CHAPTER 4 DEVELOPMENT PLAN

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4.1 Development Concept

4.1.1 Development Concept

The Fourth Five-Year Plan for Economic and Social Development (1997/98 - 2001/02) states that the agriculture sector will still be considered as the mainstay of the national economy. The GOE plans to expand the cultivable land in desert areas in Sainai and Toshuka to meet stable food supply, to create jobs, and to decrease population growth rate at the same time. The Nile water with its 55.5 billion cu.m per annum, which is limited by the Nile Water Agreement in 1959, is the only available water resource for Egypt. Under this situation, Egypt should save water by changing the cropping pattern to less water sensitive crops and improve the existing irrigation system for re-developing limited water resources.

The development plan on irrigation improvement and water environmental conservation will be formulated, in terms of effective use of limited water resources, for implementing irrigation improvement project with farmers' participation, establishing WUA to have O&M transferred, conclusively increasing agricultural productivity and farm household income to cope with the constraints in the Study Area such as water shortages in the lower part of the canals, inequitable water distribution between up and down stream reaches, old irrigation and drainage facilities causing difficulty of operation, collapse of canal slopes, aggravating water environment and so on.

In the Irrigation Improvement Plan of Old Lands, revised in 1998, the irrigation system in the old land of about 3.48 million feddan (about 1.46 million ha) will be improved by the year of 2017. Under the Plan, about 780,000 feddan (about 328,000 ha) of old lands will be improved within five (5) years from 1997 to 2002. Finally, when all IIP will be executed, about 2.48 billion cu.m (equivalent to 4.5 % of the total available water resources of Egypt) will be saved annually. This amount could be utilized for other purposes and/or in other areas in the Study Area such as the new expansion areas.

Under such circumstances, efficient use of limited water resources and agricultural development are launched as the development target for this Study. From both quantity and quality points of view, water resources should be secured.

4.1.2 Development Strategy

The limited water resources in quantity and quality should be efficiently utilized. Re-developed water resources will be utilized to solve water shortage in the Study Area and/or other new project areas outside the Study Area. Consequently, the development target of the Study will contribute to national development goals.

To secure the quantity on water resources, the following development strategies will be set up for the Study Area.

(1) To come up with future water policy inclusive of rationalization of water management and water saving farming

(2) To encourage water management through farmer's initiatives including partial water management on water controled by WUA

(3) To minimize the gaps between upstream and downstream, promote equality of farm incomes, create job opportunities, and promote privatization policy

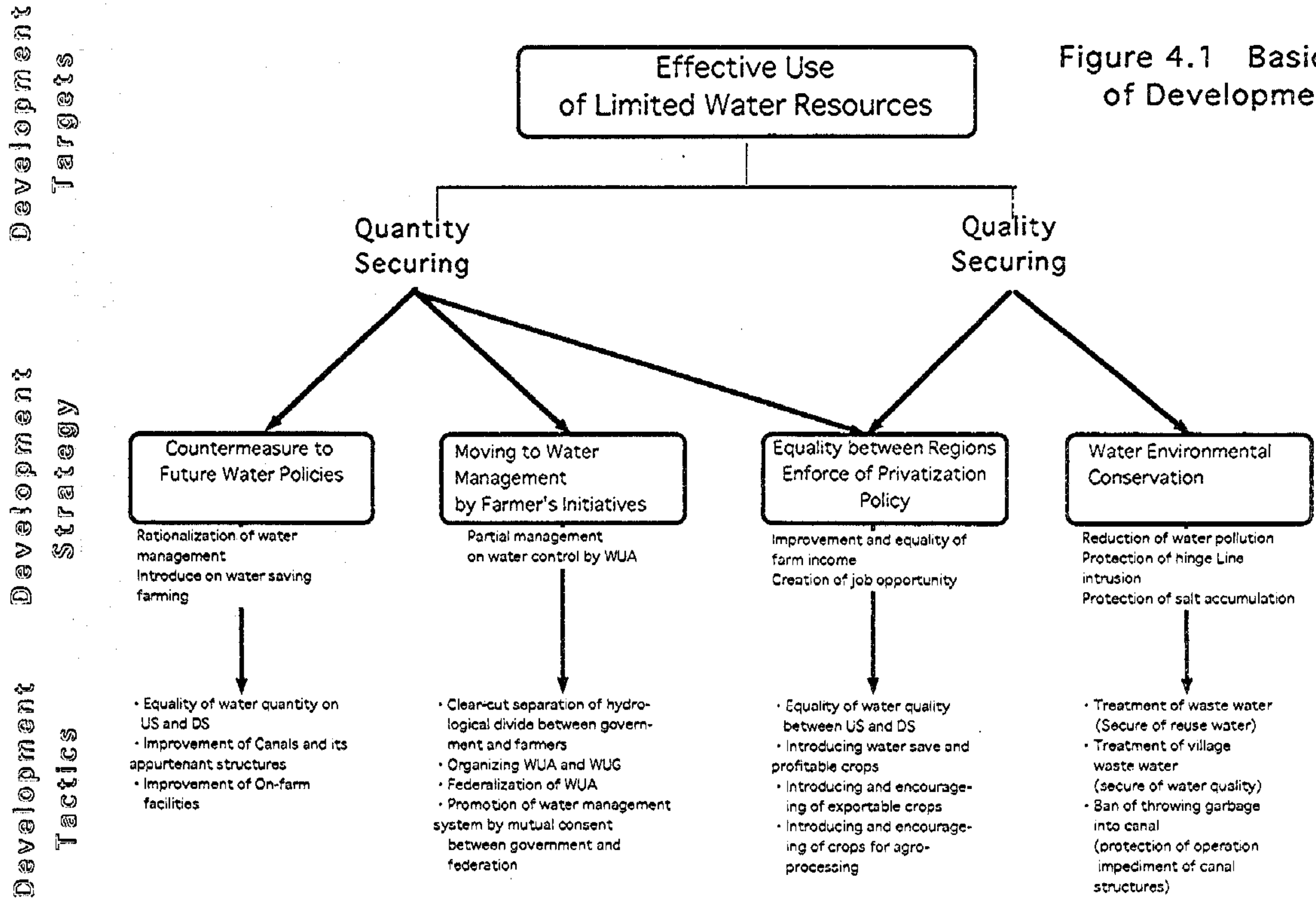
In relation to the quality of water resources, the followings shall be established.

(1) Same as above item (3), and

(2) Water environmental conservation including treatment of wasted water within and outside the Study Area, protection of hinge line intrusion and reduction of salt accumulation

Using the above development strategies for the Study Area, the development procedures will be applied to attain the final goal of efficient use of limited water resources. (Refer to Figure 4.1)

Figure 4.1 Basic Concept of Development Plan



4.2 Agricultural Development Plan

4.2.1 Strategy of Agricultural Development

(1) Basic Strategy

According, to the categories by delivery canals, Category C, E and F are the lowest productivity and few opportunities of non-farm income among the categories. Whereas the average farm size is relatively larger than the others so as to allow them to have high potential to raise their agricultural income. The strategy for agricultural development is to raise agricultural income level of farm households in the Study Area being led by those who belong to category C, E and F.

(2) Target Income

According to the Expenditure and Consumption Survey in 1995/96, the average standard of living in the rural area of the four (4) governorates is estimated at 6,600 LE that is over the national average of 5,700 LE in the rural Egypt. However 54 % of the expenditure of 6,600 LE are contributed to food expenditure that limits the other expenditures such as clothing, education, etc.

To formulate the Master Plan, the progress of the standard of living for farm households will be aimed to decrease the ratio of food expenditure to the total household expenditure up to 45 % that is about current average urban level of Egypt. As the result the target farm household income is aimed at 7,900 LE.

To raise the farm household income, increase of agricultural income and non-farm income will be considered. However, the condition of employment will be severe with the recent high unemployment and the rapid population growth. Therefore the increase of the ratio of agricultural income to the total household income is necessary to achieve the target farm household income. The target will be achieved by the tactics as follows;

- to increase the land unit productivity and cropping intensity by conducting irrigation improvement, drainage improvement and land improvement
- to introduce profitable crops

According to the tactics above, planning cropping pattern, proposed unit yield increase, and availability of water resources were studied with trial and error, so that the

target would be attained. As the result the cropping plan and irrigation plan was formulated as being mentioned as following clause. With this plan the average farm household income in the Study Area will be increased from 5,720 LE at present to 7,960 LE. (Refer to Figure 4.2.1 and Appendix L Table L.4.1, L.4.2)

4.2.2 Improvement of Farming

There is no room on horizontal agricultural development by reclaiming new land in Study Area, the vertical development is required to improve farming. Thus it is proposed to have cropping pattern with high valued crops and to raise unit yields of the respective crops as follows;

(1) Selection of crops

It is propose to introduce such crops as onion and potato, other export oriented vegetables like watermelon, tomato, cucumber etc., as well as oil crops like sunflower aside from the traditional crops under IIP. Once good quality water will be available, the horticulture including the protected horticulture will be developed for vegetables and flowers in especially in the downstream area. There is a possibility to increase the horticultural products to European and middle east counties because Study Area has a very convenient location. Presently the sweet potato, artichoke and loofah are the export oriented in Damietta Governorate. There is a possibility to introduce these crops also in Study Area.

(2) Improvement of Cropping Pattern with Crop Diversification and Water Saving

Since the upstream and midstream areas have almost same soil conditions, similar cropping patterns are prepared for these areas, where these areas cover about 80 % of Category A and B canals areas. The cropping patterns of the upstream and downstream will be applied for about 80 % of the Category A and B, respectively. The remaining of about 20 % of these canal areas will have the pattern for the downstream. The cropping pattern of the downstream will be applied for about 70 % of Category C, E and F.

The proposed cropping pattern in the upstream will have the same cropping intensity of 194 %(200 % in case of double counting for perennial crops) to the present one, while the proposed cropping intensities of the midstream and the downstream are respectively increased from 184 to 199 (200 %)and from 146 to 198 % (200 %). (Refer to Figure 4.2.1 and Annex E Table E.3.3)

Rice area is decreased by 36 % of the existing area in the proposed cropping pattern, following the governmental policy to reduce rice area to 0.9 million feddan from 1.4 million feddan in 1996/97, based on the Fourth Five-Year Plan for Economic and Social Development. Based on the result of Farm Economic Survey, it is proposed that the vegetable areas will be increased by 33 % of the rice reduction area in both summer and winter seasons. The remaining rice reduction area are allocated for other summer crops, mainly maize. Finally rice area will be maintained without any reduction in the downstream area, taking rice into account as reclamation crop for improvement of the saline soils. Resultantly rice area in both areas of the upstream and midstream will be reduced by 57 % of the presently cropped area with rice. Because the farm size is rather large in the downstream area, such non-intensive crops of oilseed crops as sunflower is introduced in the downstream area, having 6 % of intensity.

Recently, such short duration rice varieties as Giza 177, Giza 178 Sakha 101, Sakha 102 are developed in Egypt. These varieties have the growth period of about 120 days to 140 days from sowing to harvesting, while the growth period of long duration traditional ones have more than 150 days. Then the short duration varieties will save the water for the reduced period. According to the Rice Research and Training Centre, Kafr El Sheikh, the target area to introduce the short duration varieties are 70 to 75 % of total rice growing area. Governorate within the Study Area for the coming five years. There is some problems on eating quality for short duration varieties, which is inferior to that of the long duration varieties. However, it is considered that this problem will be solved through improvement of the varieties in near future. Thus, the proposed cropping pattern is formulated as the short duration varieties will be introduced fully in Study Area in near future.

