3-6 Land Reclamation and Agricultural Infrastructure

3-6-1 Land Reclamation

(1) Land Reclamation

An average land slope in whole Study area varies from 1/300 to 1/500 roughly. As for the steep area, the slope is nearly 1/200, while it is almost 1/800 in the gentle area. Because irrigation method will be sprinkler or drip system, it is not necessary to implement land leveling works to form flat fields like a paddy field. But, if there are many small basins or high undulating lands, it shall cause inferior drainage, resulting in salt accumulation and other negative impact on vegetation. Therefore, in the process that land reclamation such as constructing road and canal network, a minimum earth work will be necessary at least if it meets areas with the above problem.

And also sand dunes exist in the Study area with different undulant levels. Grading and leveling of the vast sand dunes are not only technically difficult operation but also cause high costs imposed on land development, so that some serious sand dune areas will be excluded from this development.

Even in the flat land, some areas, which consist of hard surface soil and sand mixed with pebbles, have problems regarding land cultivating. Large-scale earth works will be required for gravel removal and deep plowing to prepare farm fields. The same is true to the construction of subsurface drainage facilities. But, the above earth work will not be done with this plan because it will be not a remarkable problem when drip irrigation and fruit tree cultivation are done in these land.

(2) Farm Land Conservation

Soil texture in this Study area is sandy (fine sand or sandy silt) and is liable to be damaged by the erosion; by the rainfall and wind intrinsically. To reduce the influence of rainfall and wind on these soil is very important in conserving agricultural lands. Wind erosion not only removes soil but also damages crops, fences, buildings, and roads. And also wind makes evapotranspiration from soil surface increase and soil moisture decrease, which is unfavorable when to use limited water resources effectively. So, the following plans are proposed.

Shelterbelts (Green Ring)

- Trees of 50m width will be arranged in the circumference of this Study area as wind erosion and desertification countermeasure
- Preventing of vermin that tries to break into the Study area as a secondary effect

Windbreaks

- Trees (casurina or eucalyptus) will be arranged in single row in the circumference of each farm lot (10 feddans block) as wind erosion countermeasure
- Trees of 5m width will be installed in the boundary of excluded areas (sand dunes) to protect agricultural lands from threat of desertification

These trees are usually used as windbreaks and sand-catch forest in the agricultural land of the desert zone. The height of full-grown trees is about 10 - 15m, and generally from 15 to 25 times of the height can be anticipated as for the effective range. If these trees grow fully, these original duties will be shown perfectly. But, the effective range can be changed by the wind direction and velocity. As for the windbreak, the appearance period (during the growing period) until the effect occurs will be long time. The wind erosion countermeasure must be attempted until windbreaks grow fully by the installation of the wind break fences and the assignment of planting program.

3-6-2 Agricultural Infrastructure

(1) Irrigation Canal

The soil texture in this Study area is dominantly sandy, and the influence of the wind should be taken into account. Obviously it is forecasted that sand will accumulate in canal bed, resulting in influence on the water supply. Irrigation canals should be constructed as embanking structure, in order to prevent sand accumulation breaking into the canal, and to keep the water level of irrigation water in higher elevation. But when a canal section is large with long distance, banking volume will become huge.

Therefore, the structure of half-cutting and half-banking should be planned as shown in Figure 3-8. With banking of this level, earth works will be balanced. For the basic structure of the irrigation canal, it will be made of concrete lining of the trapezoid section which is the most general structure in the desert zone, and dimensions will be made to change by the design discharge. Riprap lining should be done onto the embankment to prevent slope surface collapse.

The shape of service unit (100 feddans) is rectangular, and branch line or secondary irrigation canal will pass along one side of this rectangle. A night storage will be constructed in each of service units. Each elevation should be adjusted so that irrigation water may be supplied into the night storage by the natural inflow through an intake which is to be set up in the irrigation canal.

(2) Drainage Canal

The basic structure of the drainage canal will be made by digging form, and will be section of the compound trapezoid as shown in the Figure 3-8. For the top section, riprap lining will be installed with the purpose of preventing slope surface collapse. Roads for operation and maintenance should preferably be set up in both sides or at least one side of the canal. Catch canals will be set up in one side of each service unit and connect with the lateral drainage canal. The structure of the catch canal is simple trapezoid section with unlined.

(3) Farm Road

Main road network will be almost completed by the roads for the operation and maintenance along with the canal network which will be constructed in the Study area. Trunk roads that link between main points and farm roads inside service unit will be necessary besides. Standard specifications are as the following:

Trunk roads

- Asphaltic paving, embankment finishing
- Width 7m (excluding road shoulder: 2+4=6m)
- The route which connects main points (main villages, existent trunk roads)

Branch roads (unites the operation and maintenance for canals)

- Simple asphaltic paving
- Width 4m (excluding road shoulder: 2+2=4m)
- Pass through the center in the service unit (100 Fed. farm block) and the both sides or one side of the higher rank canals

Farm roads

- Gravel paving or unpaving
- Width 4m
- Surroundings farm lot (10 Fed. block) and the both sides of the catch canal

3-7 Settlement and Social Infrastructure

3-7-1 Land Allocation and Population Estimates

(1) Land Allocation

Settlers are categorized into three (3) groups: small farmers/graduate farmers, small scale investors and large scale investors. The reclaimed lands will be allocated to the selected settlers according to the guidelines prepared by MPWWR as given as follows:

Land Allocation by Category

Category	Percentage of Land	Unit Land Area
Small/Graduate Farmer	25	10 feddans
Small Scale Investor	15	10 to 500 feddans
Large Scale Investor	60	over 500 feddans

Of the land designated for small/graduate farmers, 20 percent will be allocated to Bedouins. 10 feddans of land will be allocated to small/graduate farmers. While the upper limit of land holding size is set to 500 feddans per farm for small scale investors, large scale investors are allowed to have land of more than 500 feddans at their will. However, in this Study, land holding is assumed to be 100 feddans for a farm of a small scale investor and on average 720 feddans for a farm of a large scale investor, on which population estimates will be based.

(2) Population

The total population of the Study area with the net agricultural land area of 111,000 feddans has been estimated at 116,100 at full development, assuming a family consists of five (5) members.

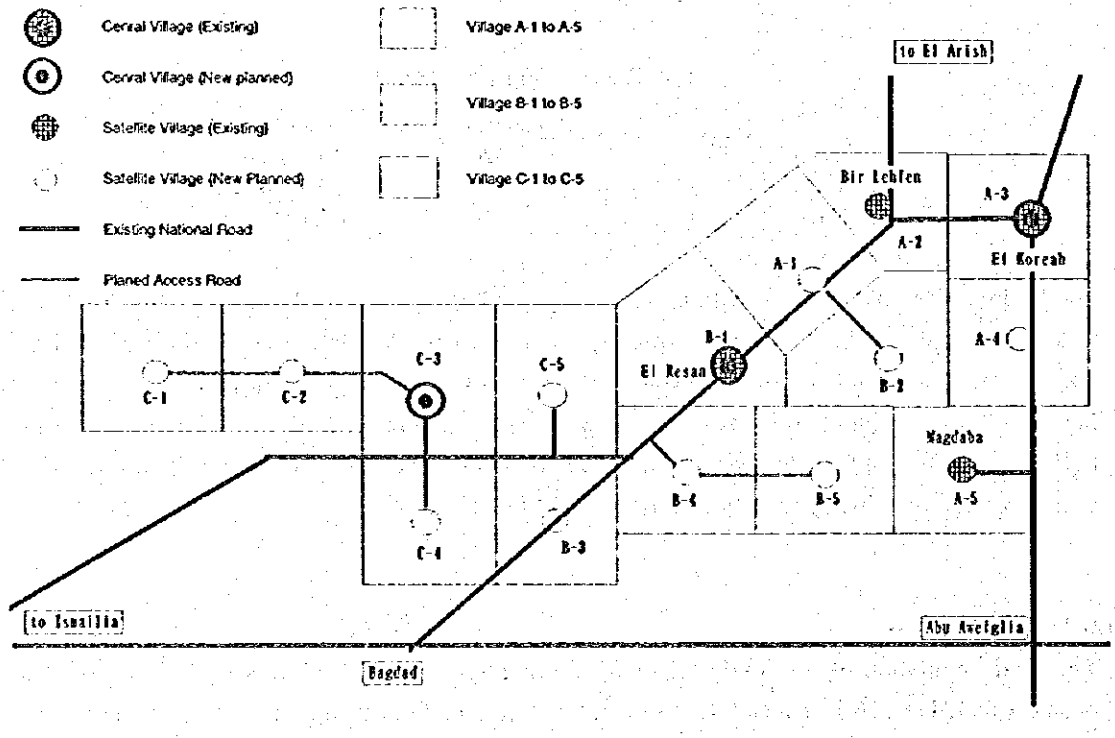
Population Estimate

Items	Farm Land (feddan)	No. of Families	Population	Remarks
Small/Graduate Farmers	27,750	2,780	13,900	
Small Scale Investors	16,650	170	850	
Large Scale Investors	66,600	90	450	
Sub-total	111,000	3,040	15,200	
Agricultural Labors (crop production)				
- Small/Graduate Farmer		220	1,100	1 labor/100 fed.
- Small Scale Investor		2,480	12,400	20 labors/100 fed.
- Large Scale Investor		10,080	50,400	20 labors/100 fed.
Irrigation Labors		1,100	5,500	1 labor/100 fed.
Livestock Staff				
- Small Scale Investor		430	2,150	5 labors/farm
- Large Scale Investor		900	4,500	40 labors/farm
Industrial Labors		1,100	5,500	
Administrative Employee		3,870	19,350	20% of above
Sub-total		20,180	100,900	
Total		23,220	116,100	1.05 person/fed.

(3) Village Arrangement

It is proposed to establish three (3) central villages, each of which has four (4) satellite villages, totaling to 15 villages, taking into consideration the total estimated population and the geographic conditions of the Study area. Of the five (5) existing villages, four (4) villages will become the centers of new villages: the two (2) villages El Koreah and El Resan as central villages, and the two (2) villages Lehfen and Megdaba as satellite villages. The proposed villages will be located at the center of the surrounding agricultural land to provide easy access to the existing national roads. The image of village arrangement is given as follows:

Image of Village Disribution



In order to support the small/graduate farmers, they will be allocated the fertile farm lands consisting of silty clay and silty sand, as well as be assigned the land which is located closely to villages.

(4) Village Plan

The size of a village should consist of sufficient land to accommodate 20 to 30 capita per feddan. The land use of a village is arranged as follows:

Village Land Arrangement

Land Use	Percentage
Residential area	40.0
Internal road network	12.5
Entertainment and green areas	12.5
Services, administration and agro-industries	25.0
Future expansion	10.0
Total	100.0

Residential areas and public facilities will be arranged according to the following planning criteria:

- Mosques, governmental offices, community centers, health units, markets and shops are arranged at the center of villages.
- Residential areas are arranged around the public zone.
- Sewage treatment plants and cemeteries are arranged outside the residential areas.
- Parks, open spaces and sports grounds are arranged at appropriate locations.
- Wind breakers are provided along the village boundaries to prevent strong wind from carrying sand dust into the villages.

3-7-2 Social Infrastructure

(1) Road Network

The following three (3) types of village roads will be provided with different purposes and structures:

Access Roads:

- being the main access roads to connect a village with the national roads.
- having road structures at national road level: two (2) asphalt paved lanes per direction with sidewalks.

Main Streets:

- being the main internal throughway to the central public zone of a village.
- being paved with asphalt; with a central segregation belt with greenery; and sidewalks to be bordered with greenery.

Village Streets:

- being the internal roads to connect residential areas with official zones.
- being paved with asphalt; with sidewalks; without central segregation belt.

(2) Domestic Water Supply

Water Demand and Water Source:

Water demand has been determined at a rate of 200 liter per capita which includes water for drinking, domestic, public, animal and small scale industrial use. The national water supply project for North Sinai development that conveys the Nile water to El Arish through Port Said canals is underway; this will also supply the Study area.

Service Level and Supply System:

Pipeline systems are provided to distribute the water to all houses and facilities. Hydrants are provided along village roads. Main systems to connect the water source with the villages consist of steel pipelines, while the distribution systems in villages are pipelines of unplasticized polyvinyl chloride pipes. The capacities of the pipelines have been determined as 125 percent of the average demand. Villages are provided with elevated tanks with a capacity of 50 percent of the total daily water demand.

(3) Electricity

The national electric power supply project for the development of North Sinai has started. Electricity will be supplied to the villages by extending the existing service networks of El Arish. Electric power demand is based on an average rate of 0.4 kW per capita including domestic, public, small scale industrial and farming use.

(4) Telephone Services

The existing telephone service system of El Arish will be expanded to cover the Study area. The numbers of service lines are:

Investors:	1 line per 5 houses
Satellite Village:	25 lines
Central Village:	40 lines

(5) Sewage and Refuse

Each village is provided with one sewage treatment plant to be located outside the village. Treated water is re-used as irrigation water for windbreaks, street trees and gardens. Residual sludge is utilized as fertilizer and compost. One (1) refuse treatment plant is provided in a central village with a capacity sufficient to treat refuse from all the villages in the Study area. Inflammable refuse is treated with small scale incinerators and non inflammable refuse is disposed at a landfill.

(6) Other Public Service Facilities

Various kinds of public service facilities for daily life are provided in order to maintain and develop new communities. The proposed public service facilities are given below:

Public Service Facilities

Facilities	Central Village	Satellite Village	Facilities	Central Village	Satellite Village
Kindergarten	O	O	Community Center	O	-
Primary School	O	O	Cinema/Theater	O	-
Preparatory School	O	-	Bank Branch Office	O	-
Secondary School	O	-	Bank Sub Office	-	O
Hospital	O	-	Bus Station	O	O
Health Center	-	O	Fuel Service Station	O	-
Government Office	O	-	Mechanical Service	O	-
Police Office	O	-	Market/Shop/Store	O	O
Police Box	O	O	Open Space/Sport Grd.	O	O
Fire Station	O	-	Mosque	O	O
Telephone Office	O	O	Cemetery	O	-
Post Office	O	O			

3-8 Agricultural Development Supporting Services

3-8-1 Extension Services

(1) Present Status

The agricultural extension services in North Sinai governorate are conducted by the Bir El Abd agricultural extension office under the agricultural board on pest control, livestock production, food security, rat control, horticulture, and farm mechanization. About 400 extension workers are engaged in these services; they distribute brochures to farmers and provide technology transfer to farmers through agricultural cooperatives. Due to the lack of equipment necessary for extension activities and insufficient farmer participation, the extension services are not functioning satisfactory.

(2) Improvement of Extension Services

With the implementation of this land reclamation project, 2,780 families of small farmers and graduate farmers, 170 farms of small scale investors and 90 farms of large scale investors will settle in the Study area. The farms will cover an area of 111,000 feddans, and will include the development of agricultural production in the fields of vegetable cropping, fruit growing, and livestock keeping for the production of milk and meat. To achieve sustainable agricultural development, it is clear that the extension and research activities need to be strengthened for the new land, placing more emphasis on small farmers and graduate farmers. The investors will be farming at their own risk as a rule. The extension services shall cover the entire production cycle, including:

- Soil improvement
- Irrigation using water containing the salt, and drainage
- Cultivation practice
- Quality control of vegetables and fruits through collection, storage and packing

- Health care and breeding of livestock
- Farm mechanization
- Correct application of fertilizer and pesticide
- Institutional credit

(3) Establishment of the North Sinai Agricultural Development Center

For effective implementation of extension services, it has been proposed to establish the North Sinai Agricultural Development Center (NSADC) under the control of North Sinai Development Organization. NSADC will serve agricultural development for the on-going five (5) land reclamation project areas of 400,000 feddans. The objective of the center is to transfer improved technology gained from research to farmers through the extension services.

NSADC will serve as both an administrative and training center and implement various applied examinations with respect to farming on newly reclaimed land, based on the results of which training programs to extension workers and farmers are prepared. NSADC will be constructed in Bir El Abd, the middle of the 400,000 feddan area. Each land reclamation project will have one (1) branch office of NSADC in its project area.

NSADC will provide for orientation courses to settlers and training courses to extension workers, and special courses for leaders which will be selected among small farmers and graduate farmers. Extension workers will attend regular training programs at the center on specific subjects; they then transfer the information to the farmers on their regular scheduled visits. To ensure that NSADC has sufficient manpower to fulfill its extension responsibilities, staff will be recruited at various levels and grades. Extension services will be operated at a ration of about one (1) extension worker to 100 farm families; 30 extension workers will be assigned to the Study area.

One (1) branch office will be established in the Study area as a base for extension activities for small farmers and graduate farmers. The branch office will select nine (9) enterprising and knowledgeable farmers as farm leaders. The branch office will provide demonstration farms in the fields of farm leaders. The demonstration farms are managed by the farm leaders themselves with close backup from extension services, and they will also provide the feedback to a large number of the other farmers. Extension advice shall firstly concentrate on soil improvement, use of irrigation water, selection of cropping patterns and farm mechanization.

3-8-2 Farmer Organizations

(1) Agricultural Cooperatives

At present, the agricultural cooperative services largely come under the control of the Ministry of Agriculture and Land Reclamation. In the North Sinai governorate, the central society of agricultural cooperatives is based in El Arish, and it consists of 52 multi-purpose cooperatives of local society and two (2) specialized societies.

