- do -	1.15	3.45	4.60
	Cauliflower	- do -	0.25	0.75	1.00
	Cabbage	- do -	0.25	0.75	1.00
	Total		9.87	29.61	39.48
4. No. of Livestock					
4-1. Milking Cow					
	Friesian	Head	1.0	3.0	4.0
	Balad	- do -	2.3	6.9	9.2
4-2. Beef Cattle					
	Friesian	- do -	0.4	1.2	1.6
	Baladi	- do -	0.9	2.7	3.6
4-3. Sheeps		- do -	0.8	2.4	3.2
5. Gross Crop Income					
	Rice	LE	524	1,572	2,096
	Soybean	- do -	445	1,335	1,780
	Sugarbeet	- do -	1,224	3,672	4,896
	Tomato	- do -	888	2,664	3,552
	Onion	- do -	918	2,754	3,672
	Cauliflower	- do -	144	432	576
	Cabbage	- do -	294	882	1,176
	Total		4,437	13,311	17,748
6. Crop Production Cost		LE	1,076	4,263	6,469
7. Crop Farm Income		- do -	3,361	9,048	11,279
8. Livestock Farm Income					
	Milk Cow	- do -	1,053	3,159	4,212
	Beef Cattle	- do -	415	1,245	1,660
	Sheeps	- do -	20	60	80
	Total		1,488	4,464	5,952
9. Gross Farm Income		- do -	4,849	13,512	17,231
10. Annual Amortization		- do -	1,250	3,990	5,191
			(1,375)	(4,368)	(5,684)

11. Irrigation Water Charge	- do -	185	555	740
12. Disposal Income	- do -	3,414	8,967	11,300
		(3,289)	(8,589)	(10,807)
13. Cost of Living	- do -	2,040	2,040	2,040
14. Balance		1,374	6,927	9,260
		(1,249)	(6,549)	(8,767)

Note: Figures is a parenthesis show value in case of five years of grace period, and figures without a parenthesis show case of three-years.

Farm management of settlers shall start in 1990. Annual financial analysis of the farm budget is an important matter. Annual balance of farm budget is different by the land class. The following analysis was carried out for two farmers with five (5) feddans. These farmers represent the settlers who will manage their farming on the fields of the second or third class and the fourth class of the land classification.

The following characteristics are observed in Table VI-12.

a. An income balance obtained for the second or third class land shall be stable in the early period.

b. An income balance during the several years after settlement is compared through the case study on grace period of loan of land and house. Both cases of three years and five years were studied. As the results, it is considered that loan condition with the five years of grace period without interest is suitable to stabilize an income balance of the fourth land class farmer.

c. Case for grace period of three years: Loan for land and houses shall be repaid off from the first year. The farmer in the fourth land class can have the positive balance in the ninth year, though difficult. On the other hand, the farmer in the second or third land class can earn the balance in the third and

the seventh year, respectively. The second or third land class farmer shall accumulate the debt of L.E. 1,822 until the year 1995, but this debt shall be greatly reduced through sale of cattle worth L.E. 1,600. (Since the acreage of berseem cropped in the Stage I is reduced in the Stage II, a part of Baladi heads have to be sold). The cumulative debt of the fourth land class farmer shall be L.E. 2,983 until the year 1996. However, this debt shall remain until the seventh year in spite of sale of cattle.

d. Case for grace period of five years: The second or third class farmer can earn the cumulative positive balance of L.E. 278 until the year 1996. The cumulative debt of the fourth land class farmer shall be L.E. 1,078, but this debt shall be resolved through L.E. 1,600 worth of cattle sold.

e. Under the condition of grace period of three years, the fourth land class farmers have to prepare the sufficient cash to resolve a heavier debt, otherwise they must cut down on their annual cost of living.

f. Cash of about L.E. 1,200 shall be necessary for the settler in the stage of settlement to offset the negative farm income and the cover half of production cost estimated in the first year.

g. If the animal husbandry is successful in the first stage of cropping pattern, the income balance after the second stage shall be in surplus.

h. Farm management in the first year starts with the production of rice. Cattle shall be raised from around January when berseem for winter season is fed to cattle. Hence the income from animal husbandry shall be limited. The surplus berseem is sold as raw fodder.

Income balance of farmers with 15 feddans and 20 feddans was studied using the same method. Detail is shown in the Appendix. Income balance of large farmer is very stable in comparison with that of farmer with five feddans. In case of three years of grace period the fourth land class farmer shall be in much deficit in 1993, but this deficit is resolved due to the surplus income in 1991 and 1992 and sale of cattle 1993.