The IIP will make it possible to apply the proposed cropping pattern with the following three reasons; (1) The frequent and timely irrigation will give the conditions to grow such crops like vegetables.(2) Farmer will able to agree with the reduction of rice area in case they will have the opportunity to grow such high value crops like vegetables. (3) The short maturing rice varieties will be successfully grown with the right time sowing and harvesting the improved water management. Rice will be transplanted even though there is a trend that direct seeding will become more popular in the world, considering the limited water resource and the prevailing small-scale farmers in Egypt. When the irrigation efficiency will be raised at more high level, or the rice area will be decreased further the direct seeding will be employed in future.

(3) Crop Production with Project

Based on the data on crop yield in the upstream and the downstream in Farm Economy Survey in Priority Area, the yield increase rate of the respective crops is estimated with IIP. The estimated rates range from 12 % to 35 %. However, the less rates at 8% to 23 % are estimated for area for the upstream area, taking into account the result on the yield in Farm Economy Survey for the area. The subsurface drainage will be newly installed in the non-installed area or will be rehabilitated for the deteriorated ones. The above said yield increase rates are applied for the crop yield with subsurface drainage. The average unit yield per feddan for the major crops of wheat, sugarbeet, berseem, cotton and rice are respectively estimated at 19.00 ardab(6.79 ton/ha),22.74ton(54.14 ton/ha), 28.85ton(68.69 ton/ha),15.85ton(37.73 ton/ha), 7.62 kantar(2.86ton/ha) and 4.07ton(9.69 ton/ha). The total crop production in Study Area is estimated respectively at 662 thousand ton of wheat(increased by 36 % of the present production , 567thousand ton of sugarbeet(48%), 5,951ton of berseem(27%), 141 thousand ton of cotton(15%) and 708 thousand ton of rice (paddy, decreased by 18% of the present production). Certain crops have by product aside from the main products. Including the by products the target crop yield with IIP are projected by year, where the full target yields are attained within four years after project implementation. Such land improvement as gypsum application and subsoiling will contribute improve crop production. Moreover the land levelling by laser beam is effective. This yield increase is included in the estimation of above crop yield . (refer to Table 4.2.1, Appendix E Table E.2.5 E.2.6 E.2.7 and E..2.3.3)

(4) Animal Husbandry

The proposed cropping pattern have the crop rotation with cropping of green fodder crops to promote sustainable agricultural development with livestock. It is proposed to maintain the present scale of animal husbandry production for family consumption and supply of materials to processing factories. Thus the proposed cropping pattern is formulated to have the present scale of forage production.

4.2.3 Improvement of On-Farm Water and Soil Conditions

Not only timely and adequate supply of irrigation water but also the improvement of water and soil conditions at on-farm level is needed to increase crop production. The supplied water have to be distributed evenly as much as possible for any crop at any place. The precise land levelling will be very effective to make water distribute evenly, comparing with the traditional levelling by farmers. The EALIP has provide the data on the land roughness at about -7 to +14 cm in the upper Egypt. The According to EALIP there is a

similar land roughness in the lower Nile delta. EWUP final report says a large part of the over irrigation was caused by unlevelled fields. The field trials on the comparative study on different land levelling reveals that the laser beam land levelling shows significant water use savings and yield increase of crops according to Agricultural Engineering Research Institute, ARC. However, the land levelling works is operated economically only in the area of more than 20 feddan so far the existing techniques is applied.(refer to Annex E Table e.2.10, 11、Figure E.2.1)

Recently land levelling work by laser beam is improved and considerable number of farmers start to apply the improved land levelling in Japan. Then it is proposed to introduce the improved land levelling which under Pilot Project. Once the proper land levelling operation is developed, this will be applied widely in the Study Area.

Presently, the Land Improvement Authority serves for farmers by conducting land improvement works of gypsum application, deep plowing, subsoiling and others according to the without collecting any related charge from farmers. These kinds of services have to be provided from now on in Study Area. The authority also has a service on operation of land levelling by laser beam at the expense of 75 to 150 LE/ feddan for farmers. With development of suitable technique for small scaled land holding it is proposed to make the land levelling by laser beam throughout Study Area. Even in this case it may require some incentive for the small scale farmers to employ the land levelling operation.

4.2.4 Improvement of Agricultural Marketing

The marketing condition of the Study Area will be improved with on going the International Mediterranean Sea Road construction and the Damietta international port which will be rehabilitated for sea freight of exporting commodities during services of the Fourth Five-Year Plan for Economic and Social Development. To get benefit from this advancing marketing condition, an improvement of shipping condition at the point of origin will be planned. The improvement plan will be conducted by utilising the benefit of Meska improvement planning and organisation planning of WUA. The basic strategies of the marketing improvement are as follows;

-Branch road improvement as the component of the Meska improvement will give better access to main roads from fields and prevent the products from damaging the products caused by bad road condition.

-Introduction of continuous flow on delivery canal will provide better condition to expand

vegetable cropping.

-Improvement of condition to farmers' co-operation for marketing by equalising the gap of water supply and location between upstream and downstream reaches of canals with the methods above.

-Upsurge of co-operation among farmers through WUA organisation program and activating conventional customs such as Mosharaka

4.2.5 Improvement Plan of Agricultural Supporting Services

The close cooperation between MPWWR and MALR at the level from national to Governorate/district level is indispensable to improve farming with IIP even from planning stage. For this purpose, the concerned agencies of Egyptian Public Authority for Drainage Projects, MPWWR and Egyptian Authority for Land Improvement Projects, Department of Agricultural Extension, and Soil, Water, and Environment Research Institute, MALR shall collaborate with each other to provide necessary agricultural supporting services regarding to the following items:

- On-farm water management to reduce field application losses by soil type and type of crops
- Drainage management in cultivation with rice also other crops mixed with rice
- Soil survey and land classification to introduce water saving diversified crops
- Optimum cultivation practices with water saving
- Crop rotation with diversified crops
- Improvement of production technology on protected horticulture

The responsible agencies for Agricultural Extension Department and Soil, water, and Environment Research Institute in MALR shall be involved to demonstrate the improved farming in the demonstration farms. The demonstration farms will be operated for about 51 of demonstration Marwa (17 Water district x 3 Categories x one Marwa). The demonstration farms will be established for each locations of Maruwa area (about 7.8 feddan, 3.3 ha per Marwa) by category for three major kinds of delivery canals by Water District. The techniques to be demonstrated to the farmers will be introduced.

The items on activities or techniques regarding to Demonstration Farms will include the followings;

- Formulation of demonstration program for Demonstration Farms by Agricultural Extension Department and Soil, Water and Environment Research Institute.
- Soil improvement and land leveling
- Training of agricultural extension staff and farmers' leaders

The federation of WUA will have Farm Management Section. The demonstrated techniques will be extended to the farmers through WUA Farm Management Section by the agricultural extension staff.

Table 4.2.1 Crop Unit Yield with Project (M/P Area)

Crop	Unit	kg per unit	Upstream		Midstream		Downstream		Rate of Yield Increase			
			Per feddan	Ton per ha	Per feddan	Ton per ha	Per feddan	Ton per ha	Upstream	Midstream	Downstream	Subsurface Drainage
											(%)	
Winter Crops												
- Wheat	Ardab	150.0	19.03	6.80	19.92	7.11	18.36	6.56	8	12	12	15
- Broadbean	Ardab	155.0	11.03	8.47	12.77	4.71	10.45	3.86	9	13	13	20
- Sugarbeet	ton	1,000.0	-	-	26.79	-	21.25	43.74	-	12	12	20
- Flax	ton	1,000.0	2.94	7.00	-	-	-	-	8	-	-	20
- Berseem(Long Term)	ton	1,000.0	27.34	65.10	25.49	60.69	27.07	64.45	9	13	13	20
- Berseem(Short Term)	ton	1,000.0	8.37	19.93	10.57	25.17	9.90	23.57	5	8	8	20
- Vegetables(Onion)	ton	1,000.0	12.29	29.26	12.32	29.33	8.83	21.02	8	12	12	20
Summer crops												
-Cotton	Kanta	157.5	7.32	2.75	8.04	3.02	8.07	3.03	21	32	32	25
- Maize	Ardab	140.0	23.72	7.91	25.71	8.57	25.88	8.63	22	33	33	15
- Rice	ton	1,000.0	4.11	9.79	4.04	9.62	4.07	9.69	19	28	28	5
- Sunflower	ton	1,000.0	-	-	-	-	1.20	2.86	-	-	30	15
- Vegetables(Tomato)	ton	1,000.0	13.47	32.07	14.55	34.64	13.70	32.62	23	35	35	25
Fruit trees(Orange)	ton	1,000.0	10.49	24.98	12.66	30.14	11.56	27.52	19	28	28	25

Note:
The increase rate of unit yield in the mid and downstream areas is estimated from the yield without IIP and the yield difference between the top and tail in Farm for the downstream area, while 67percent of the rate are applied for the upstream area because of the favorable irrigation conditions in the areas.
The unit yield without IIP is estimated for the mid and downstream areas, referring the feasibility study report on Farmland Environmental Improvement Project in Omoum Area.