Agricultural cooperatives play an important role in providing services to farmers. It has been proposed to organize a multi-purpose agricultural cooperative on the basis of private initiatives. The activities of the cooperatives are:

- Collection, shipment and sales of farm products,
- Market research,
- Procurement and sales of farm inputs and personal necessities, and
- Credit operation for liaison between farmers and the institutional credit services.

(2) Farmer Associations

In the environment of liberalizing input and output prices and marketing and eliminating crop area control, farmer associations will play a significant role for promoting the agricultural development project; farmers need to plan cropping patterns and select varieties of crops; they have to operate and maintain mechanized on-farm irrigation facilities at their cost; irrigation water is to be used jointly in conformity with the water delivery schedule of the main canal systems.

With respect to the above, it has been proposed to organize farmer associations in the specific fields of vegetable cropping, fruit tree growing, livestock keeping and water use.

The associations will function as groups which will make it easier to provide them with institutional supporting services. The associations of vegetable cropping, fruit tree growing and livestock keeping will equip joint-use facilities for collection and shipment of their products to wholesale markets through the proposed agricultural cooperatives. A program for a water user association is presented in Chapter 3. Figure 3-9 shows the proposed organization of the agricultural development supporting services.

3-9 Agricultural Marketing

In formulating the development project for the agricultural marketing system, it is prerequisite to identify prevailing constraints and potentials related to the development of the marketing system, to pay due attention to government policies for development of related sectors and to analyze carefully actual marketing conditions and future prospects at both domestic and international markets.

3-9-1 Constraints and Potentials on Development of the Plan

Constraints on development of the marketing system in the area may be summarized in the following manner:

1. Lack of adequate marketing infrastructure

   The wholesale market in El Arish - the only one in the zone of influence of the Study area - is not adequately organized; the market's available space for trading is limited and no information system is provided.

2. Deficient information on marketing

In the absence of adequate and timely marketing information on price and traded quantity, loss of optimum marketing opportunity among farmers are widely observed phenomenon and accordingly glut and shortage in supply of products results in a sharp fluctuation of prices.

3. Under-development of farmers' organization

A market-oriented farmers' cooperative has not been set up in the area up to now and trading with middlemen is to the disadvantage of farmers.

4. Crossing the Suez Canal

At this moment, agricultural products that are transported to domestic markets outside the Sinai Peninsula have to cross the Suez Canal by means of ferry boat and the delays caused by the ferry boats results in a considerable loss for both traders and farmers.

On the other hand, the following may be identified as major factors of potentials for the development of a marketing system for the project.

1. Implementation of the National Project For Development of Sinai

With the implementation of the National Project for Development of Sinai local demand of foodstuffs within the region will expand drastically and the development of transport infrastructures envisaged in the National Project will facilitate improvement of the transportation system of agro-products within and outside the Sinai Region.

2. Geographical Advantage for Export

The two principal destinations of Egyptian agricultural exports are European and Gulf countries. The project areas strategical geographical location will benefit the export of products to both these markets.

3. Development of Agro-industry

The National Project for the Development of the Sinai proposes to promote some agro-industrial development projects and demand of raw materials for these industries will therefore grow in the future.

4. Promotion of Tourism

El Arish and surrounding Mediterranean beaches are a highly potential zone for development of tourism and demand of foodstuffs to hotels and other tourism-related installations will increase.

3-9-2 Recent Transformation of Government Policy in Agricultural Marketing

Through the agricultural reform program started in 1986, the Government of Egypt has intended to make the transition from a highly intervened economy to a decentralized and market-oriented one, and in so far as price and trade policies of agricultural sector is concerned, the said reform program contemplated, among others,:

- Removal of government control on delivery quota and farm-gate price for such crops as rice, wheat, maize, broad beans, lentils, onion, sesame and groundnut.
- Elimination of wholesale and retail price control on agricultural commodities.
- Abolishment of government constraints on the private sector in marketing and import of farm inputs.
- Liberalization of the exchange rate for import/export of agricultural commodities and inputs.
- Encouragement of cooperatives and private companies to act as intermediaries between producers and consumers/exporters and promotion of small-scale processing enterprises in rural areas.

3-9-3 Outlook for Marketing of Agricultural Commodities

A total of 25 crops are proposed as crops to be cultivated on the total net area of 111,000 feddans of newly reclaimed land and an outlook for marketing of these crops is as depicted hereinafter.

As described in 3-9-1, with the implementation of the National Project for the Development of Sinai, the burgeoning population of the region shall without a doubt create increases in the demand of foodstuffs among the local inhabitants. Table 3-10 gives a prediction of the demand and supply of agricultural commodities with future population projection of 3.2 million (year 2017). This table suggests that a major portion of the agricultural output in the project may be marketed locally in that time, despite the new production of crops and livestock envisaged in other land reclamation areas within the 400,000 feddans North Sinai Agricultural Development Project.

Egypt has consistently been faced with deficiency of subsistence foodstuffs, and the local production of wheat, maize, broad beans, soybeans, sesame and livestock will serve to substitute imports which is in agreement with the government's strategic agricultural policies.

Apart from import substitution, promotion of exportation is another important agricultural policy which attempts to improve the country's foreign exchange situation. Highly potential exports include crops such as potato, onion, tomato, orange, grape, melon & water melon and peach.

Competitors exporting similar products are other Middle Eastern and Mediterranean countries like Turkey, Morocco, Israel, Jordan, Tunisia and Greece and the success of overcoming competition of these countries depends on the quality and price-competitiveness of the exports to be produced. Actually, Egyptian agribusiness lacks adequate storage and processing infrastructure, which results in a reduction of the quality and price of the exports. In this regard, the development of agro-industry for both marketing and processing shall be the lead to promote export of produce of the project area.

As far as domestic marketing conditions is concerned, the project area will have a much better chance of becoming one of Egypt's major foodstuff providers, now the Egyptian Government has decided to construct a bridge over the Suez Canal at Kantara, which will remove one major constraint in terms of marketing of products from the North Sinai Region. In addition, an airport and a seaport in El

Arish - the nearest urban center from the project area - are proposed to be developed for the use of shipment of cargo.

3-9-4 Marketing Opportunities of Project Products

The expected output of crops and livestock products with the implementation of the present project at it's fully-developed stage is shown in Table II-17. Referring to this table and taking into consideration the actual condition and future prospects of domestic and international markets, the proposal for marketing of agricultural commodities of the project is presented in the following manner.

Cereals: Wheat is an indispensable staple for Egyptian diet, and part of the production will be consumed by farmers and their family members as well as by on-farm workers. The remaining amount of the production will be traded on the local market; maize and barley are to be processed at the local mills to be established within the project area. By-products of these cereals are also used to feed animals.

Fodder Crops: The total amount of fodder crops will be consumed within the project area; sorghum will require processing, while berseem and fodder beet can be fed directly to animals.

Oil Crops: The harvests of sesame and soybeans projected within the area are relatively small and it will not be viable to process these products within the area from economic point of view. Hence, they will be processed to outside the area. By-products of soybeans are useful for use as animal feed within the area.

Broad beans: This legume provides an important foodstuff for the Egyptian diet, in particular for breakfast, thus it will be locally consumed by farmers and on-farm workers. Its remaining output will be traded at local markets.

Potato, onion, tomato, orange, grape, peach & melon: These horticultural crops are highly potential exports, mainly for EU and neighboring Saudi Arabia and Gulf countries, so these commodities are aimed for an international market in an attempt to contribute to the foreign exchange earnings of the country. Some portion will be delivered to domestic markets, mainly within the Sinai Peninsula. Two different varieties of tomato are envisaged in the project - one is for fresh consumption and the other is for processing: the latter shall be processed within the area.

Olive: The total production of this fruit will be processed within the area to extract oil.

Almond: This permanent crop will serve in its entirety as raw material for agro-industry outside the project area.

Other horticultural crops: They will be marketed in principle within the Sinai Peninsula to comply with anticipated burgeoning demand in the future as mentioned above. Some portion of their output is expected to be traded outside the region.

Medical plant (Cumin): Cumin acts as a carminative and stimulates digestive secretions and lactation and is proven to be effective in the treatment of dyspepsia, colic and flatulence. Principal destination for this plant is the domestic market, but it may be exported to North American and EU countries as well as to Middle Eastern countries.

Livestock: Egypt has been a net importer of red meat and powder milk, so introduction of cattle production within the project is expected to contribute to a cutback in the import of meat and dairy products. Cattle and milk will be processed at slaughter house and dairy plants to be established within the area and the majority of these products will be consumed with the Sinai Peninsula. Products derived from sheep husbandry will be used as subsistence foodstuff for farmers and local inhabitants within the project area.

Summary of marketing proposal for agricultural products enumerated above is given in Table 3-11.

3-9-5 Proposal for Agricultural Marketing System Development Plan

The consideration made in the previous sub-sections leads to propose the following three sub-projects within the framework of the marketing system development plan.

(1) Renovation of Existing Marketing Infrastructure

Presently there is one wholesale market situated at the outskirts of El Arish which is easily accessible from the proposed development area. It is however regrettable that this wholesale market is inadequate in terms of space availability and provision of necessary installation and equipment and, as a consequence, a very small proportion of the agricultural production under its area of influence is traded there. The implementation of the development project covering 111,000 feddans of net area will result in a significant increase of agricultural produces and, if the wholesale market in El Arish is not improved in the near future, there is no doubt that this wholesale market will not play the anticipated role of trading considerable amounts of produce generated in the project area. It is therefore suggested that the existing installation of the El Arish wholesale market is renovated and expanded to meet the increase of agricultural output of the project.

(2) Improvement of Market Information System

Most of the project's crops such as vegetable and fruits are actually traded without intervention of the public sector and prices are determined in line with the force of supply and demand. The main problem associated with this marketing system lies in the fact that, in the absence of timely and reliable market information on traded price and volume, an imbalance between supply and demand can occur very frequently and prices consequently can fluctuate drastically. To rectify this situation, it is strongly requested to establish a market information circulation system both at national and regional level.

In particular, settlers of the project will engage in the production of non-traditional crops and in their decision-making on which crop they should cultivate it is vital to provide them with accurate and up-to-date information on marketing and production.

(3) Organization of Market-oriented Cooperative

The proposed settlers for the project area consist of large and small investors, graduates and small farmers, of whom the former two categories are presumed to undertake marketing of their products by their own initiative, while the latter two categories are considered to be less capable of product marketing due to deficient financial resources and less experience in marketing. The field survey by the Study team has revealed that small farmers which are engaging in vegetables and fruits production are unable to negotiate properly with middlemen and, as a consequent, they have no other option but to accept unwillingly prices offered by middlemen. Furthermore, without proper storage facility nor transport, they are not in a position to market their produces at more opportune times, which is especially important since their products are readily perishable and vulnerable to post-harvest loss.

The foregoing diagnosis leads to the suggestion of forming market-oriented cooperatives. These cooperatives will have as function collecting and shipment of agricultural products of their members. This may include grading , quality control and provision of transport.

Table 3-1 Major Features of Alternatives

Alternative		Required Water Level of the Study Area	Water Transmission Facilities									Study Area	
			Pumping Station		Pipeline				Open Canal B=12m (Km)	Culvert (Box Type) 3.8x3.8x4 (Km)	Total length (Km)	Booster Pump No.1	Booster Pump No.2
			No.7 P.S.	No.8 P.S.	SP D3mx4 (Km)	PCCP D2mx10 (Km)	FRP D2.5mx6 (Km)	DCIP D2.8mx5 (Km)					
1	(Route A-1)	WL 90 m	O	–	39.6	-	-	-	2.2	-	41.8	O	O
2	(Route A-1)	WL 90 m	O	O	-	27.8+11.8	-	-	2.2	-	41.8	O	O
3	(Route A-1)	WL 90 m	O	O	-	-	27.8+11.8	-	2.2	-	41.8	O	O
4	(Route A-1)	WL 90 m	O	–	-	-	-	39.6	2.2	-	41.8	O	O
5	(Route A-1)	WL 90 m	O	–	20.3	-	-	-	2.2	19.3	41.8	O	O
6	(Route A-1)	WL 90 m	O	O	-	8.5+11.8	-	-	2.2	19.3	41.8	O	O
7	(Route A-1)	WL 90 m	O	O	-	-	8.5+11.8	-	2.2	19.3	41.8	O	O
8	(Route A-1)	WL 90 m	O	–	-	-	-	20.3	2.2	19.3	41.8	O	O
9	(Route B-1)	WL 90 m	O	–	16.7	-	-	-	8.7+10.2+2.2	7.8	45.6	O	O
10	(Route B-1)	WL 90 m	O	O	-	9.2+7.5	-	-	8.7+10.2+2.2	7.8	45.6	O	O
11	(Route B-1)	WL 90 m	O	O	-	-	9.2+7.5	-	8.7+10.2+2.3	7.8	45.6	O	O
12	(Route B-1)	WL 90 m	O	–	-	-	-	16.7	8.7+10.2+2.4	7.8	45.6	O	O
13	(Route A,C-1)	WL 90 m	O	–	10.6	-	-	-	13.1	19.3	43.0	O	O
14	(Route A,C-1)	WL 90 m	O	O	-	6.0+4.6	-	-	13.1	19.3	43.0	O	O
15	(Route A,C-1)	WL 90 m	O	O	-	-	6.0+4.6	-	13.1	19.3	43.0	O	O
16	(Route A,C-1)	WL 90 m	O	–	-	-	-	10.6	13.1	19.3	43.0	O	O
17	(Route B,C-1)	WL 90 m	O	–	10.6	-	-	-	8.7+4.8+13.1	7.8	45.0	O	O
18	(Route B,C-1)	WL 90 m	O	O	-	6.0+4.6	-	-	8.7+4.8+13.1	7.8	45.0	O	O
19	(Route B,C-1)	WL 90 m	O	O	-	-	6.0+4.6	-	8.7+4.8+13.2	7.8	45.0	O	O
20	(Route B,C-1)	WL 90 m	O	–	-	-	-	10.6	8.7+4.8+13.3	7.8	45.0	O	O
21	(Route A-2)	WL110 m	O	–	40.5	-	-	-	-	-	40.5	-	-
22	(Route A-2)	WL110 m	O	O	-	27.8+12.7	-	-	-	-	40.5	-	-
23	(Route A-2)	WL110 m	O	O	-	-	27.8+12.7	-	-	-	40.5	-	-
24	(Route A-2)	WL110 m	O	–	-	-	-	40.5	-	-	40.5	-	-
25	(Route A-2)	WL110 m	O	–	21.2	-	-	-	-	19.3	40.5	-	-
26	(Route A-2)	WL110 m	O	O	-	8.5+12.7	-	-	-	19.3	40.5	-	-
27	(Route A-2)	WL110 m	O	O	-	-	8.5+12.7	-	-	19.3	40.5	-	-
28	(Route A-2)	WL110 m	O	–	-	-	-	21.2	-	19.3	40.5	-	-
29	(Route B-2)	WL110 m	O	–	18.2	-	-	-	8.7+10.2	7.8	44.9	-	-
30	(Route B-2)	WL110 m	O	O	-	9.2+9.0	-	-	8.7+10.2	7.8	44.9	-	-
31	(Route B-2)	WL110 m	O	O	-	-	9.2+9.0	-	8.7+10.2	7.8	44.9	-	-
32	(Route B-2)	WL110 m	O	–	-	-	-	18.2	8.7+10.2	7.8	44.9	-	-
33	(Route A,C-2)	WL110 m	O	–	12.6	-	-	-	8.5	19.3	40.4	-	-
34	(Route A,C-2)	WL110 m	O	O	-	6.0+6.6	-	-	8.5	19.3	40.4	-	-
35	(Route A,C-2)	WL110 m	O	O	-	-	6.0+6.6	-	8.5	19.3	40.4	-	-
36	(Route A,C-2)	WL110 m	O	–	-	-	-	12.6	8.5	19.3	40.4	-	-
37	(Route B,C-2)	WL110 m	O	–	12.6	-	-	-	8.7+4.8+8.5	7.8	42.4	-	-
38	(Route B,C-2)	WL110 m	O	O	-	6.0+6.6	-	-	8.7+4.8+8.5	7.8	42.4	-	-
39	(Route B,C-2)	WL110 m	O	O	-	-	6.0+6.6	-	8.7+4.8+8.5	7.8	42.4	-	-
40	(Route B,C-2)	WL110 m	O	–	-	-	-	12.6	8.7+4.8+8.5	7.8	42.4	-	-

Table 3-2 Construction Costs of Alternatives (Million LE)