Hence, application of grace period of five years shall be unnecessary for a large farmer while no interest during grace period is desirable for stabilization of farm economy in the early period.

Table VI-12. Financial Analysis of Farm Budget of 5.0 Feddans

(Unit: LE)

	M1 Block, Land Class 2, 3					M1 Block, Land Class 4				
Year	Agri. Gross Income	Agri. Income	Amort. & Water Charge	Living Cost	Net Income Balance	Agri. Gross Income	Agri. Income	Amort. & Water Charge	Living Cost	Net Income Balance
1990	1,562	836	405	1,200	-769	1,562	836	405	1,200	-769
1991	3,864	1,650	425	1,260	-35	3,864	1,650	425	1,260	-35
1992	4,218	2,183	530	1,330	323	3,864	1,650	425	1,330	-105
1993	4,874	2,501	530	1,400	571	4,218	2,169	530	1,400	239
1994	5,405	2,746	530	1,480	736	4,999	2,562	530	1,480	552
1995	5,650	2,953	1,770	1,560	-378	5,405	2,777	1,770	1,560	-553
1996	6,216	3,250	1,770	1,650	-170	6,034	3,148	1,770	1,650	-272
1997	7,749	4,376	1,560	1,800	1,016	6,664	3,435	1,770	1,800	-135
1998	8,108	4,720	1,560	1,900	1,260	6,909	3,651	1,560	1,900	191
1999	8,206	4,804	1,560	2,040	1,204	7,142	3,881	1,560	2,040	281
2000	8,272	4,849	1,560	2,040	1,249	8,010	4,010	1,560	2,040	410
2001	8,272	4,849	1,560	2,040	1,249	8,108	4,717	1,560	2,040	1,117
2002	8,272	4,849	1,560	2,040	1,249	8,206	4,801	1,560	2,040	1,201
2003	8,272	4,849	1,560	2,040	1,249	8,272	4,849	1,560	2,040	1,249

Note: Grace Period of loan on land and house is 5 years.
Amort. means the amortization.

6.7.2. Repayment of Construction Cost

The foreign currency of construction cost is loaned by the international banking institutions and the local currency is covered under responsibility of the Government. The loan must be repaid by the public finance and the beneficiaries. The fund for repayment of construction cost is the incremental benefit from the Project from a standpoint of national economy. It is difficult to repay all debt by the public finance. Value of land to be sold to settler in this Project shall be a part of funds for repayment.

An amortization value for foreign currency depends upon loan condition of the international banking institutions. In the reply paper to the GARPAD's comments on the Draft Final Report, annual amortization value is estimated using some loan condition.

6.8. Social and Economic Impact

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

1. Employment opportunities will be created.

2. The new settler can earn a higher farm income. Agro-industry can not only employ many labor but also bring the production value added to the regional economy. Tax revenue of the Governorate shall be invested in the social infrastructure. As the result, the regional welfare shall be increased.

3. The consumption goods market in the vicinity of the Project Area shall be expanded through an increase in population of about 60,000 persons.

4. Income of the local people will increase during the construction period.

5. Production of crops as substitute for imports will save foreign currency.

6. The Project will serve as a model for the water resources development strategy in the Five Year Plan for Economic and Social Development.

Summary of Items Agreed and Clarified

Items agreed and clarified	Period of Meeting	Date of Minutes	Behalf of Egyptian Government	Behalf of Japanease Team
I. 1.Scope of Works.(Agreed) 2. Terms of Reference amended as a guideline.(Agreed) (1) Number of augering and open pit in field soil survey. (2) Number of mesuring site of hydraulic conductivity. (3) Laboratory and field leaching experiment. (4) The marketing survey and socio-economic survey.	Aug.21 to27 1983	Aug.27, 1983	Eng.Wahab Selim (Chairman of GARPAD) Eng.Morris Kamel (First Undersecretary, MOI)	Mr.K.Fujino (Leader of Supervisory Group,JICA)
II. Plan of Operation.(Agreed)	Oct.9 to 12, 1983	Oct.20, 1983	Dr.Samir Nagomoush (Technical Counselor, GARPAD)	Mr. S.Yamada (Leader of F/S Team, JICA) Mr.K.Ueda (Witness,Leader of Supervisory Group,JICA)
III. Items clarified at the meetings held on 25 to 27,Oct. 1.Joint Committee. 2.Alternative study on land tenure and disposal. 3.Target cropping intensity of 200%. 4.Water duty more than 30 cubic meters but less than 40 cubic meters per feddan per day and the annual total amount of water which shall not exceed 8,000 cubic meters per feddan. 5.Soil Survey (1) Laboratory analysis shall be completed by the end of Novenber. (2) Laboratory leaching tests equipment to be supplied by JICA would be sent to GARPAD at the soonnest time possible. The Govenment requested to carry out the field leaching experiment as soon as possible in accordance with the S/W. (3) Extra cost needed for deep boring of 10 meters will pay by GARPAD. 6.The salt content of the water in the El Salam Canal is 800 ppm after mixing. 7.The equation used for calculation of leaching requirement. 8.The alternative studies on the irrigation method of gravity and lifting by farmers.	Oct.25 t0 27, 1983	Oct.29, 1983	Dr.Samir Nagomoush (Technical Counselor, GARPAD)	Mr. S.Yamada (leader of F/S Team, JICA)