Source: MALR,DOS

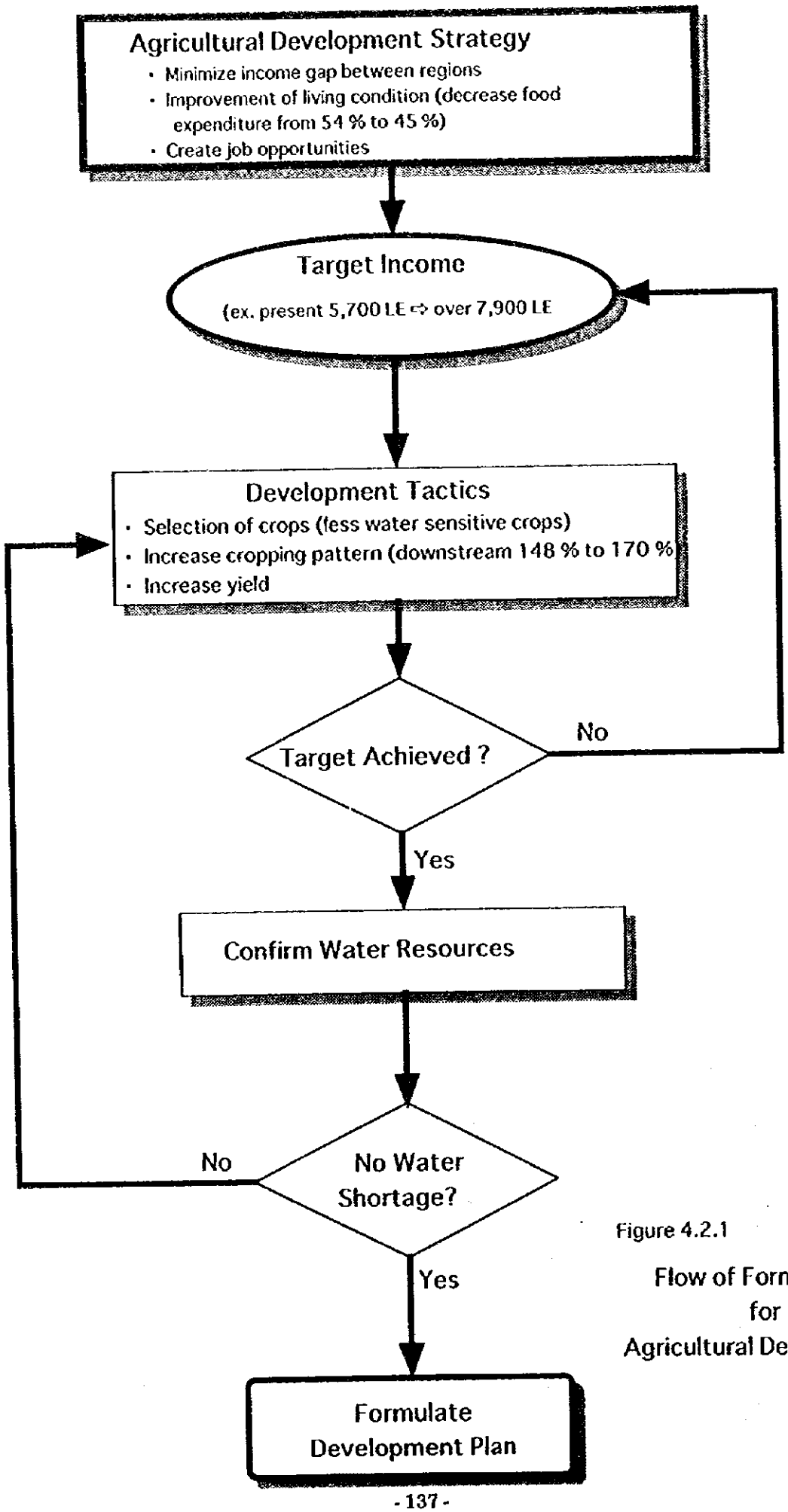
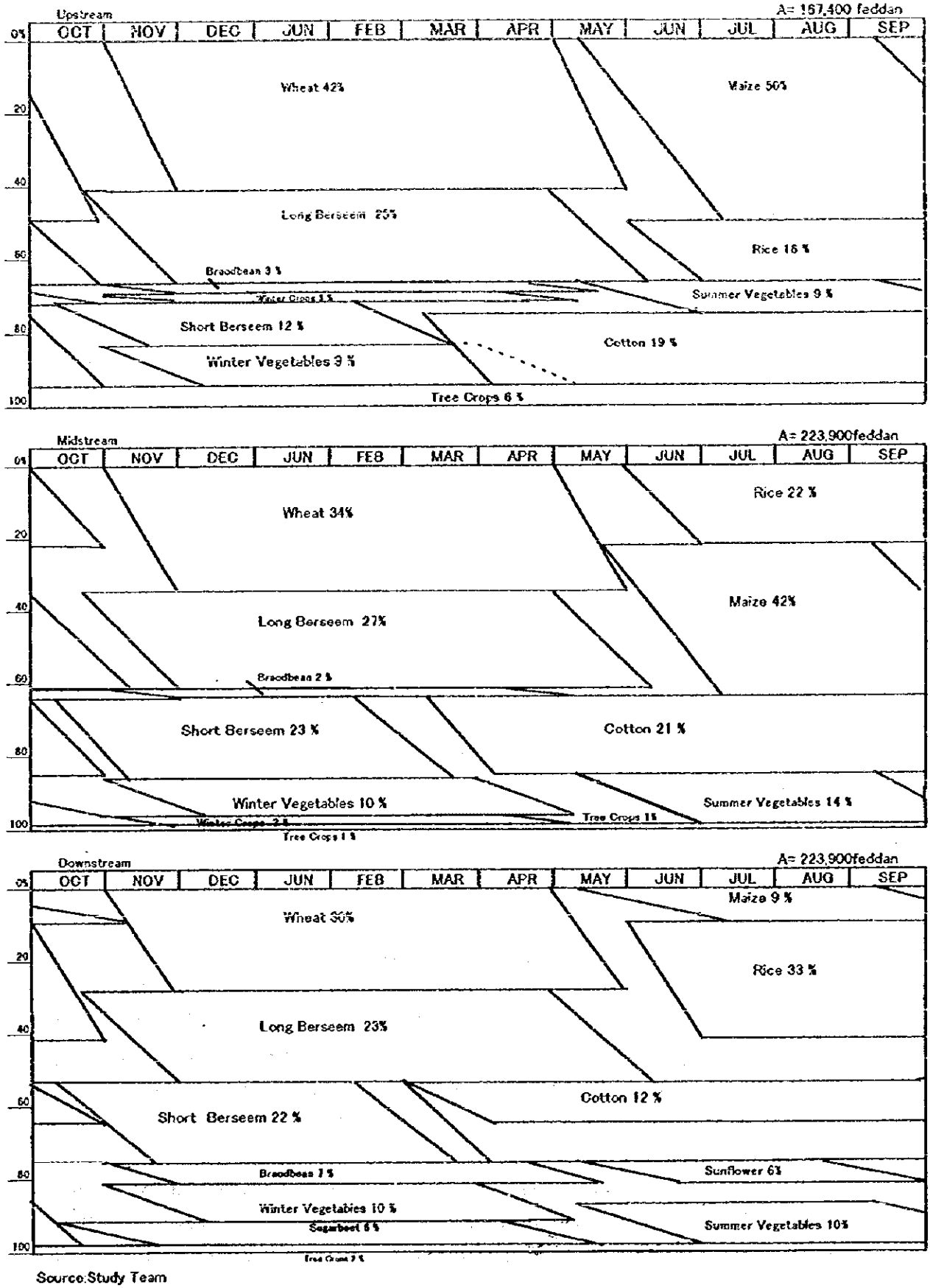


Figure 4.2.1

Flow of Formulation
for
Agricultural Development

Figure 4.2.2 Proposed Cropping Pattern (M/A Area)



Source:Study Team

4.3 Development Plan on Irrigation and Drainage

In between the Damietta Branch and Gharbia drain, the irrigation system is extensively networked. The Study Area is composed of Bahr Shebin irrigation network as its main system and other minor irrigation networks. Bahr Shebin commands an area 641,397 feddan (269,387 ha) which occupies 92 % of the whole 695,223 feddan irrigation area (excluding new reclamation area not yet commissioned). The remaining 8 % is covered by the canals of Omar Pick, G. Dahtoura, Bahr Shershaba and El Korashia.

Omar Pick and G. Dahtoura canals take water just beside the intake of Raiah Abbasee, and Bahr Shershaba and El Korashia branch from El Monofy and enter the Study Area from the upstream side. The areas served by these canals do not have any noticeable irrigation related problem including water shortage, therefore this Study mainly undertakes the Bahr Shebin Command Area for formulating the development plan.

4.3.1 Availability of Water Resources

Based on known water amount or estimates undertaken between 1993 and 1997, availability of water resources for this Study Area is assessed below;

Available Nile fresh water for the Bahr Shebin command area is composed of inflows from Raiah Abbasee and El Monofy canals. The estimates of inflow from the Raiah Abbasee is known while the flow discharged from El Monofy at the meeting point with Raiah Abbasee is not known. However, with reference to the discharge measurement at Santa Regulator located 9 km upstream of the meeting point, the flow into the Bahr Shebin command Area can be estimated. The estimated annual inflow for the last five years from 1993 and 1997 ranges from 224 MCM in 1997 to 259 MCM in 1996 with mean of 237 MCM.

With reference to the last five years (1993 - 1997) discharge records at the intake of Raiah Abbasee, the principal canal had conveyed an annual inflow ranging from 4,286 MCM in 1994 to 4,676 MCM in 1997 with the mean of 4,479 MCM. Discharge at the intake of Meet Yazied must be subtracted to estimate the water available only for the Bahr Shebin command area. Referring to the same five years, the discharge at Meet Yazied is between 1,341 MCM in 1994 and 1,497 MCM in 1996. The mean for the last five years is 1,424 MCM.

Two pump stations supply Nile fresh water into the Bahr Shebin command area; namely, Balamoun P.S. and Kafr Saad P.S. With reference to the pump operation records between 1993 and 1997, an annual amount of 192 to 220 MCM had been lifted at Balamoun P.S., and 269 to 313

MCM at Kafr Saad P.S. The mean for the five years is 208 MCM at Balamoun P.S. and 291 MCM at Kafr Saad P.S.

Considering the above estimates, the fresh water available for whole Bahr Shebin command area can be estimated. The mean annual amount for the five years from 1993 to 1997 is 3,791 MCM, the annual minimum is 3,640 MCM in 1993 (4 % less than the mean), and the annual maximum is 3,948 MCM (4 % more than the mean). The Water Distribution Sector distribute the same amount of water to all irrigation directorates since 1992 with the exception of minor changes, the available fresh water for the Bahr Shebin command area has not practically changed in volume for the last five years.

Two mixing pumping stations, East El Monofia M.P.S. and Hamoul M.P.S., lift drainage water and mix into relevant canals. East El Monofia M.P.S. lifts the drainage water in Karene drain, upstream of Gharbia drain, and discharges it to Raiah Abbasee. The annual drainage mix for the last five years from 1993 to 1997 ranges between 42 MCM in 1996 and 72 MCM in 1994 with the mean of 57 MCM. According to the Hamoul M.P.S. operation, the annual drainage mix for the last five years is between 279 MCM in 1994 and 390 MCM in 1997. The annual average is 321 MCM.

The fresh water and drainage water mentioned above consist of the total known water available for Bahr Shebin command area. This reaches an annual amount of 4,169 MCM which is composed of 3,292 MCM (79 %) from the canals, 499 MCM (12 %) from the two irrigation pumping stations, and 378 MCM (9 %) from the two mixing pumping stations (refer to Table 4.3.1 and Figure 4.3.1).

There are municipal and small scale industrial usages within the area. These have to be subtracted from the known amount in order to estimate the available water for irrigation. The usages reach an annual total amount of 143 MCM, which consists of about 3.8 % of the known total Nile fresh water of 3,791 MCM. Subtracting the municipal and industrial usages, the amount available for irrigation can be estimated. This amount reaches an annual amount of 4,026 MCM (refer to Table 4.3.1).

This Study considered the amount of 4,026 MCM as the water resources available for irrigation. This amount is to be the given condition in carrying out water balance study for both cases of present situation and future situation accompanied with irrigation improvement project.

4.3.2 Present Overall Water Consumption

Bahr Shebin whole command area is 641,397 feddan, part of which is irrigated by drainage only or feeders from Damietta Branch. The area irrigated by the drainage and the feeders can reach to as much as 76,352 feddan at the maximum. However, in case of drainage shortage and low water level at the Damietta Branch, Bahr Shebin has to compensate the shortage. Therefore, two cases are applied in estimating the overall present irrigation unit consumption; namely, Bahr Shebin whole area of 641,397 feddan and 565,045 feddan which excludes areas served by the drainage and the feeders. The annual unit consumption is worked out as follow;

Whole Area (641,397 feddan):	1,495 mm (6,277 cu.m/feddan)
Excluding areas by dr'ge/feeders (566,745 fed):	1,691 mm (7,104 cu.m/feddan)

4.3.3 Present and Planned Irrigation Efficiencies

Irrigation efficiency can be estimated by calculating the total irrigation water requirement of the Project. The efficiency in this Study is sub-divided into three stages. The efficiencies are proposed with reference to the ones undertaken in the preceding IIP projects, present field condition and practices;

- *Canal Conveyance efficiency (Ec):*

  Ratio between water received at the inlet of an irrigation block and that in-taken at the Project headwork; namely, conveyance efficiency subject to the principal canals starting at the water source(s), branch canals and delivery canals within the Project area and excluding Meska and on-farm canals.

- *Meska conveyance efficiency (Em):*

  Ratio between water received at the inlet of an irrigation block and that received at the outlet usually installed at a sub-divided irrigation block; namely, distribution efficiency subject to Meska and on-farm canal (Marwa) in the irrigation block. Efficiency relative to direct pumping and on-farm canal (Marwa) distribution are counted in this category.

- *On-farm application efficiency (Eo):*

  Ratio between water directly available to the crops and that received at the outlet of the sub-divided irrigation block, depending on irrigation scheme to be applied, experience of the farmers, soil condition and climate.

IIP and Project Preparation Department (PPD) under MPWWR prepared a Preparation

Reports, with assistance from the World Bank (WB), of the Mahmoudia, El Wasat and Manaifa irrigation improvement projects in March 1994. They identified overall efficiencies (Ep) as; 0.44 for without-project and 0.66 for with-project. The WB reviewed the irrigation efficiencies in July/August 1994 and estimated the irrigation efficiencies as; increase by 0.05 from 0.70 to 0.75 for on-farm field application, increase by 0.10 from 0.85 to 0.95 for Meska conveyance, and no change for canal conveyance of 0.85. The overall efficiency (Ep) is therefore to be from 0.50 (0.70 x 0.85 x 0.85) for without-project to 0.61 (0.75 x 0.95 x 0.85) for with-project.