Alternative No.	Route	DWL	Main Pump No.7	Main Pump No.8	Pipeline	Open Canal	Box Culvert Canal	Booster Pump	Electric Trans. Line	Total Cost	Total Canal Length	Pipe
		m									km	
1	A-1	90	379.3		2,044.3	11.0		183.2	24.2	2,642.0	41.8	SP
2	A-1	90	325.1	320.7	1,935.1	11.0		183.2	24.2	2,799.3	41.8	PCCP
3	A-1	90	306.7	312.9	2,011.6	11.0		183.2	24.2	2,849.6	41.8	FRP
4	A-1	90	376.9		4,844.8	11.0		183.2	24.2	5,440.1	41.8	DCIP
5	A-1	90	391.5		1,048.0	11.0	463.2	183.2	22.0	2,118.9	41.8	SP
6	A-1	90	294.1	320.7	992.0	11.0	463.2	183.2	22.0	2,286.2	41.8	PCCP
7	A-1	90	288.5	312.9	1,031.2	11.0	463.2	183.2	22.0	2,312.0	41.8	FRP
8	A-1	90	390.0		2,483.6	11.0	463.2	183.2	22.0	3,553.0	41.8	DCIP
9	B-1	90	384.8		862.1	105.5	187.2	183.2	18.0	1,740.8	45.6	SP
10	B-1	90	294.2	312.2	816.1	105.5	187.2	183.2	18.0	1,916.4	45.6	PCCP
11	B-1	90	288.1	307.2	848.3	105.5	187.2	183.2	18.0	1,937.5	45.6	FRP
12	B-1	90	383.5		2,043.1	105.5	187.2	183.2	18.0	2,920.5	45.6	DCIP
13	A, C-1	90	378.8		547.2	65.5	463.2	183.2	21.5	1,659.4	43.0	SP
14	A, C-1	90	289.2	308.2	518.0	65.5	463.2	183.2	21.5	1,848.8	43.0	PCCP
15	A, C-1	90	285.2	305.1	538.5	65.5	463.2	183.2	21.5	1,862.2	43.0	FRP
16	A, C-1	90	377.9		1,296.9	65.5	463.2	183.2	21.5	2,408.2	43.0	DCIP
17	B, C-1	90	376.6		547.2	133.0	187.2	183.2	21.5	1,448.7	45.0	SP
18	B, C-1	90	287.0	308.2	518.0	133.0	187.2	183.2	21.5	1,638.1	45.0	PCCP
19	B, C-1	90	283.0	305.1	538.5	133.0	187.2	183.2	21.5	1,651.5	45.0	FRP
20	B, C-1	90	375.8		1,296.9	133.0	187.2	183.2	21.5	2,197.6	45.0	DCIP
21	A-2	110	411.1		2,090.8				2.2	2,504.1	40.5	SP
22	A-2	110	325.1	361.0	1,979.1				9.1	2,674.3	40.5	PCCP
23	A-2	110	306.7	352.6	2,057.4				9.1	2,725.8	40.5	FRP
24	A-2	110	408.6		4,954.9				2.2	5,365.7	40.5	DCIP
25	A-2	110	393.9		1,094.4		463.2		2.2	1,953.7	40.5	SP
26	A-2	110	294.1	361.0	1,036.0		463.2		6.9	2,161.2	40.5	PCCP
27	A-2	110	288.5	352.6	1,076.9		463.2		6.9	2,188.1	40.5	FRP
28	A-2	110	392.5		2,593.7		463.2		2.2	3,451.6	40.5	DCIP
29	B-2	110	389.2		939.6	94.5	187.2		0.8	1,611.3	44.9	SP
30	B-2	110	294.2	353.7	889.4	94.5	187.2		5.9	1,824.9	44.9	PCCP
31	B-2	110	288.1	347.7	924.5	94.5	187.2		5.9	1,847.9	44.9	FRP
32	B-2	110	388.1		2,226.7	94.5	187.2		0.8	2,897.3	44.9	DCIP
33	A, C-2	110	384.7		650.5	42.5	463.2		2.2	1,543.1	40.4	SP
34	A, C-2	110	289.2	350.2	615.7	42.5	463.2		5.5	1,766.3	40.4	PCCP
35	A, C-2	110	285.2	345.9	640.1	42.5	463.2		5.5	1,782.4	40.4	FRP
36	A, C-2	110	383.9		1,541.5	42.5	463.2		2.2	2,433.3	40.4	DCIP
37	B, C-2	110	382.9		650.5	110.0	187.2		2.2	1,332.8	42.4	SP
38	B, C-2	110	287.0	350.2	615.7	110.0	187.2		5.5	1,555.6	42.4	PCCP
39	B, C-2	110	283.0	345.9	640.1	110.0	187.2		5.5	1,571.7	42.4	FRP
40	B, C-2	110	382.1		1,541.5	110.0	187.2		2.2	2,223.0	42.4	DCIP

Notes: DWL: Delivery Water Level above mean sea level, SP: Steel Pipe
PCCP: Prestressed Cylinder Concrete Pipe, FRP: Fiber Reinforced Pipe
DCIP: Ductile Cast Iron Pipe

Table 3-3 Construction Cost of the Water Conveyance Alternatives

	Alternative	Required Water Level of the Study Area	Main Pumping Station			Water Conveyance Facilities																Internal Booster Pumping Station	Over-all Electric Transmiss. Line	Total Construct. Cost
						Pipeline										Open Canal Bottom Width B=12m 5,000 LE/m		Box Culvert B x H x N 3.8 x 3.8 x 4 24,000 LE/m		Total Length	Total Construc. Cost			
			No.7 P.S. M.LE	No.8 P.S. M.LE	Total M.LE	SP: D3m x 4 51,624 M.LE/Km		PCCP:D2mx10 48,867 M.LE/Km		FRP:D2.5mx6 50,799 M.LE/Km		DCIP:D2.6x6 122,344 M.LE/Km		Pipeline Length Km	Pipeline Construct. Cost M.LE									
						Km	M.LE	Km	M.LE	Km	M.LE	Km	M.LE			Km	M.LE	Km	M.LE			M.LE	M.LE	M.LE
1	(Route A-1)	WL 90 m	379.31		379.31	39.6	2,044.31							39.6	2,044.31	2.2	11.00		0.00	41.8	2,055.31	183.19	24.20	2,642.01
2	(Route A-1)	WL 90 m	325.07	320.69	645.76			39.6	1,935.13					39.6	1,935.13	2.2	11.00		0.00	41.8	1,946.13	183.19	24.20	2,799.28
3	(Route A-1)	WL 90 m	306.73	312.89	619.62					39.6	2,011.64			39.6	2,011.64	2.2	11.00		0.00	41.8	2,022.64	183.19	24.20	2,849.65
4	(Route A-1)	WL 90 m	376.86		376.86							39.6	4,844.82	39.6	4,844.82	2.2	11.00		0.00	41.8	4,855.82	183.19	24.20	5,440.07
5	(Route A-1)	WL 90 m	391.54		391.54	20.3	1,047.97							20.3	1,047.97	2.2	11.00	19.3	463.20	41.8	1,522.17	183.19	22.00	2,118.90
6	(Route A-1)	WL 90 m	294.12	320.69	614.80			20.3	992.00					20.3	992.00	2.2	11.00	19.3	463.20	41.8	1,466.20	183.19	22.00	2,286.19
7	(Route A-1)	WL 90 m	288.52	312.89	601.42					20.3	1,031.22			20.3	1,031.22	2.2	11.00	19.3	463.20	41.8	1,505.42	183.19	22.00	2,312.03
8	(Route A-1)	WL 90 m	389.99		389.99							20.3	2,483.58	20.3	2,483.58	2.2	11.00	19.3	463.20	41.8	2,957.78	183.19	22.00	3,552.96
9	(Route B-1)	WL 90 m	384.84		384.84	16.7	862.12							16.7	862.12	21.1	105.50	7.8	187.20	45.6	1,154.82	183.19	17.99	1,740.84
10	(Route B-1)	WL 90 m	294.16	312.17	606.33			16.7	816.08					16.7	816.08	21.1	105.50	7.8	187.20	45.6	1,108.78	183.19	17.99	1,916.29
11	(Route B-1)	WL 90 m	288.09	307.24	595.33					16.7	848.34			16.7	848.34	21.1	105.50	7.8	187.20	45.6	1,141.04	183.19	17.99	1,937.55
12	(Route B-1)	WL 90 m	383.54		383.54							16.7	2,043.14	16.7	2,043.14	21.1	105.50	7.8	187.20	45.6	2,335.84	183.19	17.99	2,920.56
13	(Route A,C-1)	WL 90 m	378.76		378.76	10.6	547.21							10.6	547.21	13.1	65.50	19.3	463.20	43.0	1,075.91	183.19	21.45	1,659.31
14	(Route A,C-1)	WL 90 m	269.18	308.15	597.33			10.6	517.99					10.6	517.99	13.1	65.50	19.3	463.20	43.0	1,046.69	183.19	21.45	1,848.67
15	(Route A,C-1)	WL 90 m	285.22	305.10	590.32					10.6	538.47			10.6	538.47	13.1	65.50	19.3	463.20	43.0	1,067.17	183.19	21.45	1,862.13
16	(Route A,C-1)	WL 90 m	377.94		377.94							10.6	1,296.85	10.6	1,296.85	13.1	65.50	19.3	463.20	43.0	1,825.55	183.19	21.45	2,408.13
17	(Route B,C-1)	WL 90 m	376.58		376.58	10.6	547.21							10.6	547.21	26.6	133.00	7.8	187.20	45.0	867.41	183.19	21.45	1,446.64
18	(Route B,C-1)	WL 90 m	287.01	308.15	595.16			10.6	517.99					10.6	517.99	26.6	133.00	7.8	187.20	45.0	838.19	183.19	21.45	1,637.99
19	(Route B,C-1)	WL 90 m	283.04	305.10	588.14					10.6	538.47			10.6	538.47	26.6	133.00	7.8	187.20	45.0	858.67	183.19	21.45	1,651.45
20	(Route B,C-1)	WL 90 m	375.77		375.77							10.6	1,296.85	10.6	1,296.85	26.6	133.00	7.8	187.20	45.0	1,617.05	183.19	21.45	2,197.45
21	(Route A-2)	WL110 m	411.13		411.13	40.5	2,090.77							40.5	2,090.77					40.5	2,090.77		2.20	2,504.10
22	(Route A-2)	WL110 m	325.07	360.97	686.04			40.5	1,979.11					40.5	1,979.11					40.5	1,979.11		9.08	2,674.23
23	(Route A-2)	WL110 m	306.73	352.59	659.32					40.5	2,057.36			40.5	2,057.36					40.5	2,057.36		9.08	2,725.75
24	(Route A-2)	WL110 m	408.63		408.63							40.5	4,954.93	40.5	4,954.93					40.5	4,954.93		2.20	5,365.76
25	(Route A-2)	WL110 m	393.85		393.85	21.2	1,094.43							21.2	1,094.43			19.3	463.20	40.5	1,557.63		2.20	1,953.68
26	(Route A-2)	WL110 m	294.12	360.97	655.08			21.2	1,035.98					21.2	1,035.98			19.3	463.20	40.5	1,499.18		6.88	2,161.14
27	(Route A-2)	WL110 m	288.52	352.59	641.11					21.2	1,076.94			21.2	1,076.94			19.3	463.20	40.5	1,540.14		6.88	2,188.13
28	(Route A-2)	WL110 m	392.53		392.53							21.2	2,593.69	21.2	2,593.69			19.3	463.20	40.5	3,056.89		2.20	3,451.62
29	(Route B-2)	WL110 m	389.19		389.19	18.2	939.56							18.2	939.56	18.9	94.50	7.8	187.20	44.9	1,221.26		0.83	1,611.27
30	(Route B-2)	WL110 m	294.16	353.66	647.82			18.2	889.38					18.2	889.38	18.9	94.50	7.8	187.20	44.9	1,171.08		5.89	1,824.78
31	(Route B-2)	WL110 m	288.09	347.71	635.81					18.2	924.54			18.2	924.54	18.9	94.50	7.8	187.20	44.9	1,206.24		5.89	1,847.93
32	(Route B-2)	WL110 m	388.08		388.08							18.2	2,226.66	18.2	2,226.66	18.9	94.50	7.8	187.20	44.9	2,508.36		0.83	2,897.26
33	(Route A,C-2)	WL110 m	384.65		384.65	12.6	650.46							12.6	650.46	8.5	42.50	19.3	463.20	40.4	1,156.16		2.20	1,543.01
34	(Route A,C-2)	WL110 m	289.18	350.24	639.42			12.6	615.72					12.6	615.72	8.5	42.50	19.3	463.20	40.4	1,121.42		5.50	1,766.35
35	(Route A,C-2)	WL110 m	285.22	345.89	631.11					12.6	640.07			12.6	640.07	8.5	42.50	19.3	463.20	40.4	1,145.77		5.50	1,782.37
36	(Route A,C-2)	WL110 m	383.86		383.86							12.6	1,541.53	12.6	1,541.53	8.5	42.50	19.3	463.20	40.4	2,047.23		2.20	2,433.29
37	(Route B,C-2)	WL110 m	382.91		382.91	12.6	650.46							12.6	650.46	22.0	110.00	7.8	187.20	42.4	947.66		2.20	1,332.77
38	(Route B,C-2)	WL110 m	287.01	350.24	637.25			12.6	615.72					12.6	615.72	22.0	110.00	7.8	187.20	42.4	912.92		5.50	1,555.67
39	(Route B,C-2)	WL110 m	283.04	345.89	628.93					12.6	640.07			12.6	640.07	22.0	110.00	7.8	187.20	42.4	937.27		5.50	1,571.70
40	(Route B,C-2)	WL110 m	382.12		382.12							12.6	1,541.53	12.6	1,541.53	22.0	110.00	7.8	187.20	42.4	1,838.73		2.20	2,223.05

Table 3-4 Annual Power Cost of Alternatives

Alternative	No.7 Pump Station			No.8 Pump Station			Total Motor Output (KW)	Annual Amount Discharge (MCM)	Annual Operation Hour (Hr)	Annual Power Cost (M.EL)
	Total Head (m)	Pump Discharge (m^3/s)	Motor Output (KW)	Total Head (m)	Pump Discharge (m^3/s)	Motor Output (KW)				
1 (Route A-1)	113.00	52.66	71,275				71,275	690	3,640	51.754
2 (Route A-1)	67.64	52.66	42,664	60.18	52.66	37,959	80,622	690	3,640	58.542
3 (Route A-1)	58.20	52.66	36,710	56.17	52.66	35,429	72,139	690	3,640	52.381
4 (Route A-1)	111.42	52.66	70,278				70,278	690	3,640	51.030
5 (Route A-1)	101.85	52.66	64,242				64,242	690	3,640	46.647
6 (Route A-1)	51.71	52.66	32,616	60.18	52.66	37,959	70,575	690	3,640	51.246
7 (Route A-1)	48.83	52.66	30,800	56.17	52.66	35,429	66,229	690	3,640	48.090
8 (Route A-1)	101.05	52.66	63,737				63,737	690	3,640	46.281
9 (Route B-1)	98.40	52.66	62,066				62,066	690	3,640	45.067
10 (Route B-1)	51.73	52.66	32,629	55.80	52.66	35,196	67,825	690	3,640	49.249
11 (Route B-1)	48.61	52.66	30,661	53.26	52.66	33,594	64,254	690	3,640	46.656
12 (Route B-1)	97.73	52.66	61,643				61,643	690	3,640	44.760
13 (Route A,C-1)	95.27	52.66	60,092				60,092	690	3,640	43.634
14 (Route A,C-1)	49.17	52.66	31,014	53.73	52.66	33,890	64,904	690	3,640	47.128
15 (Route A,C-1)	47.13	52.66	29,727	52.16	52.66	32,900	62,627	690	3,640	45.475
16 (Route A,C-1)	94.85	52.66	59,827				59,827	690	3,640	43.441
17 (Route B,C-1)	94.15	52.66	59,385				59,385	690	3,640	43.121
18 (Route B,C-1)	48.05	52.66	30,308	53.73	52.66	33,890	64,198	690	3,640	46.615
19 (Route B,C-1)	46.01	52.66	29,021	52.16	52.66	32,900	61,921	690	3,640	44.962
20 (Route B,C-1)	93.73	52.66	59,120				59,120	690	3,640	42.928
21 (Route A-2)	133.51	52.66	84,211				84,211	690	3,640	61.148
22 (Route A-2)	67.64	52.66	42,664	80.91	52.66	51,034	93,698	690	3,640	68.036
23 (Route A-2)	58.20	52.66	36,710	76.60	52.66	48,315	85,025	690	3,640	61.738
24 (Route A-2)	131.90	52.66	83,196				83,196	690	3,640	60.410
25 (Route A-2)	122.37	52.66	77,185				77,185	690	3,640	56.045
26 (Route A-2)	51.71	52.66	32,616	80.91	52.66	51,034	83,650	690	3,640	60.740
27 (Route A-2)	48.83	52.66	30,800	76.60	52.66	48,315	79,115	690	3,640	57.447
28 (Route A-2)	121.52	52.66	76,649				76,649	690	3,640	55.656
29 (Route B-2)	119.37	52.66	75,293				75,293	690	3,640	54.671
30 (Route B-2)	51.73	52.66	32,629	77.15	52.66	48,662	81,291	690	3,640	59.027
31 (Route B-2)	48.61	52.66	30,660	74.09	52.66	46,732	77,392	690	3,640	56.196
32 (Route B-2)	118.65	52.66	74,838				74,838	690	3,640	54.342
33 (Route A,C-2)	116.44	52.66	73,445				73,445	690	3,640	53.330
34 (Route A,C-2)	49.17	52.66	31,014	75.39	52.66	47,552	78,566	690	3,640	57.049
35 (Route A,C-2)	47.13	52.66	29,727	73.15	52.66	46,139	75,867	690	3,640	55.088
36 (Route A,C-2)	115.93	52.66	73,123				73,123	690	3,640	53.096
37 (Route B,C-2)	115.32	52.66	72,738				72,738	690	3,640	52.817
38 (Route B,C-2)	48.05	52.66	30,308	75.39	52.66	47,552	77,860	690	3,640	56.536
39 (Route B,C-2)	46.01	52.66	29,021	73.15	52.66	46,139	75,160	690	3,640	54.575
40 (Route B,C-2)	114.81	52.66	72,416				72,416	690	3,640	52.583