Items agreed and clarified	Period of Meeting	Date of Minutes	Behalf of Egyptian Government	Behalf of Japanese Team
9.The drainge plans based on the results of soil survey and analysis.				
10.Selection of the projected crops.				
11.Avalability of text book for the Second Five Years Plan in English version.				
12.I.R.R. of land reclamation shoud be not less than 10 %.				
13.Calculation of I.R.R. in both cases of including and excluding social infrastructure cost.				
14.An alternative study required for planning suga beet factory.				
IV.				
The meeting was held at the GARPAD on November 30,1983,in order to discuss the project proposal presented in the field reports. GARPAD has commented as follows.	Nov.30, 1983	Dec.2, 1983	Dr.Samir Nagomoush (Technical Counselor, GARPAD)	Mr.S.Yamada (Leader of F/S Team, JICA)
1.Land Disposal				
(1) Study on land disposal to agricultural cooperatives farms,JV farms and state farms.				
(2) Settler may not be required for the construction works,because the works shall be mostly implemented with consruction equipment.				
2.Irrigation and Drainge				
(1) The GARPAD considers 55% of irrigation efficiency in the beginning of reclamation,when canals are not lined.				
(2) As for rotational irrigation,water supply of 4 days on and 4 days off is recommendable.				
(3) The depth of drains should be more than 1.3m.				
(4) In the early stage of reclamation, drain spacing should be less than 25m.				
3.Rural Development .				
(1) Study on a regional planning in wide area including not only three areas but also adjacent regions.				
(2) Housing plans and building materials.				
(3) Connecting roads with adjacent area and main roads along the El Salaam Canal.				
(4) The Nile river or Ismailia Canal as source of portable water. Community fountain for each groups is recommendable.				
(5) Requirement to new advanced sewage system.				
(6) The availability of the existence of trasmission lines to the Projects.				
4.Construction Schedule				
Start of construction of the pumping station and main drains in early stage (1984)				
5.Crop Rotation				
Approach to planning of crop rotation is acceptable.				

Items of Agreed and Clarified	Period of Meeting	Dates of Minutes	Behalf of Egyptian Government	Behalf of Japanese Team
6. Land Reclamation Leaching requirments seem not enough. 7. Crop Cultivation Study on validity of introducing summer vegetables.Crop yields are acceptable. 8. Marketing Study on the international marketability. 9. Agro-industry Proposal for milk plants are agreeable.Study in selection of type taking into consideration Egyptian's preference and marketability. 10.Mechanization Sub-soiler is essentilly required.Moudboard is not applicable and chiesel plow is recommendable. 11.Economics Study on sensitivity analyses. 12.Soil Field investigation was satisfactory.Agree the approach of soil classification shoud be measured in Japan. 13.Others (1)To take careful attention whether the equation for leaching water requirement is applicable for the project area or not. (2)All of proposals and suggestion shoud be backed up with figures. (3)The official comments will be send to the consultants through JICA within two weeks time.				
V. The Team held meeting with GARPAD of MOLR,MOI and other authorities concerned in order to discuss the Draft Final Report which was forwarded to the Government by JICA prior to the arrival of the Team. The Government of Egypt finally commented to the Draft Final Report. After several discussions,both parties agreed as described herein. 1.Irrigation 1)Water Requirement a.The leaching requirement will be checked again. b.The water requirement after replacing open drains with pipe drains will be studied. 2)Earth Volumes for Embankement In case of the gravity irrigation system,the shortage of earth volumes	Jan.27 to Feb.2, 1984	Feb.2, 1984	Dr.Samir Nagomoush (Technical Counselor, GARPAD) Eng.Wahab Selim (Witness,Chairman of GARPAD)	Mr.S.Yamada (Leader of F/S Team, JICA) Mr.K.Fujino (Witness,Leader of Supervisory Group,JICA)

Items of Agreed and Clarified	Period of Meeting	Dates of Minutes	Behalf of Egyptian Govenment	Behalf of Japanese Team

for embankment of irrigation canals will be planned to compensate within the project area.