The ISAWIP, assisted by the Canadian Government, was designed to undertake an integrated approach composed of both irrigation and drainage improvements. The project assumed impacts showed irrigation efficiency change as; +2 % for canal automation, +7 % for Meska improvement, +8 % for on-farm water management, -3 % for external drainage reuse, and -4 % for sub-surface drainage installation; giving an overall 10 % increase. The measured overall efficiency before project implementation was 37 %, with 10 % overall increase when the proposed project will be implemented and thereby increasing the irrigation system efficiency (Ep) to a new level of 47 % (with-project data is not available yet).

The observations in the Study Area suggests a certain high level of irrigation practices in view of no noticeable loss from government controlled canal and even from Meskas, and of prevailing water shortages, which in turn enhance the farmers' water management. Therefore, this Study applies relatively high efficiencies for without-project, and improved ones for with-project are proposed considering the above discussions. The efficiencies are shown below; giving overall efficiency of 0.56 for without-project and 0.66 (10 % increment) for with project as the base case. Also, another case with further improvement of 2 % is undertaken, giving overall efficiency of 0.68, with a highly improved irrigation realized.

Item	Without-Project	With-Project (base)	With-Project (enhanced)
On-farm Application, Eo	0.65	0.73	
Meska Conveyance, Em	0.90	0.95	
Main, Sec. Del. Conveyance, Ec	0.95	0.95	
Overall Efficiency, Ep	0.56	0.66	0.68

4.3.4 Irrigation Water Requirement

(1) Crop Evapotranspiration

For calculating crop water requirement, modified Penman method usually gives the most satisfactory results under the condition that such measured data as temperature, humidity, wind

and sunshine duration are available as compared to other methods such as Blaney-Criddle and Radiation methods. This Study employed the modified Penman method in estimating reference crop evapotranspiration (ETo) with reference to the mean data provided by the Meteorological Authority.

The stations referred to are Damietta for northern part of the Study Area, defined as downstream area in this Study, and Mansoura for the rest of the areas which are defined as upstream and midstream areas. Annual ETos are 1,695mm for Damietta with daily maximum of 7.03mm and 1,748 mm and for Mansoura with daily maximum of 7.48mm.

Station	Annual ETo, mm	Monthly Max ETo, mm	Daily Max ETo, mm	Remarks
Damietta	1,695	217 (July)	7.03 (June)	For Downstream
Mansoura	1,748	224 (June)	7.48 (June)	For Med/Upstream

Crop evapotranspiration (ETcrop) is calculated by multiplying crop coefficients (Kc) to the ETo. The crop coefficients (Kc), corresponding to the crops presented in "4.2. Agricultural Development Plan" are decided with reference to the ones proposed by FAO Irrigation and Drainage Paper No. 24 and also General Authority for Rehabilitation Projects and Agricultural Development (GARPAD) under MALR.

In calculating water requirement for paddy, land preparation and percolation should be considered in addition to crop evapotranspiration. A total of 80 mm, composed of 30 mm for supplement into the soil and 50 mm for ponding were undertaken, and 2.0 mm/day was considered as the percolation.

(2) Irrigation Water Requirement and Water Balance Assessment

With the cropping patterns proposed and irrigation efficiencies applied, the following cases were studied. Also, each case were examined with two conditions for areas, 61,644 feddan (25,890 ha) in total, currently irrigated by gravity-fed drainage. One is that no supplemental fresh water feeds the areas, thus to be irrigated by drainage only (referred to as "Drainage not Supplemented"), and the other is that half of the required irrigation water is supplemented by fresh water (referred to as "Drainage Supplemented"). Therefore the total number of case study became 12.

Cropping Pattern	Without Project Ep=0.56	With Project Ep=0.66	With Project Ep=0.68	Remarks
Present	O	O		Crop intensity; DS 148%
Pattern 1		O	O	Crop intensity; DS 170%
Pattern 2		O	O	Crop intensity; all 200%

Note; Cropping pattern 1 has a downstream cropping intensity of 170 % with mid and upstreams' cropping intensities of 200 % each. Cropping pattern 2 has cropping intensity of 200% for all areas.

The case studies revealed the following (refer to Appendix F.14, Table 4.3.2 and Figures 4.3.2 to 4.3.10);

- Present cropping pattern under without-project (Ep=0.56) requires an annual amount of 4,169 MCM ("drainage not supplemented") just more than the annual available water of 4,026 MCM (3.6% over). For monthly peak, though a maximum of 799 MCM is required in July ("drainage not supplemented"), the actual in-taken is 621 MCM which is about 29 % less than the required, suggesting that water shortage especially during the summer season prevails in the Study Area (refer to Figures 4.3.2 and 4.3.3).
- With-project (Ep=0.66) will enable the present cropping patten to meet the annual available water even for the case of "drainage supplemented". The annual water requirement is about 6 % less even for "drainage supplemented" than the annual available water of 4,026 MCM. However, the monthly peak amount of 681 to 718 MCM is still more than the actual peak in-taken amount of 621 MCM in July (refer to Figures 4.3.2 and 4.3.3).
- Cropping pattern 1 (downstream cropping intensity 170 %) under both Ep=0.66 and 0.68 requires less irrigation water than the annual available due to the decreased cropping intensity for the downstream area. The required irrigation waters are 7.6 % less in case of Ep=0.66 and 10.5 % less in case of Ep=0.68 than the annual available even under the condition of "drainage supplemented" (refer to Figure 4.3.2).
- Cropping pattern 2 (cropping intensity all 200 %) also meets the annual available except the case with Ep=0.66 and "drainage supplemented". The case requires 4,048 MCM annual requirement that is just more than the presently available 4,026 MCM (refer to Figure 4.3.2).
- In terms of monthly peak water requirement, only the case of cropping pattern 1 (downstream cropping intensity 170 %) with "drainage not supplemented" can meet the presently available monthly peak volume, suggesting water reallocation among months (refer to Figure 4.3.3).
- In considering the water reallocation among months, barrage flow capacity has to be considered. Design discharge at Raiah Abbasee is 270 cu.m/sec, and downstream cropping intensities more than 175 % (Ep=0.66) and 183 % (Ep=0.68) require more water than the designed discharge. This makes it unable to intake irrigation water required for the cropping patters more than the intensities of 175 % (Ep=0.66) and 183 % (Ep=0.68), even if annual requirement could be less than the annual available

(refer to Figure 4.3.4).

4.3.5 Irrigation and Drainage Development

Considering the above discussions, the following are proposed for irrigation and drainage development;

- Cropping pattern 1 (downstream cropping intensity of 170 %) should be applied in the short and mid term irrigation development. Then, the intensity should be increased to 200 % for the long term irrigation development in line with the renovation of the barrages or otherwise new feeder(s) from Damietta Branch, keeping the total irrigation amount less than what is presently available.
- For areas of 61,644 feddan (25,890 ha) currently irrigated by drainage water only, supplemental irrigation water that will be provided must be equivalent to about half the total irrigation requirement, to improve water quality.
- In the long term development, 200 % cropping intensity could be realized with the renovation of the barrages or the construction of the new feeder. The latter must be supported by a lifting pumping station, constructed at Damietta Branch about 10 km of downstream of Mansoura City. The pumping station is proposed to lift the Nile water, and then feed into both the Raiah Bilqas and Basandila canals.
- Monthly water reallocation shall be considered in order to meet peak water requirement during the summer season. In considering the reallocation, the following conditions should be considered: 1) minimum should not be less than the present December level to keep water level that can feed the succeeding canal, and 2) water presently available for January and February should not be changed considering the canal closure period though the actual requirements are more than the presently available (Figures 4.3.5 to 4.3.10).
- After the reallocation, there could be 394 MCM (about 9.80 % the annual available of 4,026 MCM) saving in case of cropping pattern 1 (downstream cropping intensity 170 %) with Ep=0.66 and "drainage supplemented", and 84 MCM (2.09 % the annual available of 4,026 MCM) in case of cropping pattern 2 (cropping intensity all 200%) with the same condition (Figures 4.3.5 & 4.3.8).
- The saved water of 84 MCM could be transferred, after the Study Area realized all 200 % cropping intensity, to the New Reclamation Area located contiguous to Hafir Water District. The saved water would consists of about 25 % of the probable total requirement of 330 MCM (23,520 ha x 1,400 mm). Therefore, the rest of the requirement shall still be arranged from the Nile and from nearby drains as

originally planned.

- Since the 200 % cropping intensity would be realized in the long term development, the New Reclamation Area shall be provided the required water from the Nile in short and mid term development as originally planned. The peak discharge required for the Area is 9.7 cu.m/sec, calculated based on the maximum water duty of 30 cu.m/feddan and one-third of total requirement from Nile. The discharge correspond to 3.6 % increase to the Raiah Abbasee design discharge. This could be in-taken with a free board even if no major renovation of the barrages are done. However, the new pumping station envisaged in the long term development could make the transfer easier for the required amount into the Area.

- Hamoul pumping station feeds about 84,755 feddan (35,597 ha) with the annual mixing amount of 321 MCM. The Gharbia drain is already almost fully developed, therefore the probable decrease of the drainage volume to be incurred by irrigation improvement must be supplemented. With irrigation efficiency improved from Ep=0.56 to 0.66, the drainage would decrease by as much as 20 % ((0.66-0.56)/0.56). An annual supplement of 64 MCM (321 x 0.2) will be transferred from Bahr Tera. The supplement could be managed within the annual available water of 4,026 MCM in cases of both downstream cropping intensity of 170 % and 200 % under the condition of Ep=0.66 (Refer to Figures 4.3.5 and 4.3.8).

- Project intervention has to start at the upstream and midstream areas and not at the downstream areas though the downstream areas are obviously suffering from acute water shortage. By starting irrigation improvement at the upstream and midstream, saved water is provided to the downstream area. Also, in line with this project intervention, dilapidated facilities such as intake and regulator shall be rehabilitated at the early stage of development. Rehabilitation will be applied even in downstream areas according to urgency.

- At first stage, the delivery of the water should be by individual lifting pumps as a major rule. Conventional Meska shall not be undertaken. Meska improvement is easier and this could become a facilitator in rectifying individual pumping. Individual pumping will be rectified by organizing into groups a number of individual pumpings into a water users group (not association), then into a water users association with several number of water users groups. Downstream continuous flow will be accompanied with improved Meska system and rectified direct pumping, otherwise continue the conventional rotation irrigation system.