Table 3-5 Operation and Maintenance Cost of Alternatives

ALT	Main Pumping Station			Pipeline			Open Canal			Culvert			Total Length	Patrol & Inspec.	Elc.Trnsm.Line		Rst.PS	Total	Pump Stations Running Cost			Total
	No.7 P.S. No.8 P.S. C.Cost (M.LE)	Mainte. Cost 15%/25Yr (1000LE)	Operator Cost 240LE/D/PS (1000LE)	Length (Km)	Const. Cost (M.LE)	Mainte. Cost 4%/50Yr (1000LE)	Length (Km)	Const. Cost (M.LE)	Mainte. Cost 10%/50Yr (1000LE)	Length (Km)	Const. Cost (M.LE)	Mainte. Cost 4%/50Yr (1000LE)	(Km)	4.5LE/Km /Day (1000LE)	Const. Cost (M.LE)	Mainte. Cost 4%/50Yr (1000LE)	Operator & Mainte. Cost (1000LE)	Mainte. Cost (1000LE)	Pump(7,8) (Electric) Cost (1000LE)	B.S.Pump (Electric) Cost (1000LE)	Total (Electric) Cost (1000LE)	Operation & Mainte. Cost (1000LE)
1	379.31	2,275.9	87.6	39.6	2,044.3	1,635.4	2.2	11.0	22.0		0.0	0.0	41.8	68.7	24.2	19.4	1,057.8	5,167	51,754	5,848	57,602	62,769
2	645.76	3,874.5	175.2	39.6	1,935.1	1,548.1	2.2	11.0	22.0		0.0	0.0	41.8	68.7	24.2	19.4	1,057.8	6,766	58,542	5,848	64,390	71,155
3	619.62	3,717.7	175.2	39.6	2,011.6	1,609.3	2.2	11.0	22.0		0.0	0.0	41.8	68.7	24.2	19.4	1,057.8	6,670	52,381	5,848	58,229	64,900
4	376.86	2,261.2	87.6	39.6	4,844.8	3,875.9	2.2	11.0	22.0		0.0	0.0	41.8	68.7	24.2	19.4	1,057.8	7,392	51,030	5,848	56,878	64,271
5	391.54	2,349.3	87.6	20.3	1,048.0	838.4	2.2	11.0	22.0	19.3	463.2	370.6	41.8	68.7	22.0	17.6	1,057.8	4,812	46,647	5,848	52,495	57,307
6	614.80	3,688.8	175.2	20.3	992.0	793.6	2.2	11.0	22.0	19.3	463.2	370.6	41.8	68.7	22.0	17.6	1,057.8	6,194	51,246	5,848	57,094	63,288
7	601.42	3,608.5	175.2	20.3	1,031.2	825.0	2.2	11.0	22.0	19.3	463.2	370.6	41.8	68.7	22.0	17.6	1,057.8	6,145	48,090	5,848	53,938	60,083
8	389.99	2,339.9	87.6	20.3	2,483.6	1,986.9	2.2	11.0	22.0	19.3	463.2	370.6	41.8	68.7	22.0	17.6	1,057.8	5,951	46,281	5,848	52,129	58,080
9	384.84	2,309.0	87.6	16.7	862.1	689.7	21.1	105.5	211.0	7.8	187.2	149.8	45.6	74.9	18.0	14.4	1,057.8	4,594	45,067	5,848	50,915	55,509
10	606.33	3,638.0	175.2	16.7	816.1	652.9	21.1	105.5	211.0	7.8	187.2	149.8	45.6	74.9	18.0	14.4	1,057.8	5,974	49,249	5,848	55,097	61,071
11	595.33	3,572.0	175.2	16.7	848.3	678.7	21.1	105.5	211.0	7.8	187.2	149.8	45.6	74.9	18.0	14.4	1,057.8	5,934	46,656	5,848	52,504	58,438
12	383.54	2,301.2	87.6	16.7	2,043.1	1,634.5	21.1	105.5	211.0	7.8	187.2	149.8	45.6	74.9	18.0	14.4	1,057.8	5,531	44,760	5,848	50,608	56,140
13	378.76	2,272.6	87.6	10.6	547.2	437.8	13.1	65.5	131.0	19.3	463.2	370.6	43.0	70.6	21.4	17.1	1,057.8	4,445	43,634	5,848	49,482	53,927
14	597.33	3,584.0	175.2	10.6	518.0	414.4	13.1	65.5	131.0	19.3	463.2	370.6	43.0	70.6	21.4	17.1	1,057.8	5,821	47,128	5,848	52,976	58,797
15	590.32	3,541.9	175.2	10.6	538.5	430.8	13.1	65.5	131.0	19.3	463.2	370.6	43.0	70.6	21.4	17.1	1,057.8	5,795	45,475	5,848	51,323	57,118
16	377.94	2,267.7	87.6	10.6	1,296.8	1,037.5	13.1	65.5	131.0	19.3	463.2	370.6	43.0	70.6	21.4	17.1	1,057.8	5,040	43,441	5,848	49,289	54,329
17	376.58	2,259.5	87.6	10.6	547.2	437.8	26.6	133.0	266.0	7.8	187.2	149.8	45.0	73.9	21.4	17.1	1,057.8	4,349	43,121	5,848	48,969	53,318
18	595.16	3,571.0	175.2	10.6	518.0	414.4	26.6	133.0	266.0	7.8	187.2	149.8	45.0	73.9	21.4	17.1	1,057.8	5,725	46,615	5,848	52,463	58,188
19	588.14	3,528.9	175.2	10.6	538.5	430.8	26.6	133.0	266.0	7.8	187.2	149.8	45.0	73.9	21.4	17.1	1,057.8	5,699	44,962	5,848	50,810	56,509
20	375.77	2,254.6	87.6	10.6	1,296.8	1,037.5	26.6	133.0	266.0	7.8	187.2	149.8	45.0	73.9	21.4	17.1	1,057.8	4,944	42,928	5,848	48,776	53,721
21	411.13	2,466.8	87.6	40.5	2,090.8	1,672.6		0.0	0.0		0.0	0.0	40.5	66.5	2.2	1.8		4,295	61,148		61,148	65,443
22	686.04	4,116.2	175.2	40.5	1,979.1	1,583.3		0.0	0.0		0.0	0.0	40.5	66.5	9.1	7.3		5,949	68,036		68,036	73,984
23	659.32	3,955.9	175.2	40.5	2,057.4	1,645.9		0.0	0.0		0.0	0.0	40.5	66.5	9.1	7.3		5,851	61,738		61,738	67,589
24	408.63	2,451.8	87.6	40.5	4,954.9	3,963.9		0.0	0.0		0.0	0.0	40.5	66.5	2.2	1.8		6,572	60,410		60,410	66,982
25	393.85	2,363.1	87.6	21.2	1,094.4	875.5		0.0	0.0	19.3	463.2	370.6	40.5	66.5	2.2	1.8		3,765	56,045		56,045	59,811
26	655.08	3,930.5	175.2	21.2	1,036.0	828.8		0.0	0.0	19.3	463.2	370.6	40.5	66.5	6.9	5.5		5,377	60,740		60,740	66,117
27	641.11	3,846.7	175.2	21.2	1,076.9	861.6		0.0	0.0	19.3	463.2	370.6	40.5	66.5	6.9	5.5		5,326	57,447		57,447	62,773
28	392.53	2,355.2	87.6	21.2	2,593.7	2,075.0		0.0	0.0	19.3	463.2	370.6	40.5	66.5	2.2	1.8		4,957	55,656		55,656	60,613
29	389.19	2,335.2	87.6	18.2	939.6	751.6	18.9	94.5	189.0	7.8	187.2	149.8	44.9	73.7	0.8	0.6		3,588	54,671		54,671	58,259
30	647.82	3,886.9	175.2	18.2	889.4	711.5	18.9	94.5	189.0	7.8	187.2	149.8	44.9	73.7	5.9	4.7		5,191	59,027		59,027	64,218
31	635.81	3,814.8	175.2	18.2	924.5	739.6	18.9	94.5	189.0	7.8	187.2	149.8	44.9	73.7	5.9	4.7		5,147	56,196		56,196	61,343
32	388.08	2,328.5	87.6	18.2	2,226.7	1,781.3	18.9	94.5	189.0	7.8	187.2	149.8	44.9	73.7	0.8	0.6		4,611	54,342		54,342	58,952
33	384.65	2,307.9	87.6	12.6	650.5	520.4	8.5	42.5	85.0	19.3	463.2	370.6	40.4	66.4	2.2	1.8		3,440	53,330		53,330	56,769
34	639.42	3,836.5	175.2	12.6	615.7	492.6	8.5	42.5	85.0	19.3	463.2	370.6	40.4	66.4	5.5	4.4		5,031	57,049		57,049	62,079
35	631.11	3,786.6	175.2	12.6	640.1	512.1	8.5	42.5	85.0	19.3	463.2	370.6	40.4	66.4	5.5	4.4		5,000	55,088		55,088	60,088
36	383.86	2,303.1	87.6	12.6	1,541.5	1,233.2	8.5	42.5	85.0	19.3	463.2	370.6	40.4	66.4	2.2	1.8		4,148	53,096		53,096	57,244
37	382.91	2,297.5	87.6	12.6	650.5	520.4	22.0	110.0	220.0	7.8	187.2	149.8	42.4	69.6	2.2	1.8		3,347	52,817		52,817	56,163
38	637.25	3,823.5	175.2	12.6	615.7	492.6	22.0	110.0	220.0	7.8	187.2	149.8	42.4	69.6	5.5	4.4		4,935	56,536		56,536	61,471
39	628.93	3,773.6	175.2	12.6	640.1	512.1	22.0	110.0	220.0	7.8	187.2	149.8	42.4	69.6	5.5	4.4		4,905	54,575		54,575	59,480
40	382.12	2,292.7	87.6	12.6	1,541.5	1,233.2	22.0	110.0	220.0	7.8	187.2	149.8	42.4	69.6	2.2	1.8		4,055	52,583		52,583	56,638

Table 3-6 Present Value of Alternative Costs

	Alternative (Route:Pipe)	Water Level at Study Area	Construct.Cost		O & M COST		Present Value		
			Total Construct. Cost (M.LE)	Order	Annual O & M Cost (M.LE)	Order	Interest I = 12 %		
							N.P.V. (M.LE)	Ratio	Order
1	(A-1:SP)	WL 90 m	2,642	30	62.8	29	2,594	1.780	30
2	(A-1:PCCP)	WL 90 m	2,799	33	71.2	39	2,783	1.910	34
3	(A-1:FRP)	WL 90 m	2,850	34	64.9	34	2,787	1.913	36
4	(A-1:DCIP)	WL 90 m	5,440	40	64.3	33	4,939	3.390	40
5	(A-1:SP)	WL 90 m	2,119	20	57.3	13	2,125	1.459	20
6	(A-1:PCCP)	WL 90 m	2,286	25	63.3	31	2,307	1.584	25
7	(A-1:FRP)	WL 90 m	2,312	26	60.1	22	2,309	1.585	26
8	(A-1:DCIP)	WL 90 m	3,553	38	58.1	14	3,327	2.283	38
9	(B-1:SP)	WL 90 m	1,741	10	55.5	5	1,799	1.234	10
10	(B-1:PCCP)	WL 90 m	1,916	17	61.1	25	1,985	1.362	17
11	(B-1:FRP)	WL 90 m	1,938	18	58.4	17	1,987	1.364	18
12	(B-1:DCIP)	WL 90 m	2,921	36	56.1	6	2,787	1.913	35
13	(A,C-1:SP)	WL 90 m	1,659	9	53.9	3	1,721	1.181	7
14	(A,C-1:PCCP)	WL 90 m	1,849	15	58.8	18	1,915	1.314	13
15	(A,C-1:FRP)	WL 90 m	1,862	16	57.1	11	1,916	1.315	14
16	(A,C-1:DCIP)	WL 90 m	2,408	27	54.3	4	2,349	1.612	27
17	(B,C-1:SP)	WL 90 m	1,449	2	53.3	1	1,541	1.058	2
18	(B,C-1:PCCP)	WL 90 m	1,638	7	58.2	15	1,735	1.191	8
19	(B,C-1:FRP)	WL 90 m	1,651	8	56.5	8	1,736	1.192	9
20	(B,C-1:DCIP)	WL 90 m	2,197	23	53.7	2	2,169	1.489	21
21	(A-2:SP)	WL110 m	2,504	29	65.4	35	2,491	1.709	29
22	(A-2:PCCP)	WL110 m	2,674	31	74.0	40	2,692	1.848	31
23	(A-2:FRP)	WL110 m	2,726	32	67.6	38	2,696	1.851	32
24	(A-2:DCIP)	WL110 m	5,366	39	67.0	37	4,889	3.356	39
25	(A-2:SP)	WL110 m	1,954	19	59.8	21	1,997	1.371	19
26	(A-2:PCCP)	WL110 m	2,161	21	66.1	36	2,216	1.521	23
27	(A-2:FRP)	WL110 m	2,168	22	62.8	30	2,218	1.523	24
28	(A-2:DCIP)	WL110 m	3,452	37	60.6	24	3,253	2.233	37
29	(B-2:SP)	WL110 m	1,611	6	58.3	16	1,702	1.168	6
30	(B-2:PCCP)	WL110 m	1,825	13	64.2	32	1,924	1.320	15
31	(B-2:FRP)	WL110 m	1,848	14	61.3	26	1,926	1.322	16
32	(B-2:DCIP)	WL110 m	2,897	35	59.0	19	2,780	1.908	33
33	(A,C-2:SP)	WL110 m	1,543	3	56.8	10	1,636	1.123	3
34	(A,C-2:PCCP)	WL110 m	1,766	11	62.1	28	1,862	1.278	11
35	(A,C-2:FRP)	WL110 m	1,782	12	60.1	23	1,863	1.279	12
36	(A,C-2:DCIP)	WL110 m	2,433	28	57.2	12	2,382	1.635	28
37	(B,C-2:SP)	WL110 m	1,333	1	56.2	7	1,457	1.000	1
38	(B,C-2:PCCP)	WL110 m	1,556	4	61.5	27	1,683	1.155	4
39	(B,C-2:FRP)	WL110 m	1,572	5	59.5	20	1,684	1.156	5
40	(B,C-2:DCIP)	WL110 m	2,223	24	56.6	9	2,203	1.512	22

Table 3-7 List of Structures related to Water Control (El Salam Canal)

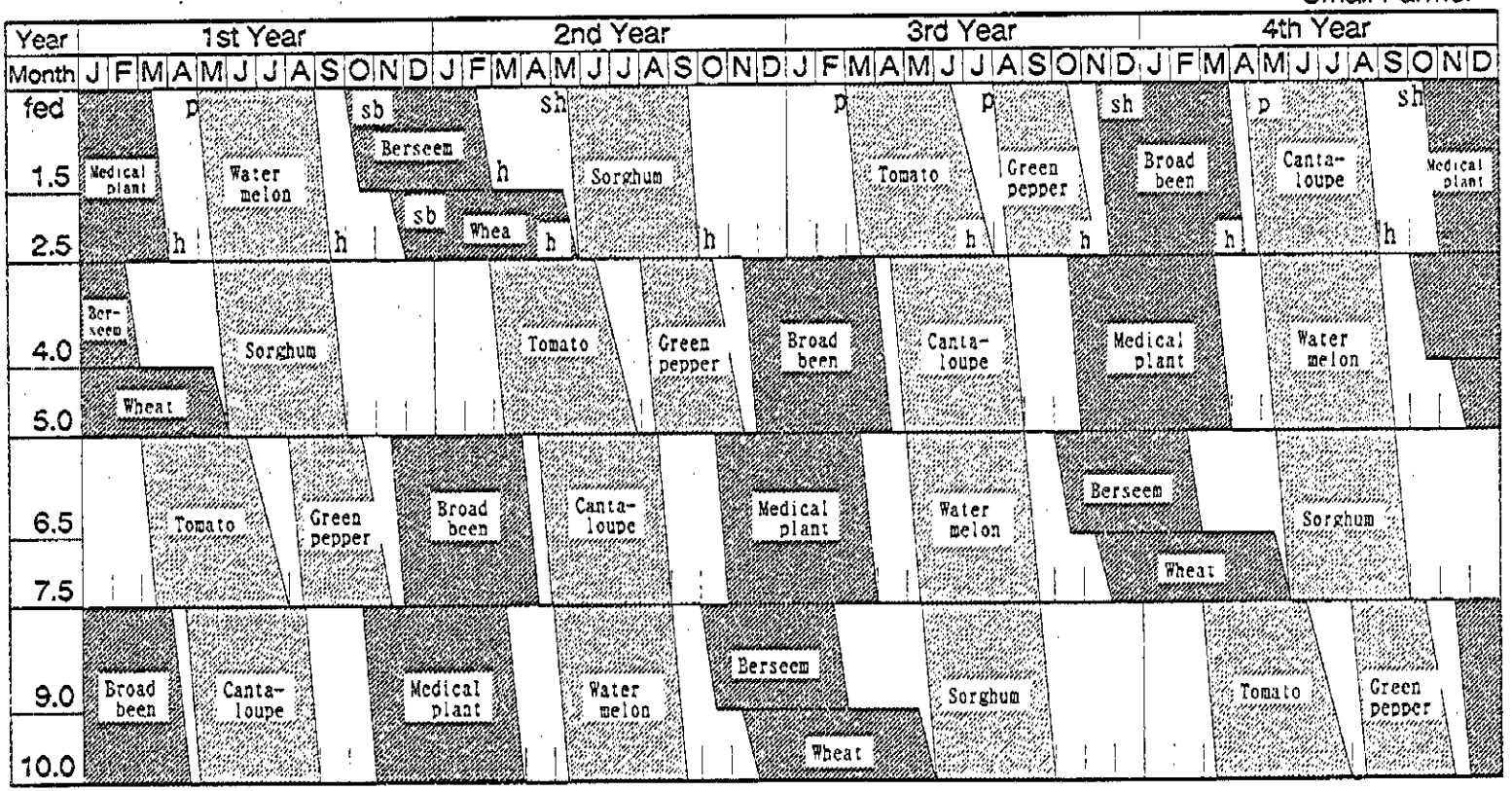
Structures	Particulars
Damietta Intake	at station 0.0 KM
- Design discharge	109.09 m^3/s
- Gates	Double leaf sluice type, 2 gates
- Water observation	2 water level gages at upstream and downstream
Serw Drain Intake	at station 18.0 KM
- Design discharge	109.09 m^3/s at upstream
- Drainage water mixing	23.15 m^3/s
- Design discharge	132.24 m^3/s at downstream
- Gates	Sluice type, 2 gates
- Water observation	2 water level gages at upstream and downstream
No.1 Pumping Station	at station 22.0 KM
- Design discharge	132.34 m^3/s
- Pumps	Inclined axial flow type, 10 units
- Water observation	2 water level gages at upstream and downstream
No.2 Pumping Station	at station 52.2 KM
- Design discharge	128.76 m^3/s
- Pumps	Inclined axial flow type, 10 units
- Water observation	2 water level gages at upstream and downstream
No.3 Pumping Station	at station 52.2 KM
- Drainage water mixing	85.49 m^3/s
- Pumps	Inclined axial flow type, 10 units
- Water observation	2 water level gages at upstream and downstream
Hadous Drain Intake	at station 52.7 KM
- Design discharge	128.76 m^3/s at upstream
- Drainage water mixing	85.94 m^3/s
- Design discharge	214.70 m^3/s
Spillway	at station 77 KM (approximated)
Offtakes	at 9 locations
- Discharge	0.17 - 8.66 m^3/s