3) Comparison of irrigation methods by gravity with small field lift units taking into consideration the lining cost.

4) Countermeasures against weeds and canal gradients
Various methods such as use of chemicals,specially by fish speceis or machinery,etc.,will be studied,and the initial cost and running cost in case of incresing the canal gradient for a higher flow velocity will be studied.

5) To make the colored map showing irrigation rotation .

6) Rotational Water Management
Structures which are easy to handle and have sufficient accuracy will be studied.

7) Back data for discharge computation of tertiary canals will be shown in detail.

8) Execution Plan of reclaiming submerged lands.

9) Reasons for lining of canal.
A comparative study on irrigation facilities,irrigable area,and cost in cases with and without lining will be carried out.

10) Dimension of Basin
The best dimension of the basin will be shown for a few cases with different land slopes.

11) Berm Width
The term "berm width" in the text will be revised to "top width of embankment".

12) Study on water measurement structure at turnouts

13) Design of escape-tails

14) Implementation Schedule
a. The alternative with a construction period as short as possible will be studied to cope with the schedule of Five-Year Plan.
b. Execution of roads,potable water,electricity,and housing shoud be started without delay to cpoe with the general plan of land reclamation.

15) Source of Raw Construction Materials
Alternatives on supply system of cement blocks will be studied.

16) Alternative study on squater's lands will be carried out taking into consideration the present cultivatied land tenure conditions.

Items of Agreed and Clarified	Period of Meeting	Dates of Minutes	Behalf of Egyptian Government	Behalf of Japanese Team

2. Rural Development

1) Mosques will be built by the Government,and the cost will be included in the Project.

2) Location of Villages

A study on water feeding facilities to domestic animals at emergent time.An alternative study will be made to locate villages as much as possible next to the main canals.

3) The construction cost of roads and electricity will be checked.

4) Alternative study on sewage disposal.

3. Soils

1) Preparation of clear maps for the Final Report.

2) Soil Alkalinity and Gypsum Requirement.

3) Nomenclature of Family Category

4) Preparation of Gemorphological Map.

5) Preparation of Salinity Classification Maps.

6) Only some paragraphs concerning the Classification of Swamp and Inundated Lands.

4. Agriculture

1) Crop Rotation in Second Stage

GARPAD accepted the Teams explanation that some vegetables will not be included in the crop rotation for summer cropping in the second stage.

2) Present of Fodder Cropping Area

Open drains will be replaced with pipe drains,resulting in an increase in the total cropping area.A further study will be carried out to balance the fodder cropping areas in both seasons in the way to utilize the increased area for this purpose.

3) Introduction of Broccoli

The possibility to substitution cauliflower for broccoli will be studied.

4) The cost for grading and packing plants for vegetables will be included in the Final Report.

5) Small Machines for Settler' Field

The small scale mechanization of settler' field will be mentioned in more detail.A training center will be studied to be set up in the Project Area.

6) Picking Methods of Some Crops like Tomatos.

7) A further study on buffaloes breeding.

8) The possibility to increase the number of imported friezian cows.

9) Economic approach to sheep breeding

10) Feedable number of freizien cows

11) A study on europian market for fresh vegetables

Items of Agreed and Clarified	Period of Meeting	Dates of Minutes	Behalf of Egyptian Govenment	Behalf of Japanese Team

5. Economic Justfication

1) Study on the analysis period in estimating EIRR.

2) EIRR

a. EIRR of the integrated project will be estimatied by using some hypothetic methods in the Final Report.

b. The isolatied EIRR for the land reclamation project will be re-estimated since the total cultivated area will be revised.

c. EIRR in case of combining the land reclamation project and the housing & infrastructure project in consideration of the cost of El Salam Canal Phase I will be re-estimatied.

d. The EIRR fpr sugar beet factory and milk processing factory will be re-estimated based on the revised cultivated area.

f. More detailed analysis will be made for various combination of the project components.

g. Pay-back study of investment will be made.