Table 4.3.1 Known Water Amount Avairable for Bahr Shebin Command Area in MCM and Estimation of Unit Irrigation Cunsumption

Intake	Avrg Duration	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ralah Abbasee	1993-1997	145.90	191.45	296.10	317.35	388.18	651.68	710.29	610.78	430.43	236.90	289.21	210.94	4,479
El Monofy	do	10.96	9.98	17.04	12.87	17.78	30.73	27.65	29.46	21.56	18.46	15.82	17.74	237
Meet Zaied	do	-45.06	-59.91	-97.08	-103.76	-119.47	-203.47	-217.84	-191.69	-145.59	-79.28	-89.62	-71.69	-1,424
Sub Total	do	111.80	141.52	216.06	226.46	286.49	478.94	520.10	448.55	306.40	176.08	215.41	156.99	3,292
Balamoun I.P.S.	1993-1997	9.07	7.70	17.59	16.56	19.64	24.91	30.32	28.17	21.04	11.69	13.29	8.18	208
Kafr Saad I.P.S.	do	10.13	12.28	21.66	25.22	29.11	40.45	40.67	37.02	29.72	16.38	17.86	10.50	291
Sub Total	do	19.20	19.99	39.26	41.78	48.76	65.36	70.98	65.19	50.76	28.07	31.14	18.68	499
Sub Total of Fresh Nile	do	130.99	161.51	255.31	268.24	335.25	544.30	591.08	513.75	357.16	204.14	246.55	175.67	3,791
East El Monofia M.P.S.	1993-1997	4.31	3.60	7.21	5.83	3.97	3.69	3.84	4.71	6.60	4.31	4.65	4.13	57
Hamoul M.P.S.	do	12.65	11.48	24.89	27.53	30.48	33.11	39.33	40.57	39.24	27.19	20.52	13.80	321
Sub Total of Drainage	do	16.96	15.08	32.09	33.36	34.45	36.80	43.17	45.29	45.84	31.50	25.17	17.94	378
Known Total Amount in MCM		**147.96**	**176.59**	**287.41**	**301.61**	**369.70**	**581.10**	**634.26**	**559.03**	**403.00**	**235.65**	**271.72**	**193.60**	**4,169**
Munucipality & Industry		**12.79**	**8.33**	**12.79**	**12.46**	**12.79**	**12.46**	**12.79**	**11.80**	**11.47**	**11.80**	**11.47**	**11.20**	**143**
Avairable for Irrigation		**135.17**	**168.26**	**274.62**	**289.15**	**356.90**	**568.64**	**621.47**	**547.23**	**391.53**	**223.85**	**260.25**	**181.30**	**4,026**

Bahr Shebin Whole Area Served = 641,397 fed. 269,387 ha U.C.= 1,495 mm 6,277 CUM/fed

Bahr Shebin excluding Areas Served by Drainage & Feeder= 566,745 fed. 238,033 ha U.C.= 1,691 mm 7,104 CUM/fed

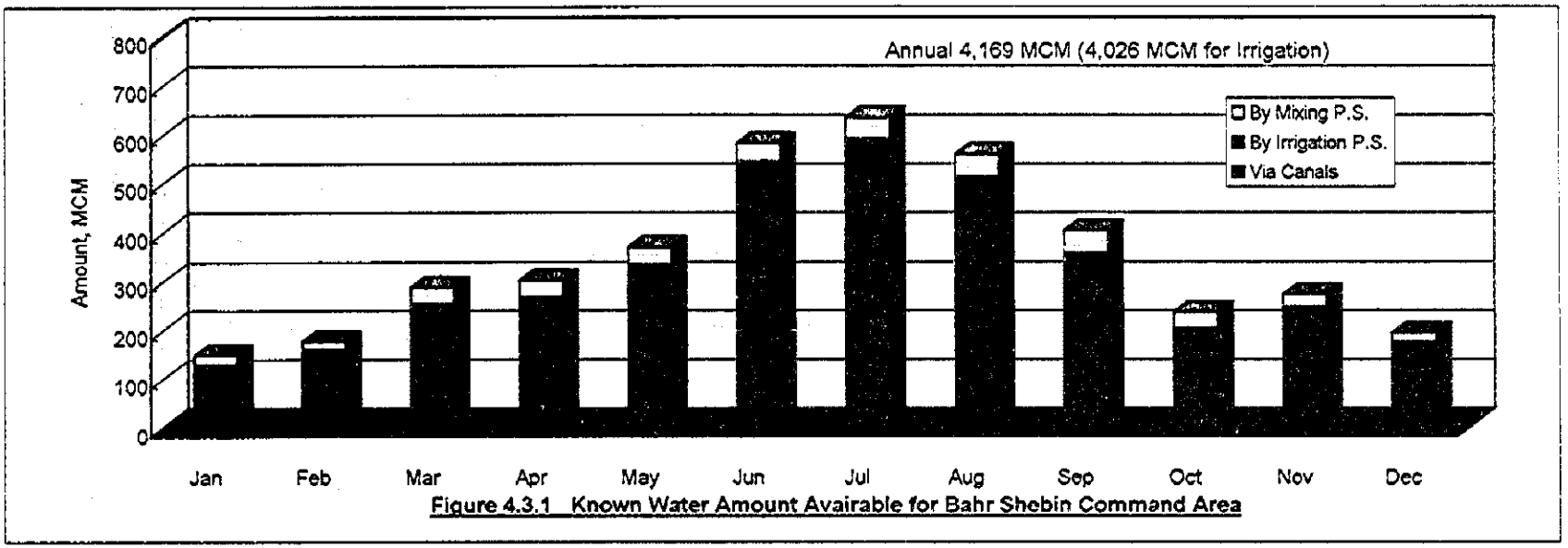


Figure 4.3.1 Known Water Amount Avairable for Bahr Shebin Command Area

Table 4.3.2 Summary of Water Requirements for Master Plan Area, Surpluss or Deficit and Modified Water Allocation, '000 CUM

Cropping	Ep	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	% to Original
Avairable for Bahr Shebin		135,169	168,264	274,616	289,145	356,904	568,640	621,467	547,233	391,532	223,846	260,253	181,803	4,026,117	
Water Requirement															
Crop Intensity 170% (Drainage not supplemented)	0.66	208,164	260,783	266,997	146,088	128,587	457,038	619,316	616,445	388,349	108,992	114,601	165,005	3,480,365	
Surplass or Deficit, %		-54.0	-55.0	2.8	49.5	64.0	19.6	0.3	-12.6	0.8	51.3	56.0	9.2	13.6	
Modified		135,169	168,264	266,997	146,088	128,587	457,038	619,316	616,445	388,349	181,803	181,803	181,803	3,471,662	13.77
Surplass or Deficit, %		-54.0	-55.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	37.0	9.2	-0.3	
Crop Intensity 170% (Drainage supplemented)	0.66	226,232	282,963	289,606	157,622	136,508	484,020	654,412	650,456	410,289	114,970	124,493	179,599	3,719,706	
Surplass or Deficit, %		-67.4	-68.2	-5.5	45.5	61.8	14.9	-5.3	-18.9	-4.8	48.6	52.2	1.2	7.6	
Modified		135,169	168,264	289,606	157,622	136,508	484,020	654,412	650,456	410,289	181,803	181,803	181,803	3,631,756	9.80
Surplass or Deficit, %		-67.4	-68.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	31.5	1.2	-2.4	
Crop Intensity 170% (Drainage not supplemented)	0.68	201,682	252,663	258,683	141,539	124,583	442,806	600,030	597,249	376,256	105,598	111,033	159,867	3,371,988	
Surplass or Deficit, %		-49.2	-50.2	5.8	51.0	65.1	22.1	3.4	-9.1	3.9	52.8	57.3	12.1	16.2	
Modified		135,169	168,264	258,683	141,539	124,583	442,806	600,030	597,249	376,256	181,803	181,803	181,803	3,389,988	15.80
Surplass or Deficit, %		-49.2	-50.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.9	38.9	12.1	0.5	
Crop Intensity 170% (Drainage supplemented)	0.68	219,187	274,152	280,588	152,713	132,258	468,948	634,034	630,201	397,513	111,390	120,616	174,006	3,603,875	
Surplass or Deficit, %		-62.2	-62.9	-2.2	47.2	62.9	17.5	-2.0	-15.2	-1.5	50.2	53.7	4.3	10.5	
Modified		135,169	168,264	280,588	152,713	132,258	468,948	634,034	630,201	397,513	181,803	181,803	181,803	3,545,097	11.95
Surplass or Deficit, %		-62.2	-62.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.7	33.7	4.3	-1.7	
Crop Intensity 200% (Drainage not supplemented)	0.66	210,000	263,465	271,260	155,323	153,758	506,250	692,484	690,397	423,674	116,782	113,485	166,234	3,765,112	
Surplass or Deficit, %		-55.4	-56.6	1.2	46.3	56.9	11.0	-11.4	-26.2	-8.2	47.8	55.6	8.6	6.5	
Modified		135,169	168,264	271,260	155,323	153,758	506,250	692,484	690,397	423,674	181,803	181,803	181,803	3,741,988	7.06
Surplass or Deficit, %		-55.4	-56.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.8	36.5	8.6	-0.6	
Crop Intensity 200% (Drainage supplemented)	0.66	228,427	286,170	294,703	168,664	166,606	540,113	737,810	734,747	450,553	123,849	125,550	181,068	4,048,140	
Surplass or Deficit, %		-69.0	-70.1	-7.3	41.7	53.3	5.0	-18.7	-34.3	-15.1	44.7	51.8	0.4	-0.5	
Modified		135,169	168,264	294,703	168,664	166,606	540,113	737,810	734,747	450,553	181,803	181,803	181,803	3,942,038	2.09
Surplass or Deficit, %		-69.0	-70.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.9	30.9	0.4	-2.7	
Crop Intensity 200% (Drainage not supplemented)	0.68	203,461	255,261	262,813	150,487	148,970	490,486	670,920	668,898	410,481	113,145	111,889	161,057	3,647,868	
Surplass or Deficit, %		-50.5	-51.7	4.3	48.0	58.3	13.7	-8.0	-22.2	-4.8	49.5	57.0	11.4	9.4	
Modified		135,169	168,264	262,813	150,487	148,970	490,486	670,920	668,898	410,481	181,803	181,803	181,803	3,651,896	9.29
Surplass or Deficit, %		-50.5	-51.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.8	38.5	11.4	0.1	
Crop Intensity 200% (Drainage supplemented)	0.68	221,314	277,259	285,526	163,412	161,418	523,294	714,834	711,868	436,523	119,993	121,640	175,429	3,922,082	
Surplass or Deficit, %		-63.7	-64.8	-4.0	43.5	54.8	8.0	-15.0	-30.1	-11.5	46.4	53.3	3.5	2.6	
Modified		135,169	168,264	285,526	163,412	161,418	523,294	714,834	711,868	436,523	181,803	181,803	181,803	3,845,717	4.48
Surplass or Deficit, %		-63.7	-64.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.0	33.1	3.5	-2.0	
Present Cropping (Drainage not supplemented)	0.56	216,666	266,306	265,527	157,452	160,312	636,196	799,023	753,889	490,790	131,179	120,342	171,703	4,169,385	
Surplass or Deficit, %		-60.3	-58.3	3.3	45.5	55.1	-11.9	-28.6	-37.8	-25.4	41.4	53.8	5.6	-3.6	
Modified		135,169	168,264	265,527	157,452	160,312	636,196	799,023	753,889	490,790	181,803	181,803	181,803	4,112,031	-2.13
Surplass or Deficit, %		-60.3	-58.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	33.8	5.6	-1.4	
Present Cropping (Drainage supplemented)	0.56	233,530	286,567	285,743	169,851	172,978	670,055	841,788	794,016	516,196	137,903	129,857	185,438	4,434,652	
Surplass or Deficit, %		-72.8	-70.3	-4.1	41.3	51.5	-17.8	-35.5	-45.1	-31.8	38.4	50.1	-2.0	-10.1	
Modified		135,169	168,264	285,743	169,851	172,978	670,055	841,788	794,016	516,196	181,803	181,803	181,803	4,299,468	-6.79
Surplass or Deficit, %		-72.8	-70.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.1	28.6	-2.0	-3.1	
Present Cropping (Drainage not supplemented)	0.66	182,768	224,642	223,984	132,818	135,231	550,552	681,190	643,118	420,950	113,048	101,514	144,839	3,554,654	
Surplass or Deficit, %		-35.2	-33.5	18.4	54.1	62.1	3.2	-9.6	-17.5	-7.5	49.5	61.0	20.3	11.7	
Modified		135,169	168,264	223,984	132,818	135,231	550,552	681,190	643,118	420,950	181,803	181,803	181,803	3,636,685	9.67
Surplass or Deficit, %		-35.2	-33.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.8	44.2	20.3	2.3	
Present Cropping (Drainage supplemented)	0.66	196,993	241,733	241,038	143,277	145,915	579,847	717,644	677,346	442,748	118,846	109,541	156,426	3,780,554	
Surplass or Deficit, %		-45.7	-43.7	12.2	50.4	59.1	-2.0	-15.5	-23.8	-13.1	46.9	57.9	14.0	6.1	
Modified		135,169	168,264	241,038	143,277	145,915	579,847	717,644	677,346	442,748	181,803	181,803	181,803	3,796,656	5.70
Surplass or Deficit, %		-45.7	-43.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.6	39.7	14.0	0.4	