Table 3-8 List of Structures related to Water Control (Shikh Gaber El Sabah Canal)

Structures	Particulars	Remarks
Suez Siphon	at station 0.0 KM from Suez Canal	underway
- Design discharge	160.00 m^3/s	
- Siphon	4 tunnels, ϕ 5,100 mm	
No.4 Pumping Station	at station 3.0 KM	underway
- Design discharge	144.67 m^3/s	
- Pumps	Inclined axial flow type, 10 units, 21 m^3/s/unit	
Tal Elooly Cross Regulator	at station 14.73 KM	designed
- Gates	Radial type, 5 gates	
No.5 Pumping Station	at station 24.75 KM	designed
- Design discharge	101.27 m^3/s	
- Pumps	Inclined axial flow type, 10 units, 12 m^3/s/unit	
Romana Cross Regulator	at station 34.5 KM	designed
- Gates	Radial type, 4 gates	
No.6 Pumping Station	at station 46.5 KM	designed
- Design discharge	91.50 m^3/s	
- Pumps	Inclined axial flow type, 10 units, 12 m^3/s/unit	
Nigala Cross Regulator	at station 59.3 KM	designed
- Gates	Radial type, 4 gates	
Bir El Abd Cross Regulator	at station 75.75 KM	designed
- Gates	Radial type, 4 gates	
Cross Regulator	at station 84.9 KM	proposed
- Gates	Radial type, 4 gates	
Spillway	at station 102.0 KM	proposed
- Gates	Radial type, 4 gates	
No.7 Pumping Station	at station 107.9 KM	proposed
- Design discharge	52.66 m^3/s	
- Pumps	Vertical type, 8 units	
Offtakes	at 31 locations for 265,000 fed.	designed
- Design discharge	0.45 - 27.01 m^3/s	
Delivery Tank	at station 129.0 KM, the end point for 135,000 fed.	proposed

Table 3-9 (1) Proposed Cropping Pattern (1-1)

-Small Farmer

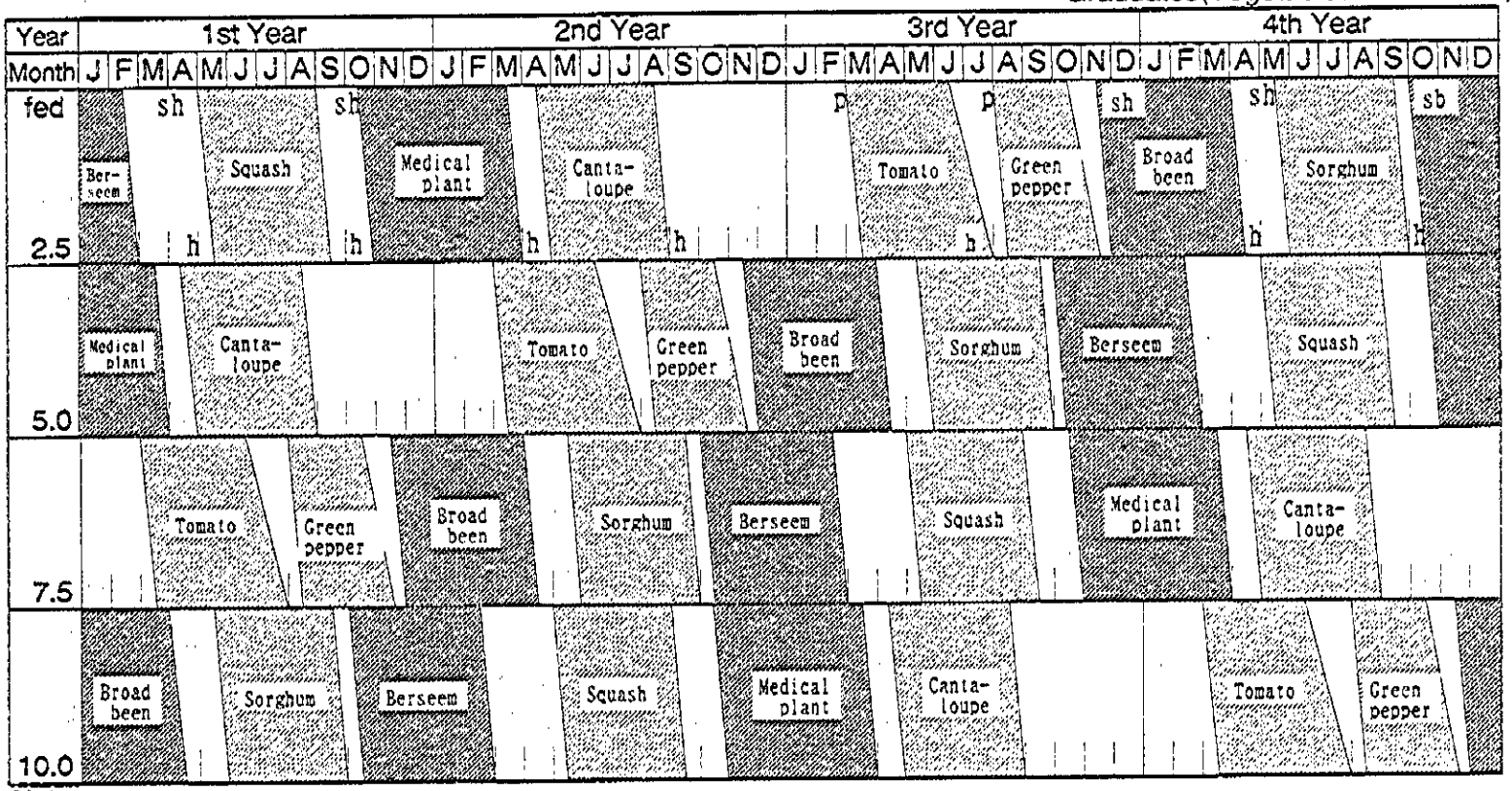


Note:

1) sb : broadcast seeding sh : hill seeding or stripe seeding p : planting h : harvesting
2) Medical plant (Cumin,Herbaccus,Carcadeh,Caraway)
3) Nursery of fruit vegetables by growing in vinyl house and tomato planting under plastic tunnels.

Table 3-9 (2) Proposed Cropping Pattern(1-2)

-Graduates(Vegetables + Livestock)



Note:

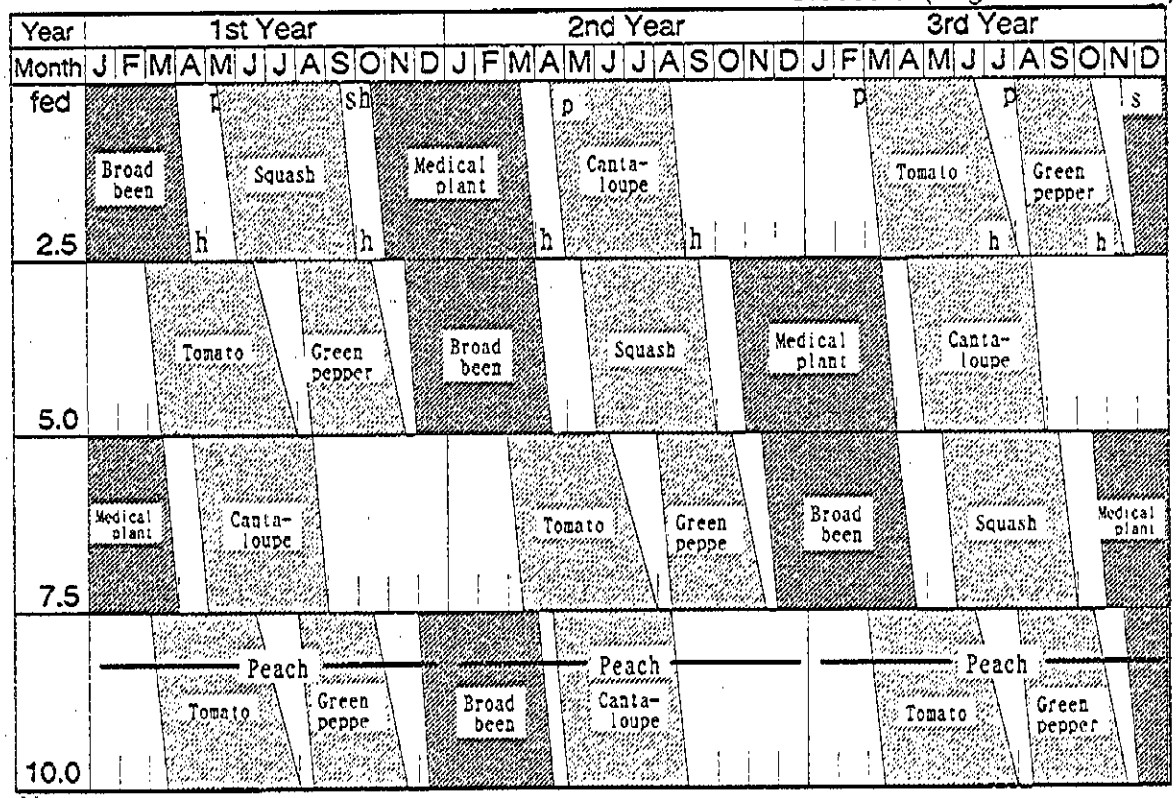
1) sb : broadcast seeding sh : hill seeding/stripe seeding p : planting h : harvesting

2) Medical plant (Cumin,Herbaccus,Carcadeh,Caraway)

3) Nursery of fruit vegetables by growing in vinyl house and tomato planting under plastic tunnels

Table 3-9 (3) Proposed Cropping Pattern (1-3)

-Graduates(Vegetables + Fruit)

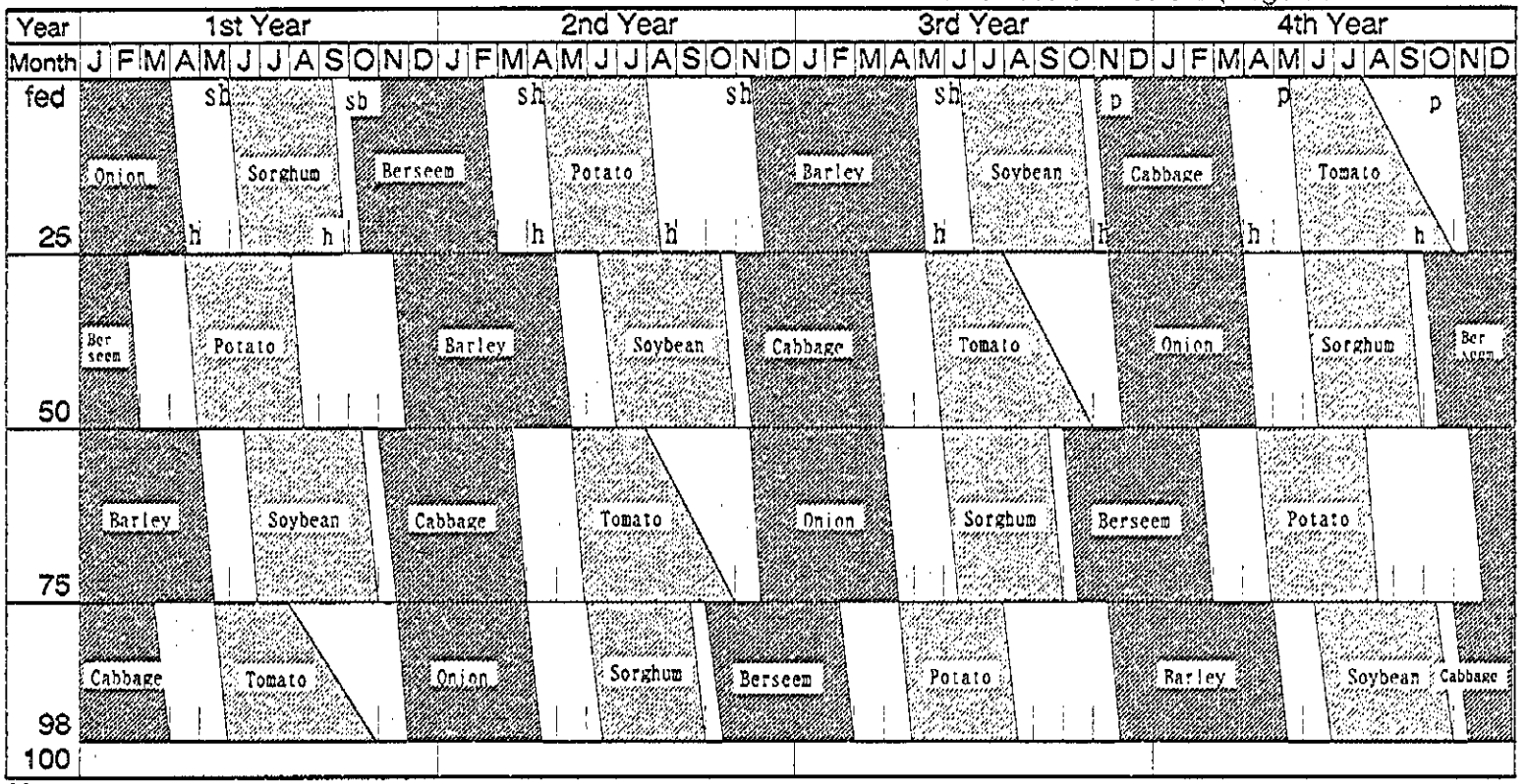


Note:

1) sb : broadcast seeding sh : hill seeding/stripe seeding p : planting h : harvesting.
2) Medical plant(Cumin,Herbaccus,Carcadeh,Caraway)
3) Nursery of fruit vegetables by growing in vinyl house and tomato planting under plastic tunnels
4) Planting inter-crops in young tree orchard.
5) Early peach varieties are picked from end of March to end of May.

Table 3-9 (4) Proposed Cropping Pattern (2-1)

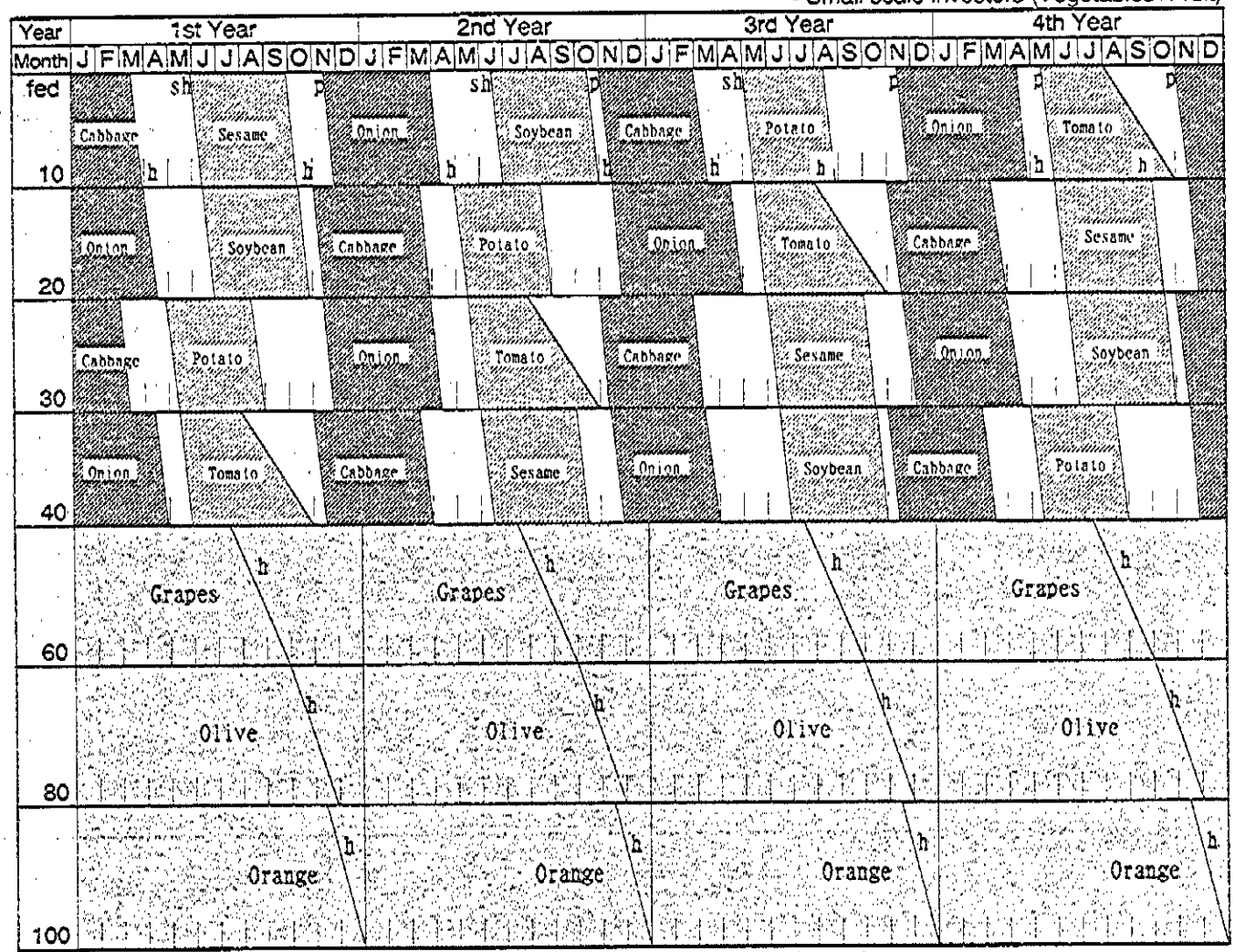
- Small scale investors (Vegetables+Beef Cattle)



Note: 1) sb : broadcast seeding sh : hill seeding or stripe seeding p : planting h : harvesting

Table 3-9 (5) Proposed Cropping Pattern (2-2)

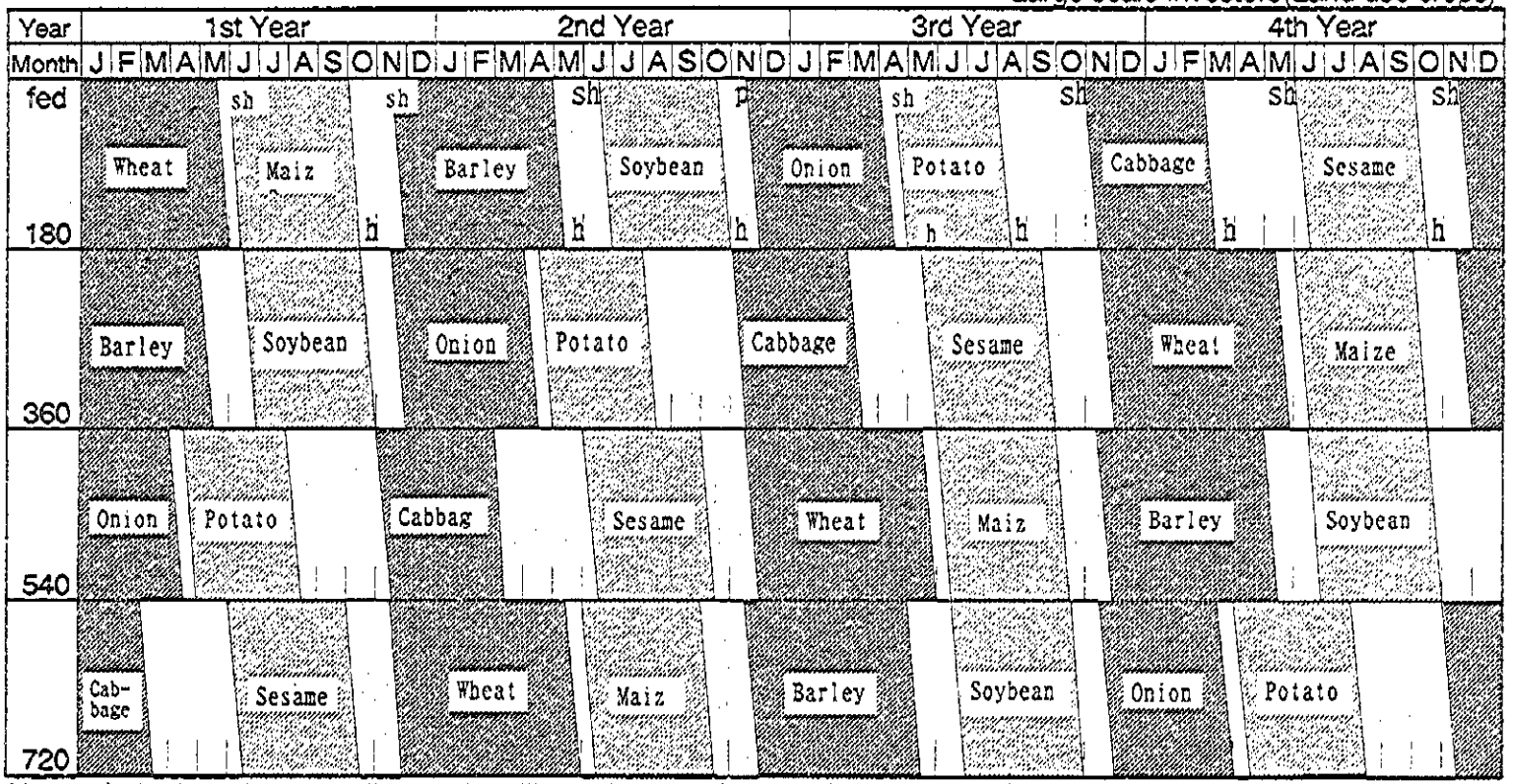
- Small scale investors (Vegetables+Fruit)



Note: 1) sb : broadcast seeding sh : hill seeding or stripe seeding p : planting h : harvesting

Table 3-9(6) Proposed Cropping Pattern(3-1)

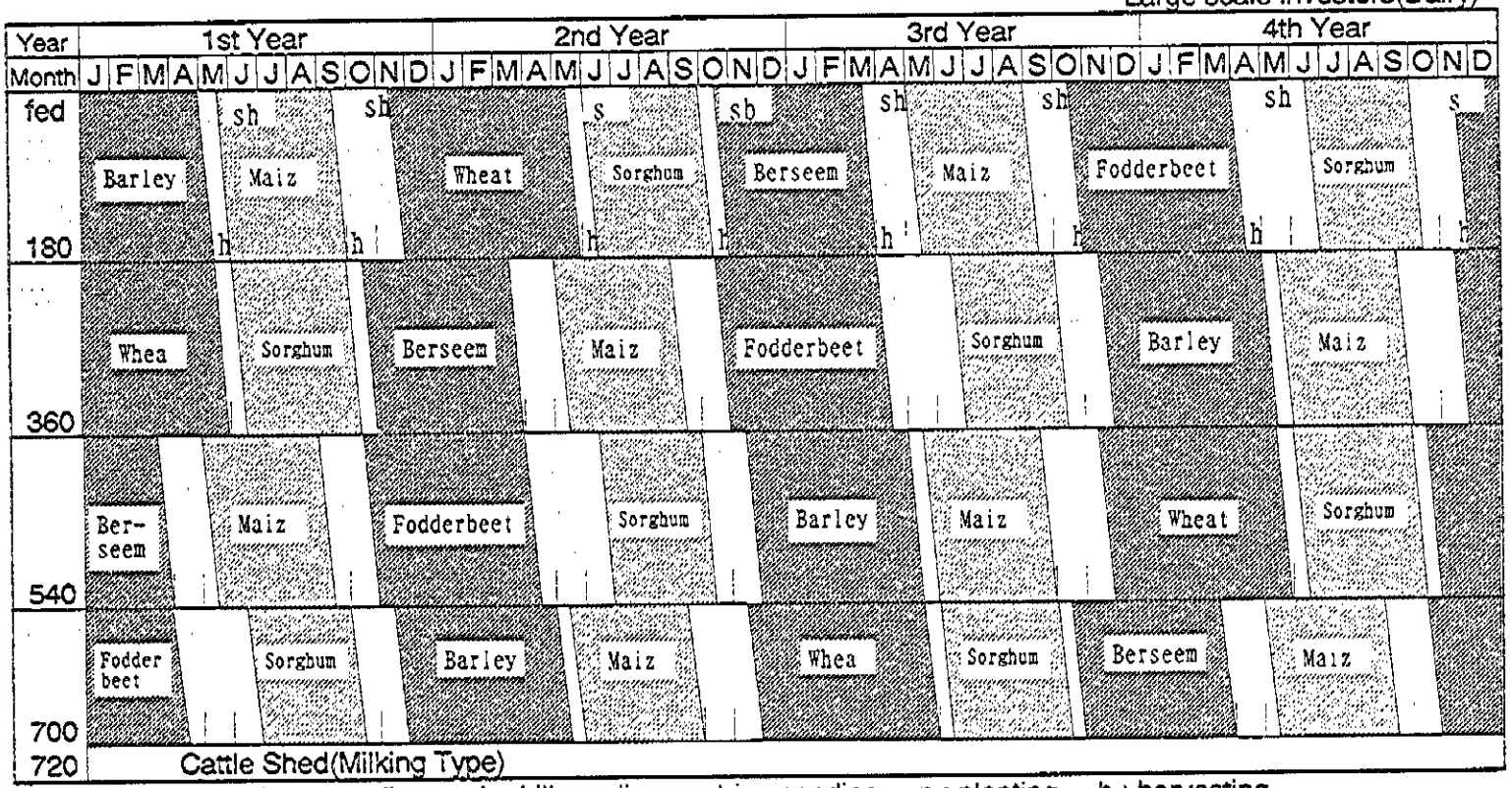
-Large scale investors(Land use crops)



Note: 1) sb : broadcast seeding sh : hill seeding or stripe seeding p : planting h : harvesting

Table 3-9 (7) Proposed Cropping Pattern (3-2)

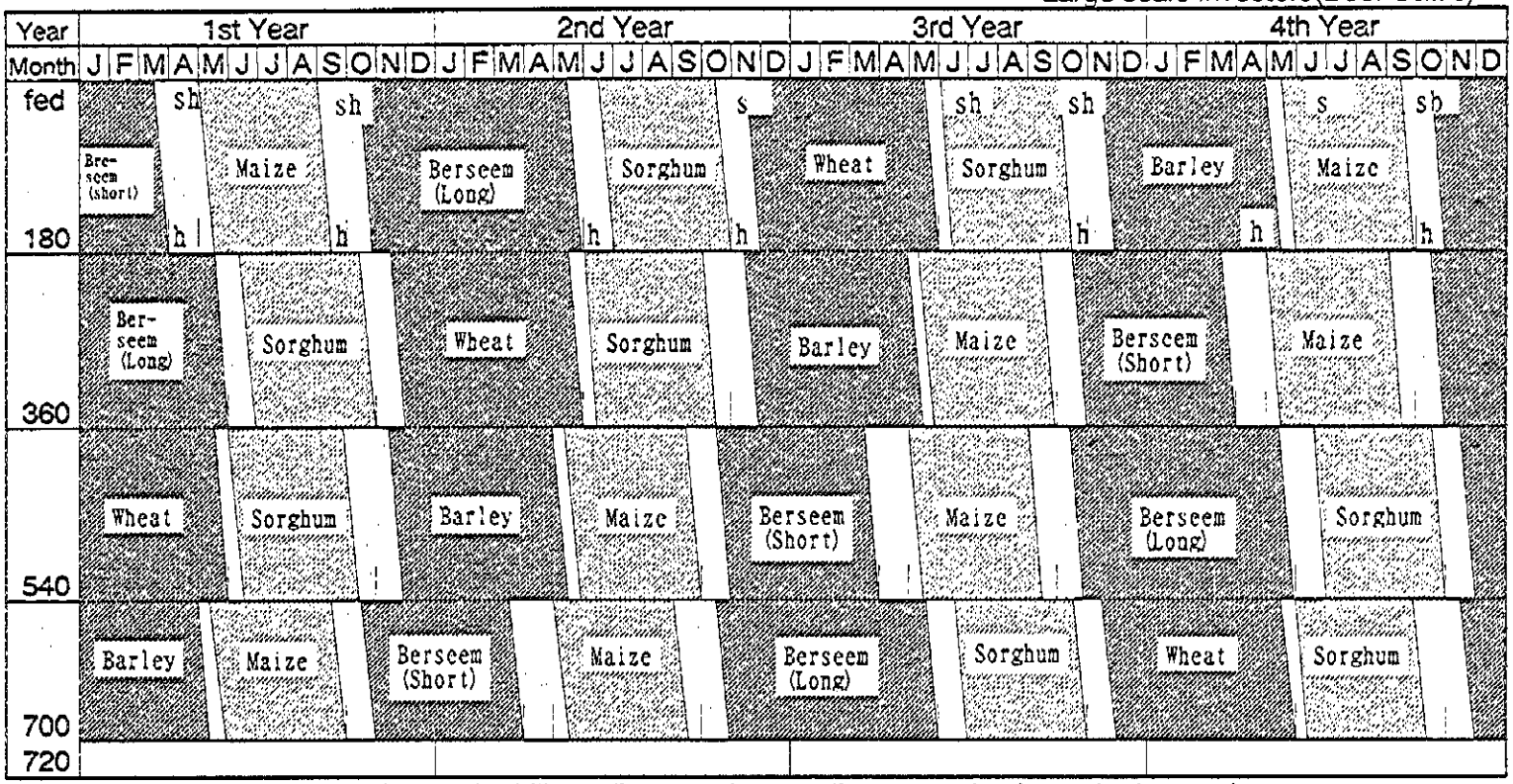
-Large scale investors(Dairy)



Note: 1) sb : broadcast seeding sh : hill seeding or stripe seeding p : planting h : harvesting

Table 3-9 (8) Proposed Cropping Pattern (3-3)

-Large scale investors(Beef Cattle)



Note: 1) sb : broadcast seeding sh : hill seeding or stripe seeding p : planting h : harvesting.