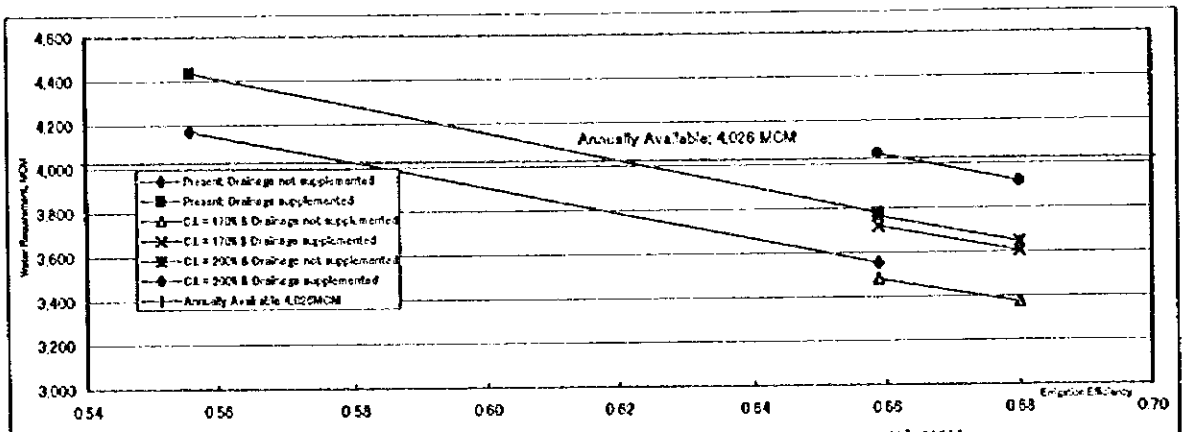


Figure 4.3.2 Summary of Annual Requirement (Present C.P. & C.I. DS170% & AI200%), MCM

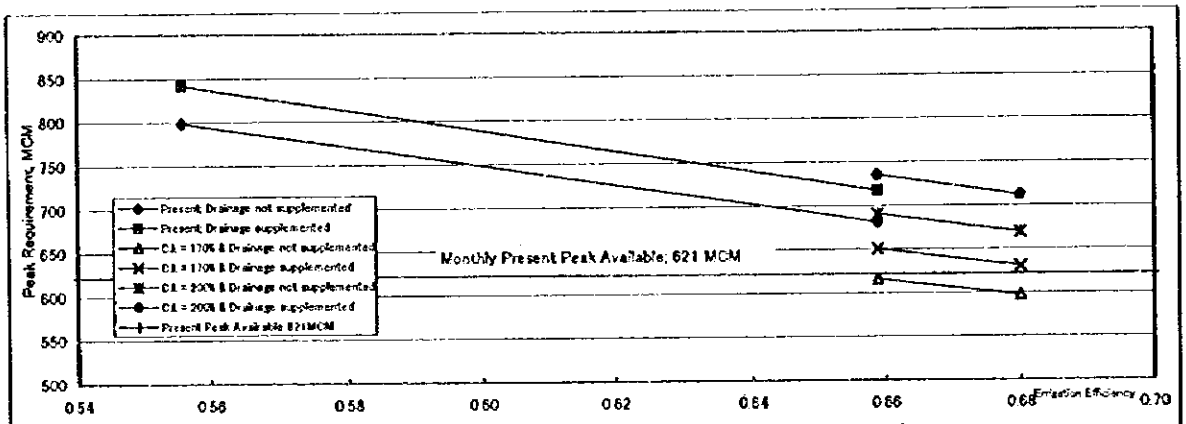


Figure 4.3.3 Summary of Monthly Peak Requirement (Present C.P. & C.I. DS170% & AI200%), MCM

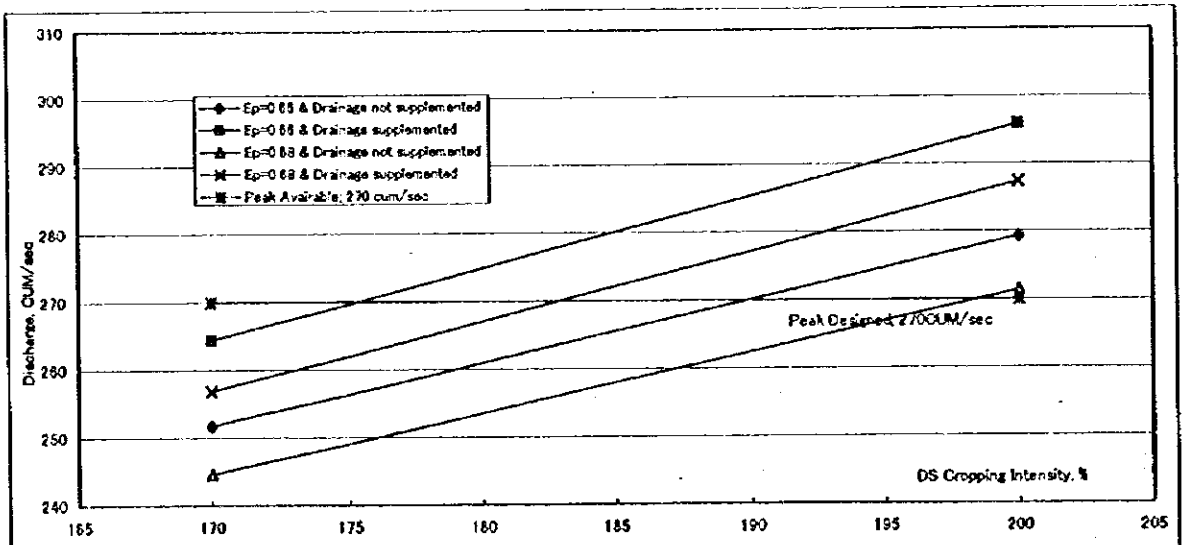


Figure 4.3.4 Peak Discharge Required at Rajah Abbasee Intake, CUM/sec

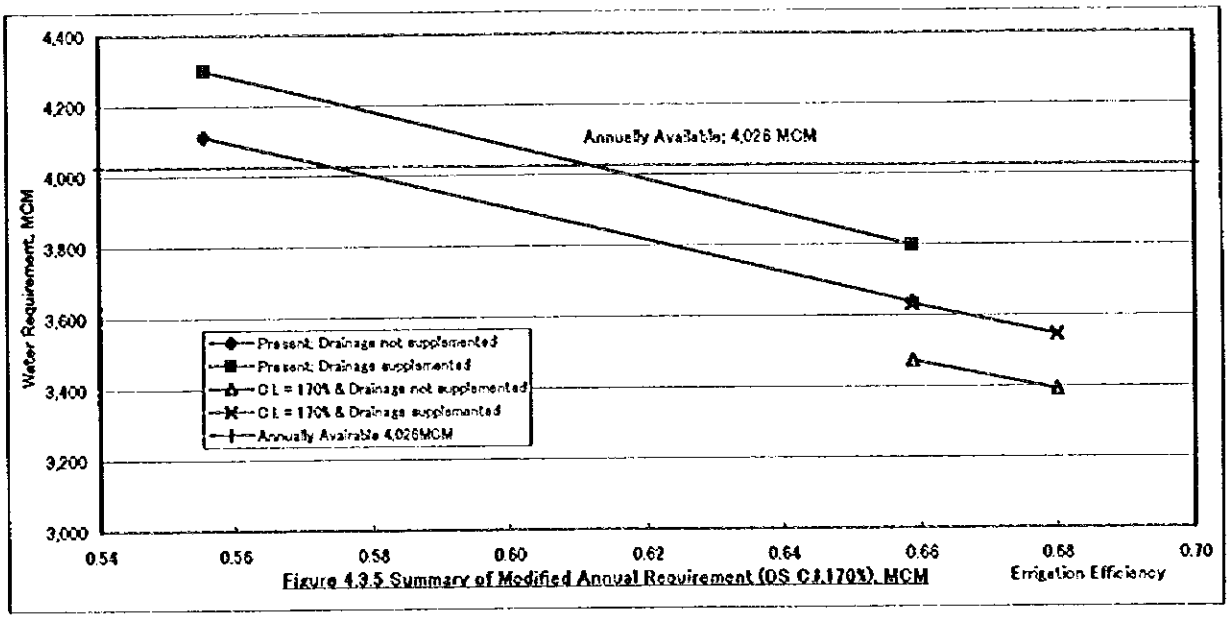


Figure 4.3.5 Summary of Modified Annual Requirement (DS C.I.170%), MCM

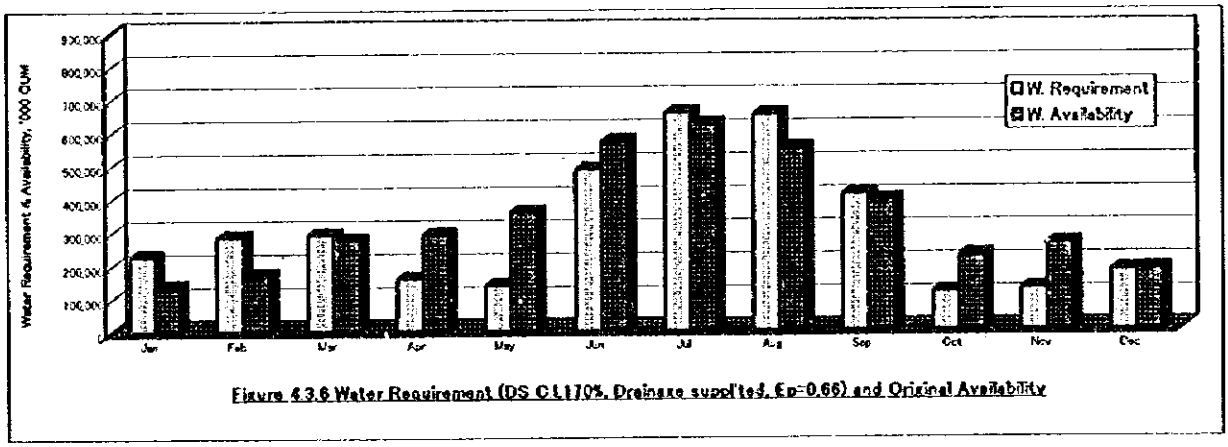


Figure 4.3.6 Water Requirement (DS C.I.170%, Drainage supplied, Ep=0.66) and Original Availability

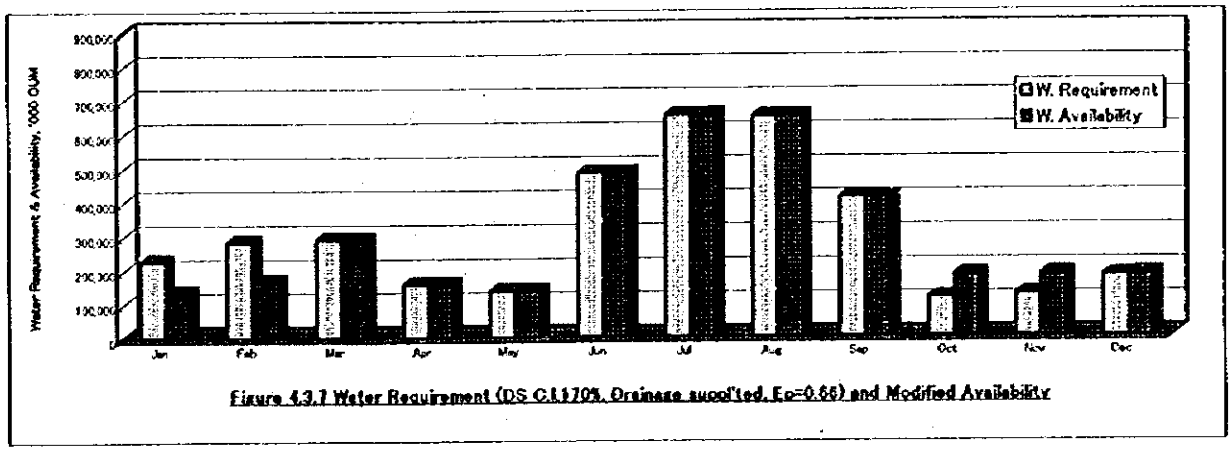


Figure 4.3.7 Water Requirement (DS C.I.170%, Drainage supplied, Ep=0.66) and Modified Availability