Table 3-9 (9) Proposed Cropping Pattern (3-4)

-Large scale investors(Fruit)

Year	1st Year												2nd Year												3rd Year												4th Year											
Month	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
fed																																																
180					h												h												h												h									
					Almonds												Almonds												Almonds												Almonds									
360						h																																										
						Grapes												Grapes												Grapes												Grapes									
540									h																																							
						Olive												Olive												Olive												Olive									
720										h																																						
						Orange												Orange												Orange												Orange									

Note: 1) h : harvesting

Table 3-10 Projection of Supply and Demand of Agricultural Commodities in Sinai Region

Commodities	Per capita Annual Consumption (Kg) 1/	Demand (x 1000 tons) Human Consumption 2/	Losses, Seed, Feed 1/	Total	Supply (x 1000 tons) Actual Production 3/	New Lands 265,000 fed. 4/	New Lands 135,000 fed 5/	Total	Balance
Wheat	147	471.9	10.3	482.2	89.2	16.7	30.9	136.8	-345.4
Maize	74	237.5	52.7	290.2	0.0	12.3	55.6	67.9	-222.3
Broad beans	5	16.1	2.6	18.7	0.0	7.5	8.3	15.8	-2.9
Potatos	22	70.6	9.7	80.3	0.2	26.5	84.2	110.9	30.6
Tomato	40	128.8	54.8	183.6	30.0	237.0	348.0	615.0	431.4
Cantaloupe & water melon	28	89.9	4.1	94.0	19.4	60.3	110.0	189.7	95.7
Other vegetables	129	414.1	18.8	432.9	37.2	178.0	589.0	804.2	371.3
Orange	27	86.7	4.5	91.2	6.6	87.3	86.1	180.0	88.8
Grape	9	28.9	1.3	30.2	0.0	0.0	81.5	81.5	51.3
Other fruits	201	645.2	29.2	674.4	206.3	231.1	41.7	479.1	-195.3

Note: 1/ - The Impact of the Structural Adjustment Programme on Food Production, Supply and Consumption in Egypt; FAO 1995

2/ - Based on the population projection prepared by the National Project for the Development of Sinai

3/ - Governorate Office of North Sinai

4/ - Agricultural production plan for North Sinai Agricultural Development Project (250,000 feddans); GARPAD

5/ - Production plan of the present study

Table 3-11 Marketing Proposal of Project's Agricultural Commodities

Group	Crops/ Livestock	Self-Sufficiency	National Market		International Market		Animal Feed		Agro-industry		By-products
			Within Sinai	Outside Sinai	European Countries	Arab Countries	Green Fodder	Concent-rates	Project Area	Outside Area	
Cereals	Wheat	◎	△								☆
	Maize							◎	☆		☆
	Barley							◎	☆		☆
Fodder Crops	Sorghum							◎	☆		☆
	Berseem						◎				
	Fodder beet						◎				
Oil Crops	Soybeans									☆	☆
	Sesame									☆	
Pulse	Broad beans	○	◎	△							
Vegetables	Tomato		△	◎		○			☆		
	Cantaloupe		△	◎		○					
	Water melon		△	◎		○					
	Squash		◎	○							
	Green pepper		◎	○							
	Cabbage		◎	○							
	Potato		◎	△	○						
	Onion		◎	△		○					
Medical Plant	Cumin		○	◎	△						
Permanent Crops	Almond									☆	
	Peach		○	◎		△					
	Grape		○	◎	△	△					
	Olive								☆		
	Orange		△	◎	○	△					
Livestock Products	Beef		◎	○					☆		
	Mutton	◎	○								
	Milk (Cattle)		◎	○					☆		
	Milk (Sheep)	◎	○								

Note: ◎ - Principal Destination ○ - Secondary Destination △ - Minor Destination ☆ - Yes

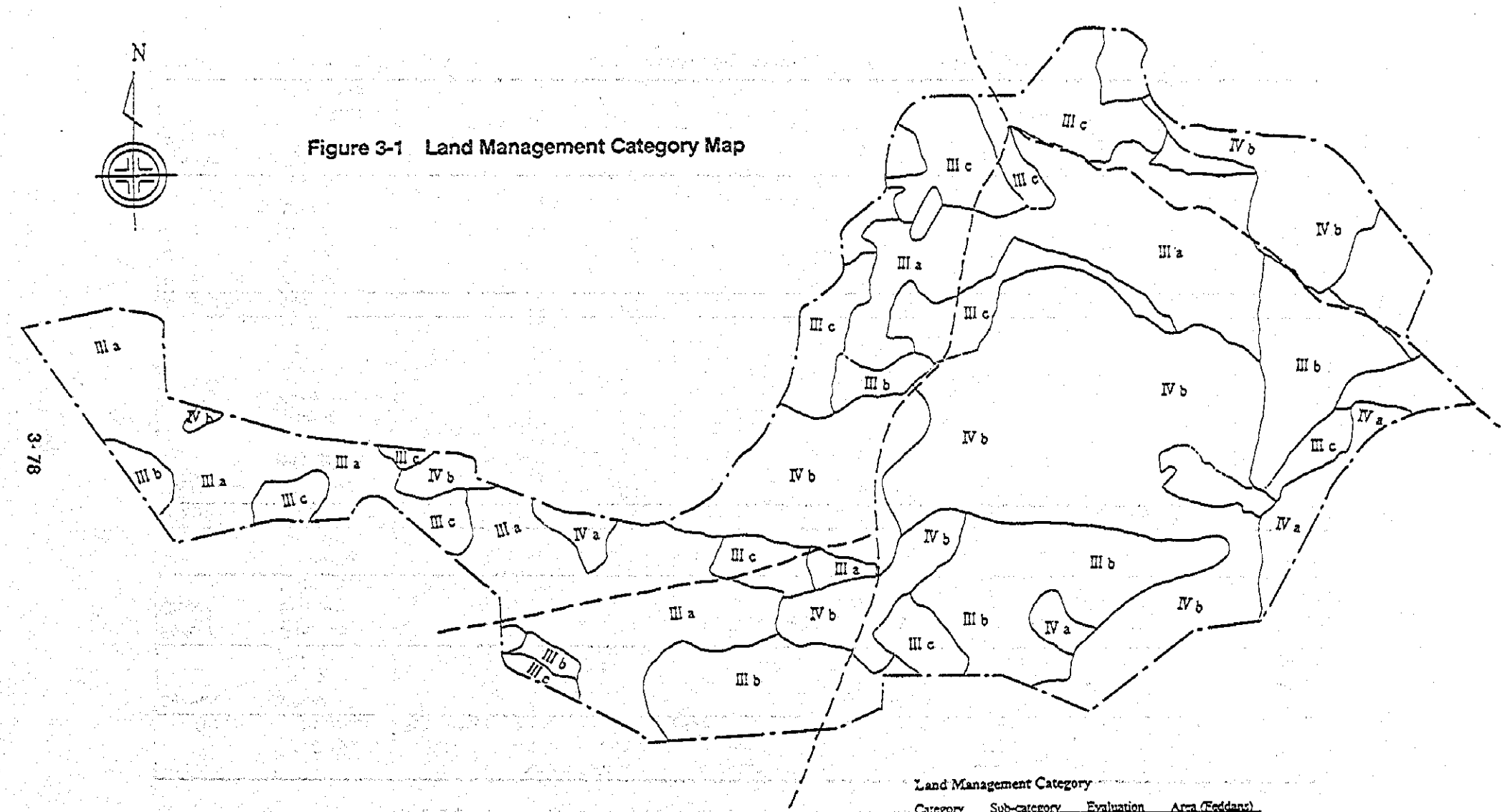


Figure 3-1 Land Management Category Map

Land Management Category

Category	Sub-category	Evaluation	Area (Feddans)
III	III a III b III c	Moderate	70,567
IV	IV a IV b	Poor	64,633

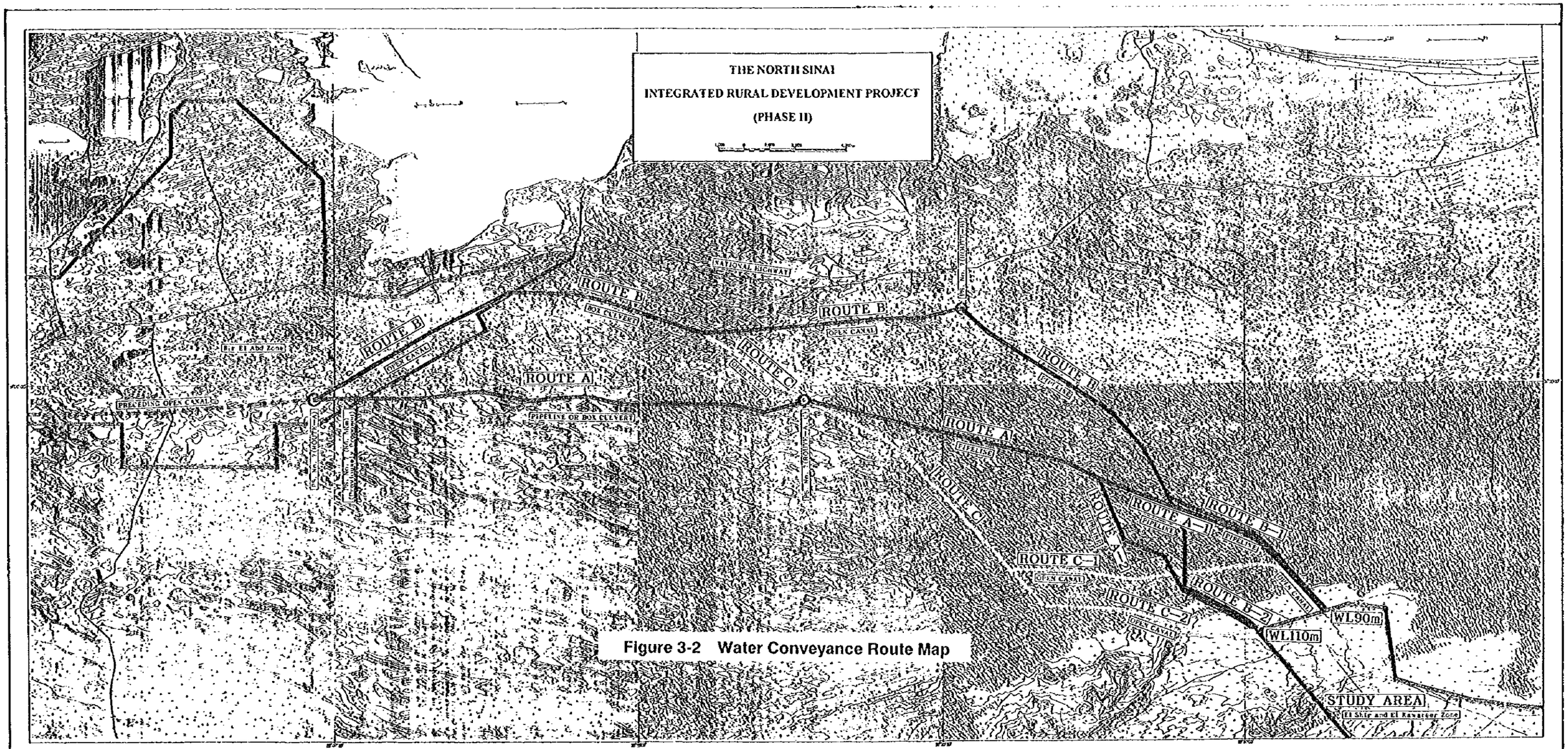
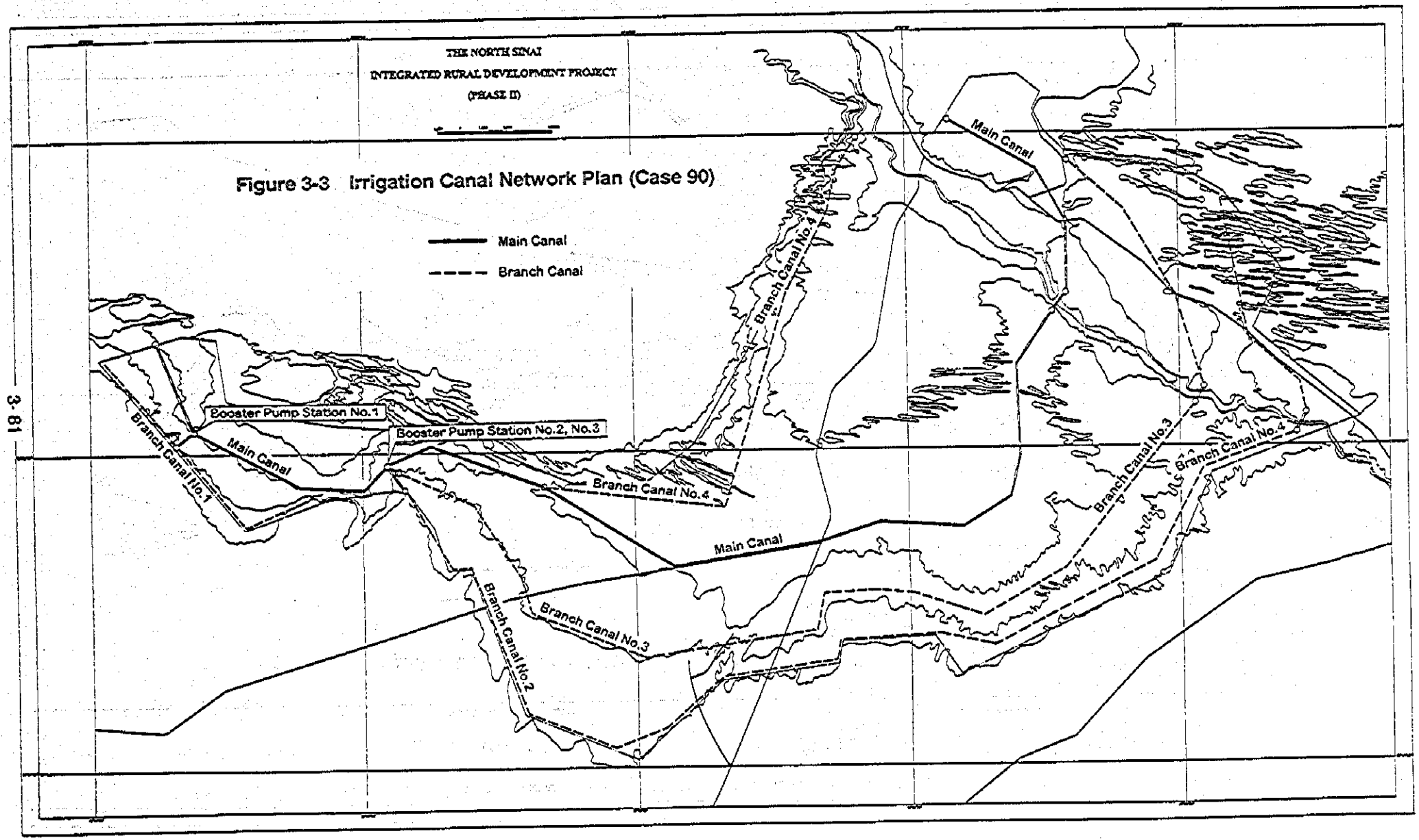
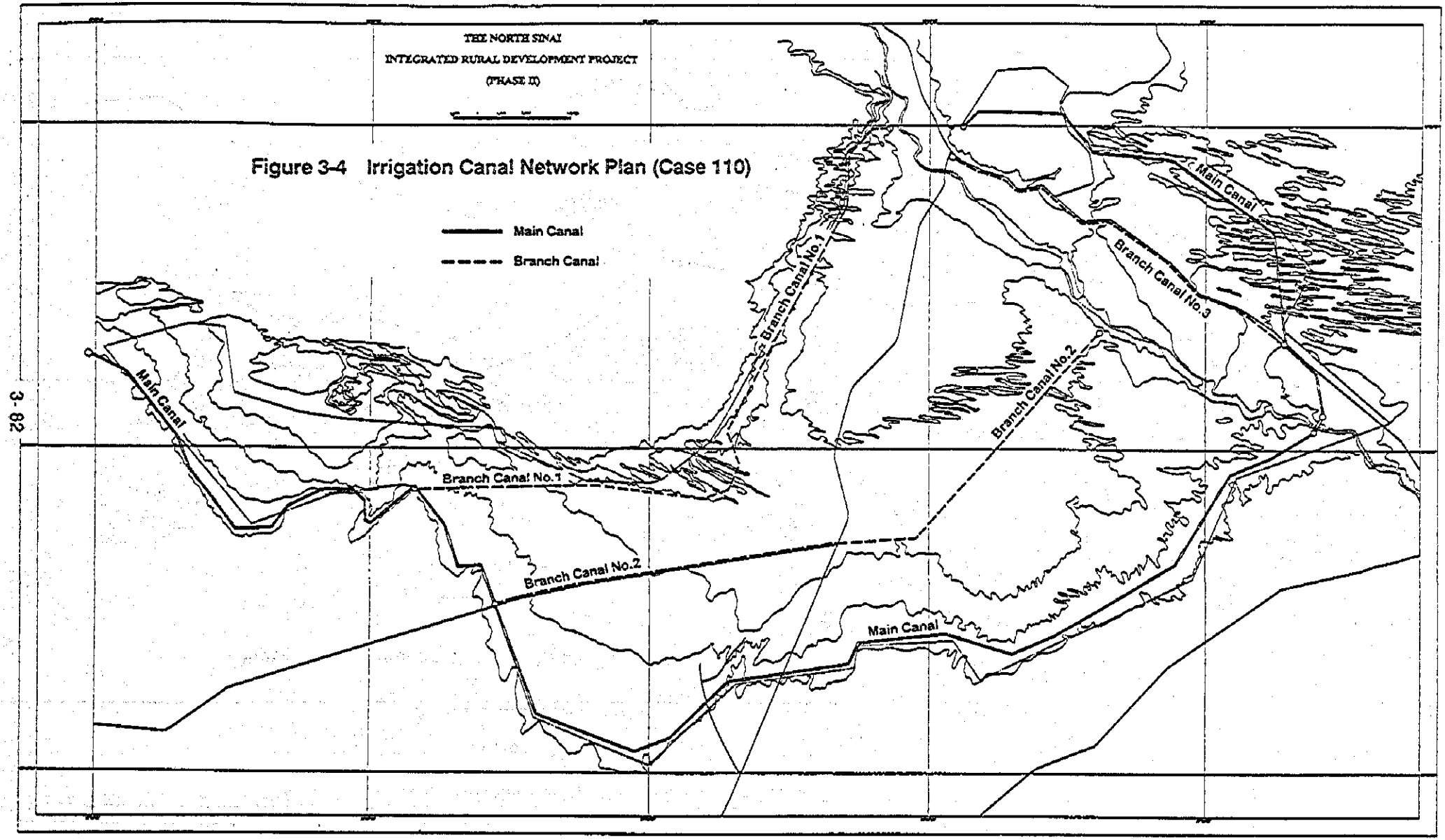


Figure 3-2 Water Conveyance Route Map


THE NORTH SINAI
INTEGRATED RURAL DEVELOPMENT PROJECT
(PHASE II)
Figure 3-3 Irrigation Canal Network Plan (Case 90)
Main Canal
Branch Canal
Booster Pump Station No.1
Booster Pump Station No.2, No.3
Branch Canal No.1
Main Canal
Branch Canal No.4
Main Canal
Branch Canal No.2
Branch Canal No.3
Branch Canal No.4
Main Canal
Branch Canal No.3
Branch Canal No.4


THE NORTH SINAI
INTEGRATED RURAL DEVELOPMENT PROJECT
(PHASE II)
Figure 3-4 Irrigation Canal Network Plan (Case 110)
Main Canal
Branch Canal
Main Canal
Branch Canal No.1
Branch Canal No.2
Branch Canal No.1
Branch Canal No.2
Main Canal
Main Canal
Branch Canal No.3

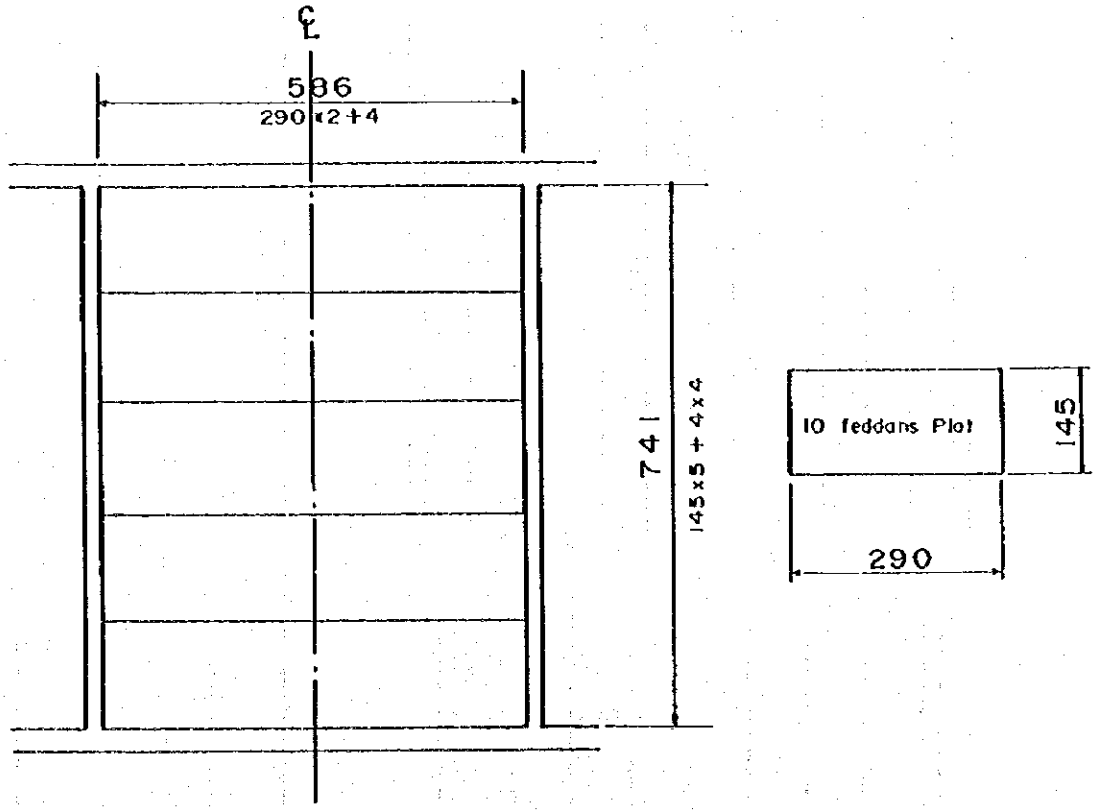


Figure 3-5 Typical Irrigation Unit for Small Scale & Graduate

Note: This applies to vegetable + fruits small scale investors too.

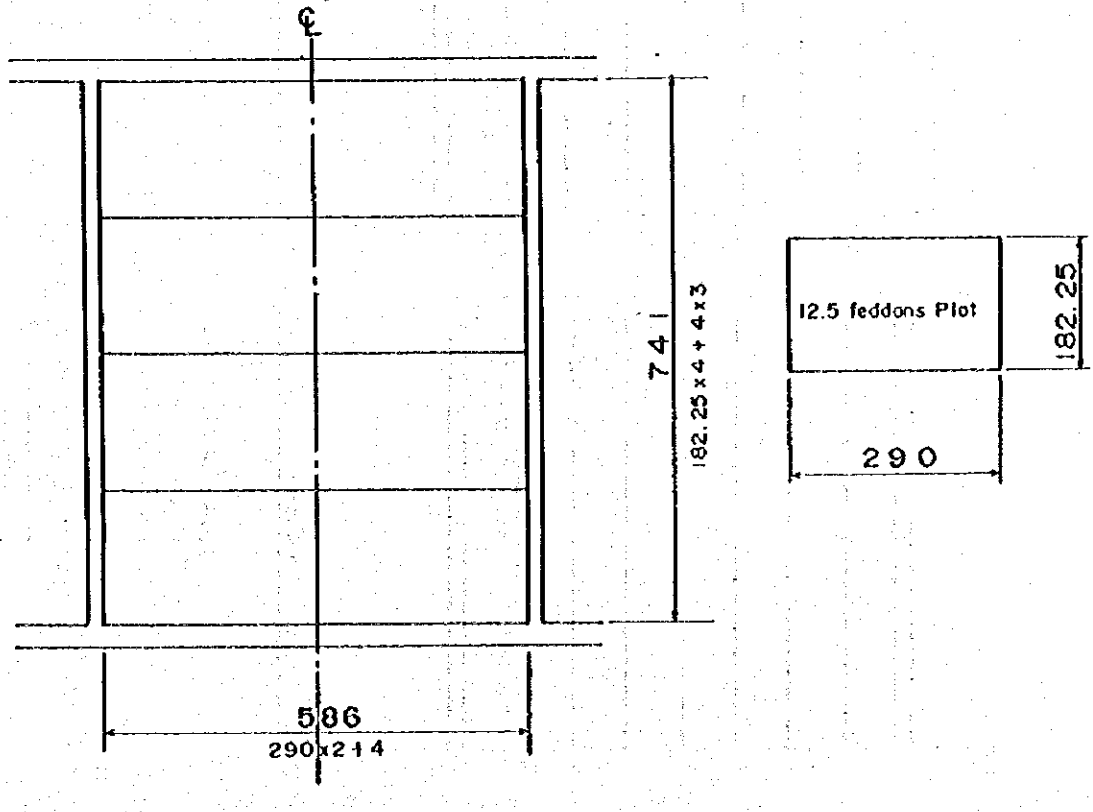


Figure 3-6 Typical Irrigation Unit for Small Scale Investors

Note: This applies to vegetables + beef cattle growers only.

Note: Inner roads' width is 4 meter. Unit: meter

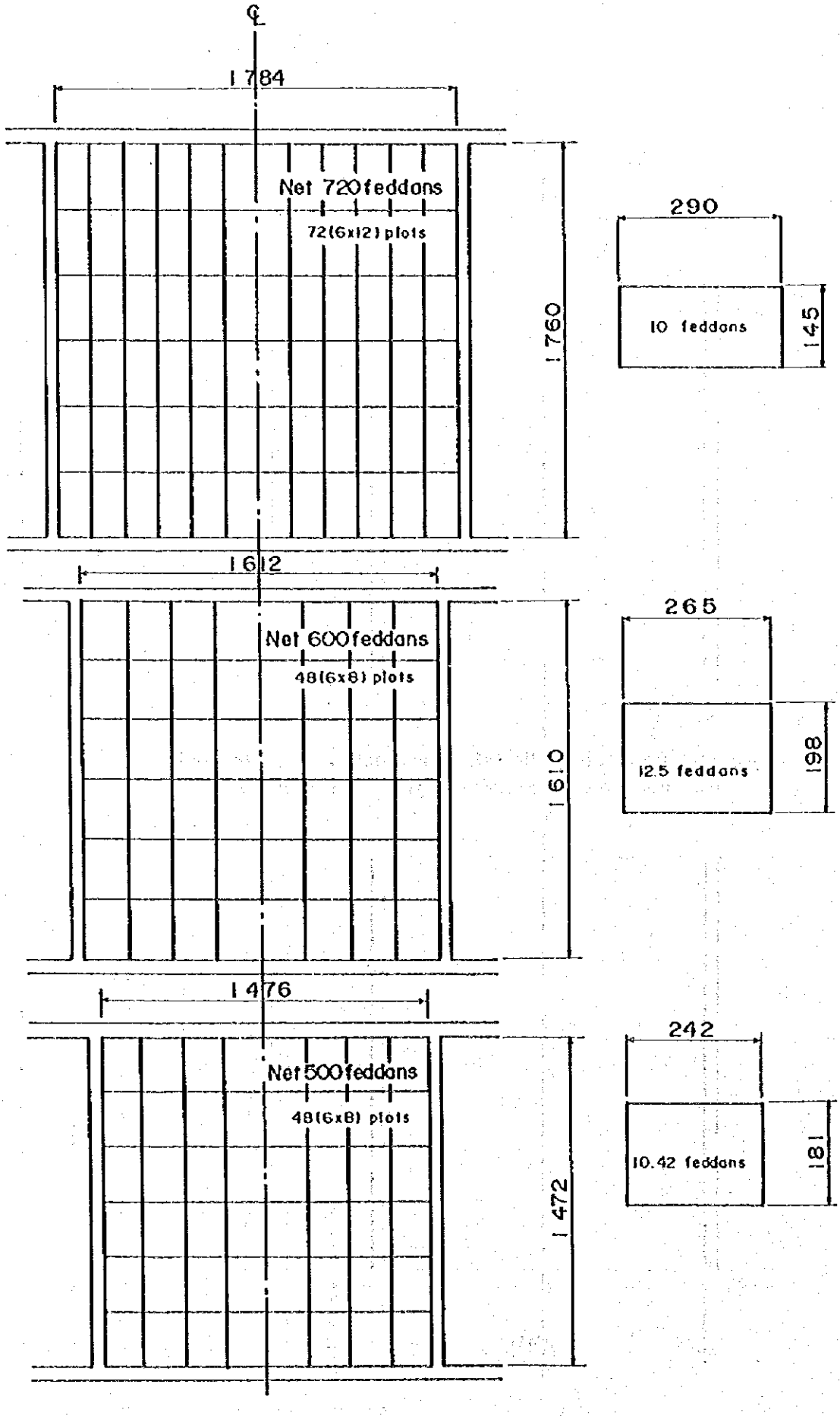
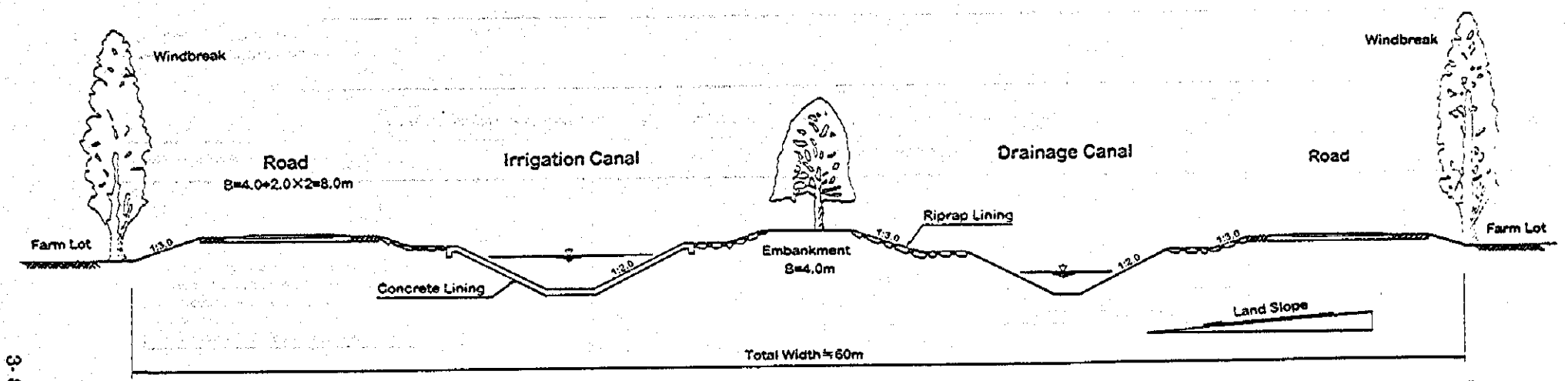


Figure 3-7 Typical Irrigation Unit for Large Scale Investors

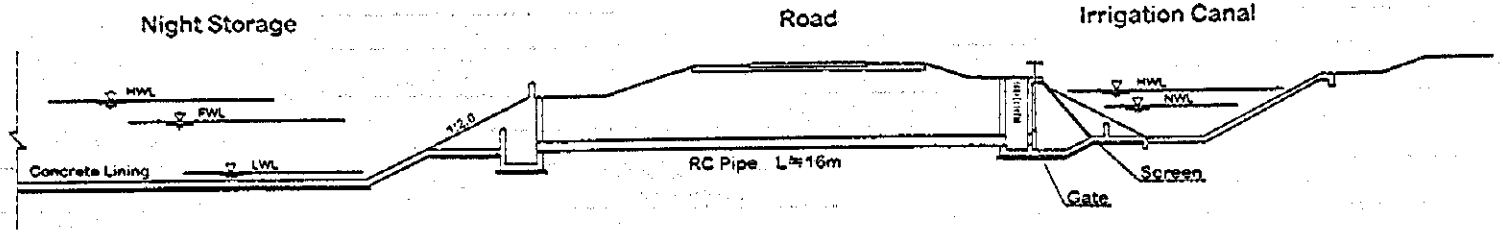
Note : Inner roads' width is 4 meter. Unit : meter

Figure 3-8 (1) Typical Cross Section of Canals and Roads S=1:250



Note : Drainage canals shall be so aligned that the distance from the adjacent irrigation canal shall keep at least 1:5 hydraulic gradient.

Figure 3-8 (2) Typical Cross Section of Intake Structure S=1:250



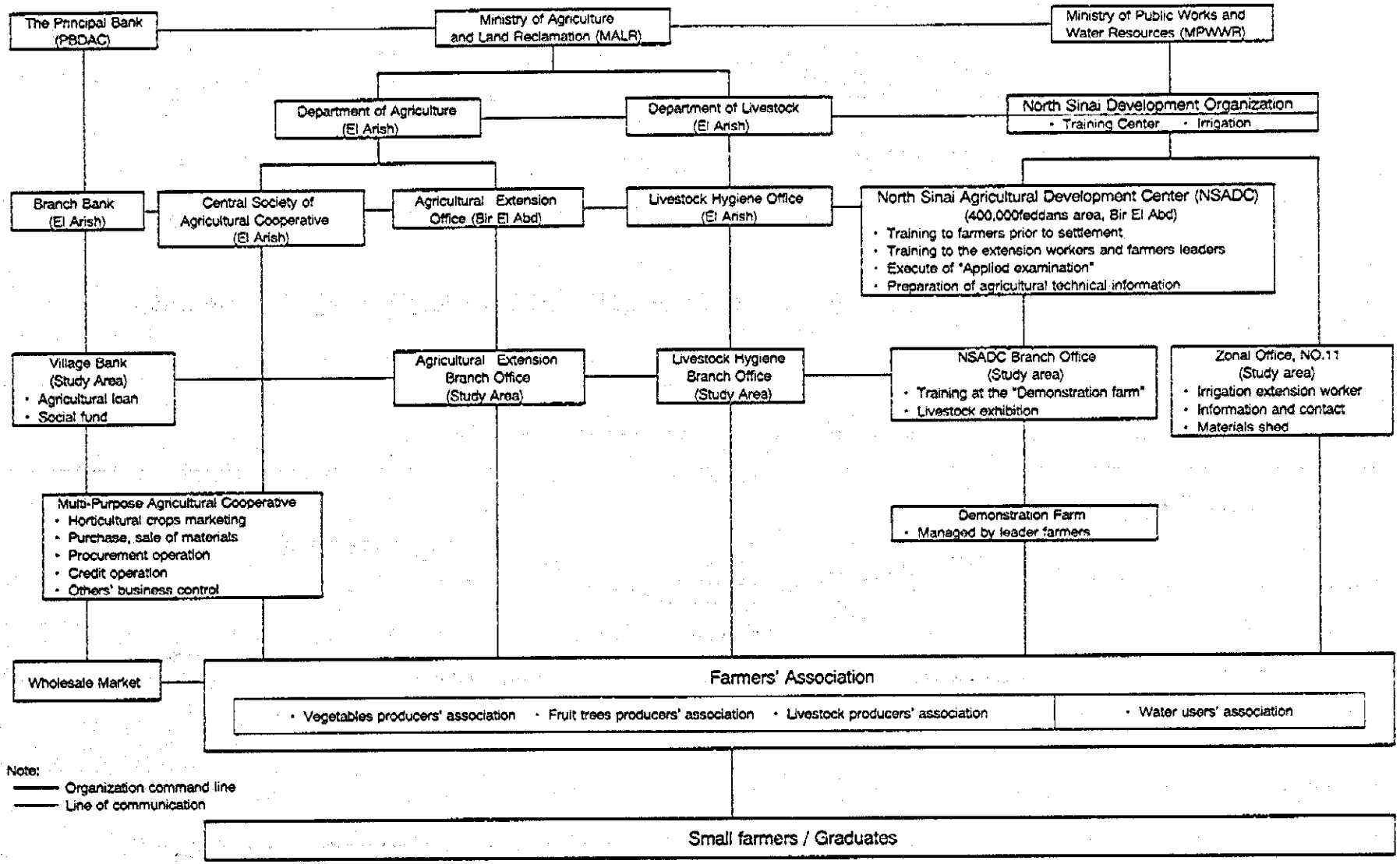


Figure 3-9 Organization of Agricultural Development Supporting Services