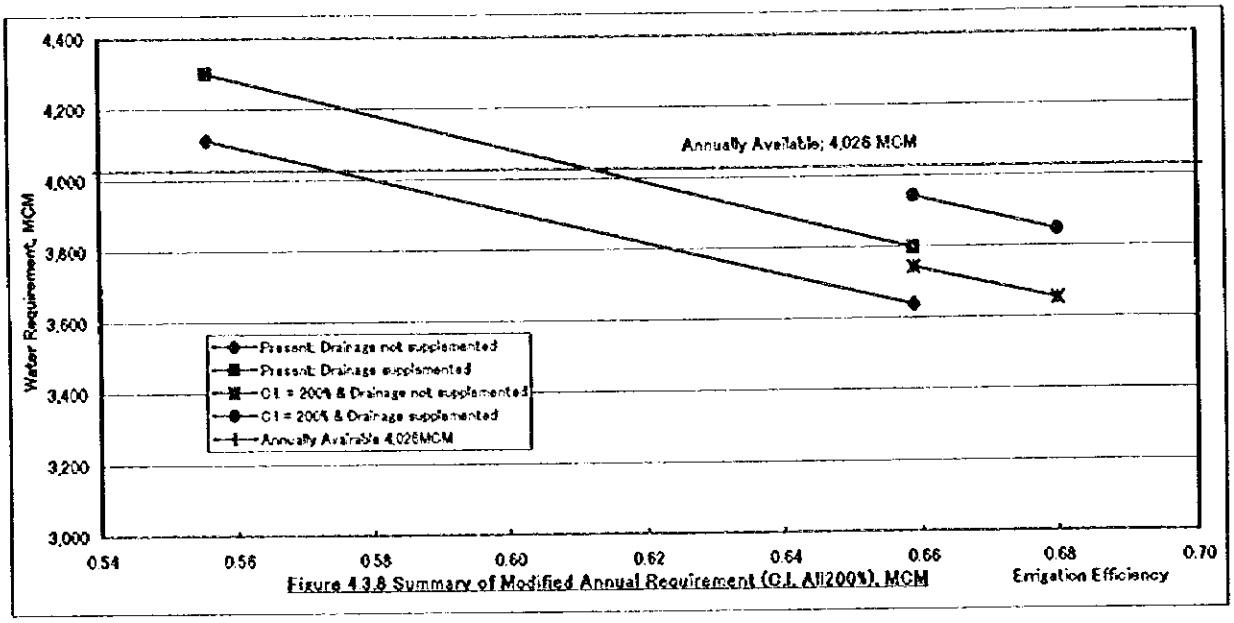


Figure 4.3.8 Summary of Modified Annual Requirement (C.I. All200%), MCM

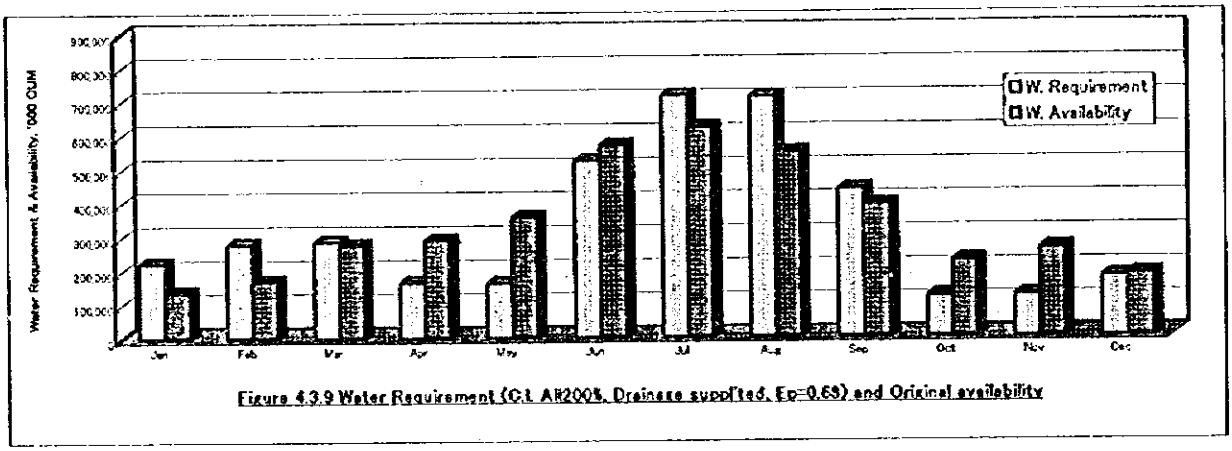


Figure 4.3.9 Water Requirement (C.I. All200%, Drainage supplied, Ep=0.68) and Original availability

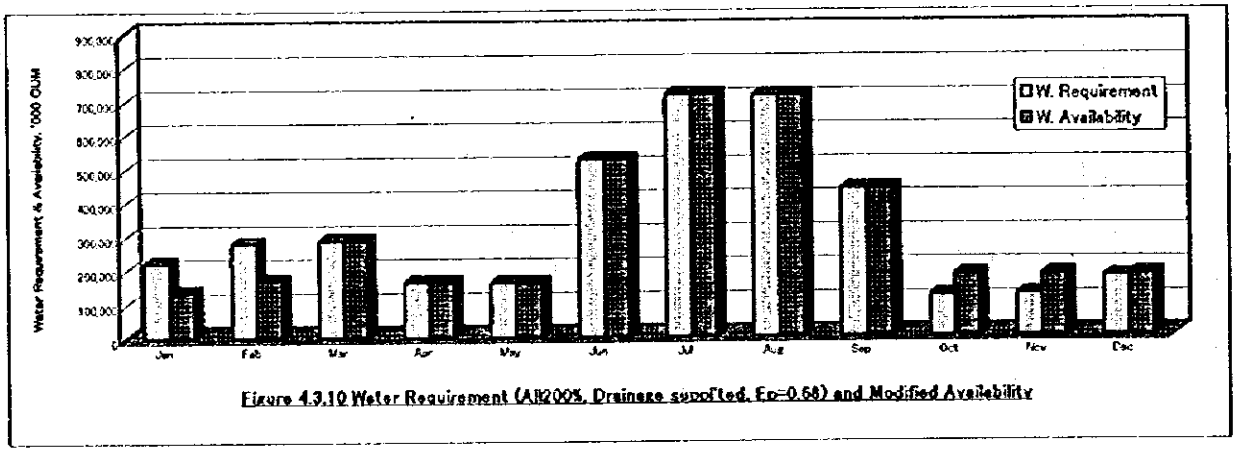


Figure 4.3.10 Water Requirement (All200%, Drainage supplied, Ep=0.68) and Modified Availability

4.4 Development Plan of Irrigation and Drainage Facilities

4.4.1 Major Improvement Plan of Major Irrigation Facilities

(1) General

The existing irrigation and drainage facilities have hydraulic and physical problems. Under such conditions, improvement program as repair of existing major structures, including erection of new check structure along the delivery canal, improvement of intake structure, canal slope protection, provision of motorized hoist for key regulators and water intake structures in the principal and main canals are proposed. For the water supply irrigation at the terminal area, the present Meska irrigation system will be improved to unify a single point lifting pump irrigation system.

For the water supply operation of the canal networks in the Study Area, some existing major structures will be improved. Also, new structures will be built to save water operation loss under the limited water resources policy. The improvement plan are as follows ;

(2) Establishment of New Regulator in the Monofy Canal

A new regulator will be established at the end of the Mnofy main canal originating from the Delta barrage. This regulator will be controlled at a maximum function of only 17 cu.m/sec to the Raiah Abbase principal canal for purposes of supplemental water supply from the Delta Barrage, according to the water supply schedule. At present, backward flow from the Raiah principal canal to the Monofy canal occurs when there is full water supply in the Raiah canal. So the new regulator will also play a return back flow control from the Raiah Abbase principal canal to Monofy canal to save water operation and to control water operation losses.

(3) Improvement of Rahbeen Regulator in the Bahr Shebin main canal

This regulator is important in the control water supply of about 150 cu.m/sec at the downstcam in the Bahr Shebin main canal, equvalent to 52 % of the total water conveyance capacity. The regulator is located near the governorate boundary as a crucial point of discharge (Most of the important canals have regulators to control discharge around administrative boundaries). The regulator was renovated to keep design discharge and save head loss at the regulation point by constructing a by-pass. However the head loss still reaches 70 cm in June, the peak period of rice planting season. Accordingly The canal bed is scoured

4.1 m deep in downstream due to the hydraulric flow energy. The canal formation is unstable under the progress of hydraulic phenomena. Furthermore the regulator was built 70 years ago as old as scarring collapse. Therefore the renewal of the regulator is proposed.

(4) Improvement of Demara Regulator and Other Miscellaneos

At the Bahr Shebin main canal end is the Demara regulator controlling water into the Bahr Basandila and Raiah Belkas canals. These two intake gates are not operating well due to the old age of the gates composed of navigator and leaf gates. The Raiah Belkas canal is divided into two canals, one of which is the Bahr Hafir canal and other is the reformed by-pass canal constructed in relation to the Bahr El Maasara canal. However, because of the narrow section of the cross culvert under the rail way, 100 cm of backwater occurs at the peak water discharge and overflows both sides of the by-pass canal. The improvement of the cross culvert is proposed to solve the problem. The aged Demara regulator will be improved to control effectively the discharge.

(5) Improvement of Bahr Tera Main Canal

There is a section of 19km length at the lower part of Bahr Tera Main Canal from Abshan regulator to Hamoul MPS where the height of the banks are low as there are no room at the cross section capable for design high water discharge. It is required to raise by two (2) meters the banks so as to secure the inhabitants and farms around the section as well as to keep the discharge.

(6) Improvement of Hamoul Pumping Station

Hamoul MPS is lifting drainage water from the Gharbia drain and supplying the drain water to Bahr Tera main canal. Hamoul MPS has been suspended for 40 to 50 days annualy when the water level in Gharbia drain is low due to a danger of cavitation. Also the pumping station has been used for about 40 years and the pump efficiency is degraded. Therefore the replacement of Hamoul MPS is proposed to maintain the stable re-use water supply. The re-use water is a valuable water resource in Egypt, hence to maintain Hamoul MPS is necessary in the way of utilizing re-use water and saving fresh water.

(7) Slope protection of canal

In total length of main canal network (total 410km), 72km (about 18 %) which pass through villages suffer from water losses due to the collapse of the slopes by man and animal

use of the canals. Therefore the slope protection by wet pitching is required for that portion. This construction method is common and has been implemented in the Study Area.

(8) Weed control

Since unlined and continuos flow, the weeds have grown thick in the main canals. This gives additional losses, so that design flow cannot be attained with the designated water level. This problem becomes severe during winter season when water level is low. There is no adequate equipment to control the weeds in MPWWR. A dragline currently used for dredging a heap in the canal is not effective to remove the weeds only to stroke above the weeds by the bucket. Vehicles, such as, a vessel and a back hoe to control the weeds, and two (2) dump trucks to carry the weeds are proposed to distribute in each main canal.

(9) Motor Gate Operation and Control

Water supply operation and control in the canal networks needs safe and stable water conveyance, accordingly reducing water loss. For the major structures like regulator and the intake gates with telemeter system along the main canal, electric motor will be installed with water level meter for easy gate operation according to discharge, leading to reduce water loss caused by slow gate operation. Gate opening meters for each gate will be installed in addition to existing telemeter system. The proposed graphic panel board which will be set in the irrigation directorate offices of the four (4) governorates shall display the water level and gate opening for 24 hours monitoring.

4.4.2 Improvement of Delivery Canal

(1) New Check Structure for Water level Control

A pump will be installed at the beginning point of improved Meska to take water from a delivery canal. To control the water level of the delivery canal, establishment of check structures with certain interval length on the delivery canal (every 3.0 km as standard) is proposed.

(2) Improvement of intake work

Following works are required for the intake works. They are 1) maintain; 200 delivery canals (56 % of the total), 2) repair; 80 delivery canals (22 %), and 3) rehabilitation; 77 delivery canals (22 %). These improvements do not include earthwork.

4.4.3 Improvement of Meska Irrigation System

(1) Improvement of Intake Structure and Meska

A small mobile pump set with diesel engine is used for supplying irrigation water from a delivery canal onto a farmland. Transferring O&M of from a delivery canal to terminal facility to farmers by organizing WUA and Federation of WUAs is proposed to reduce water loss on conveyance and save water. To support this plan, the existing Meska will be paved or pipelined. Also the pumping system will be unified abolishing innumerable private small pumps in order to ease the O&M of the delivery canal.

(2) Pump House

A pump house is required to protect the pump and the engine with apparatus and the other instruments from weather variation and dust materials, and to keep the equipment operation condition for a extended life time. The pump house is the standard type with reinforced a concrete post brick, concrete joint mortal wall and corrugated steel plate roof material coated by galvanized and paint.

(3) Pump Set and Procurement

Design capacity of irrigation pump is 60, 90, and 120 lit/sec and the proposed pump units are one (1) to three (3) per Meska. These pumps are low pump heads and small sizes with diesel engines. Procurement of these pumps are taken from Egyptian made and follow the IIP specification.

4. 4. 4 Improvement of Hardware System

(1) Supervisory Devices for Water Operation in Each Governorate

In the Study Area, water supply contol has been conducted by four governorate (Damietta, Dakhalia, Kafr El sheik and Ghrbia) under the total water management system established in the MPWWR in Cairo. Under the configulation system, improvement proposed are follows:

A Water Operation Monitoring Panel(WOMP) will be established at each Governarate water operation room. The WOMP shall consists of a display panel with information on water level, gate opening meter and discharge quantities from the existing data

transmission system (VHF) on a digital form.

As a result of the WOMP established in the each Governorate, the water operation and control can be carried safety. Gate operation can be undertaken without water operation losses in each Governorate because the inspector will see immediately on the WOMP figures needed for.

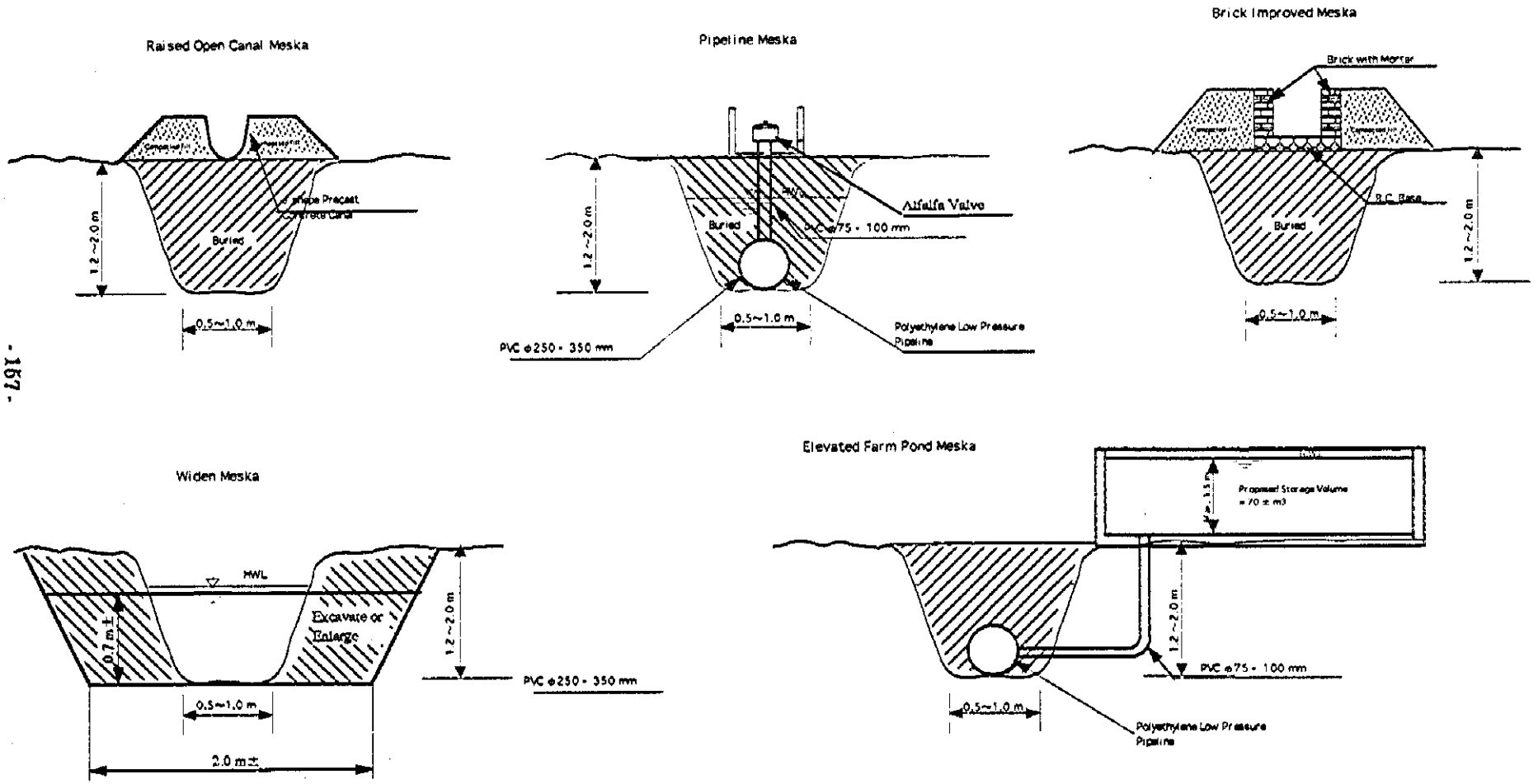
(2) Devices for Gate Operation in Major Structures

Under the water level measuring device installed at the major structures will be installed electric motors for gate operation in place of the existing manual hoist system so as to follow up water level variation and monitoring system. The devices will include electric motors and gate opening meters related to the existing telemeter unit. As a result of the improved devices, the gate opening meters will be seen in the WOMP in addition to the water level variation at upper and lower locations of the major structures.

(3) Establishment of Repair shop for Pump and Gate

Under the water supply on farm, an extensive numbers of pump will be installed in the Study Area. The work services to be provided will mainly be for repair and maintenance services of the farm pump and gas oil engine. For these services in the repair shop, the work shop will be accommodated with a crane line, lathe, pit and welding set equipment as well as related instrument. These work shop function will be given for these repair and maintenance services.

Figure 4.4.1 Alternative Plan of Improved Meska



4.5 Development Plan on Water Management and O&M

(1) Basic Lines

As is described in 3.6.1(1) two nationwide water management projects are currently under operation. Particularly, the Telemetry Project has been accumulating hydraulic information based on systematic observations during the past eight years. Accordingly, basic concept for development plan formulation on water management and O&M in this study do not overlap with both projects but aims to establish an integrated Nile basin water management system in the future.

Improved water management cannot be achieved without the corresponding improvement on institutional arrangement. It is therefore proposed to start on information management, which is the major subject of water management so that institutional improvement will consequently follow. In this case, stage-wise plans are recommended with the expectation that operational outcome of the plan under the Irrigation Directorate will serve as prototype sample in the above-mentioned integrated basin system.

(2) Development Plan

It is proposed to increase the number of personal computers (PC) at each Irrigation Directorate and related organizations along with the basic lines mentioned in preceding (1) and to extend networking to the organizations in the final stage. This will enable the digitization of relevant information for water management and building of Intranet by linking each PC. Technical instructions and integral operations are expected to collaborate with the ongoing Projects. Materialization of the development plan is based on the following stage-wise implementation program. The water management issues relevant to irrigation facilities such as motorized operation of regulators etc. and cost estimate are presented in 4.4 and 4.7, respectively.

The first stage is a familiarization process on computer through positive application of PC to daily works. Regardless of figure, letter or graphics, digitizing operations of every information relevant to water management are the starting point and the most effective approach to the goal of improved water management in the long term.

The second stage is the build up of an inter-agency LAN (Local Area Network). A number of computers are currently operated at each post in the Irrigation Directorates for daily works. It is proposed to link the computers with Ethernet cables to build up the inter-agency LAN. The LAN aims to share relevant information providing "Open Collaboration Environment"

among users and is effective for every sort of daily works like document management.

The third stage is a networking of the LAN to build up WAN (Wide Area Networking). Such networking can easily extend to E-mail or Internet communications if it is connected with external telephone lines. This approach promises to save cost and time while it encourages young engineers to proceed with the improvement of water management operations.

(3) Future Plan

It is also suggested to apply updated technology, such as RS (Remote Sensing), GPS (Global Positioning System), CAD (Computer Aided Design), GIS (Geographical Information System) and CALS (Continuous Acquisition and Life-cycle Support) to the operational water management in collaboration with relevant Agencies. The current water management system such as the Telemetry Project and the water distribution system are expected to be integrated with the proposed PC system.

4.6 Development Plan on Farmers' Organization

(1) Measures for vitalization of farmers incentives

In line with "Privatization Policy", Egyptian farmers are to be insured a vitalized free-hands in directing their farm management at their own beck and call, and by this, agricultural production would be greatly increased as a whole. Based on this understanding, necessity of improvement of each branch canal, meska and/or maruwa and technical means and ways to be adopted in each IIP are to be decided by the opinion/request of beneficiary farmers in accordance with geological and social background of each canal.

(2) Clear-cut separation of water divide

As a first step of such vitally privatized agriculture, farmers are to be insured "their own water" or "hydrological de-centralization". For this purpose, a regulating structure, which enables accurate allocation and measurement of water at the head of each branch canal, is to be consolidated. The most important issues such as seasonal water allocation at the head of each branch canal is to be decided by a "Joint Committee" which is to be organized and managed by representatives from both the government officials and farmers groups.

(3) Hierarchy of farmers' organizations

For this purpose, beneficiary farmers of each branch canal are to be organized in a "Federation of WUAs". The Federation of WUAs is to be comprised of representatives from each WUA, and all or a part of them are to be members in the Joint Committee. Meanwhile, a rather large-scale WUA, comprised of such as 50 and more farmers, is to be recommended to organize sub-groups named "WUG (Water Users Group)s" in each WAU aiming at unification of a number of maruwas into a minimum water unit, and also aiming at the stronger and more practical grouping activities. In this connection, structural improvement at the terminal end is to be the one which coincides with the needs and/or requests from the WUGs.

(4) Roles of the government

When considering predominant advantages in saving both water resources and national expenditure, which are brought by IIP, the government is to subsidize a part of the cost for IIP to encourage farmers and accordingly to expand this work to the whole nation. For the reference to farmers who want to improve the existing irrigation systems, the government is to test and demonstrate probably feasible technologies at pilot farms introducing several new ideas. Also, the government is to adopt some new ideas such as transfer of its

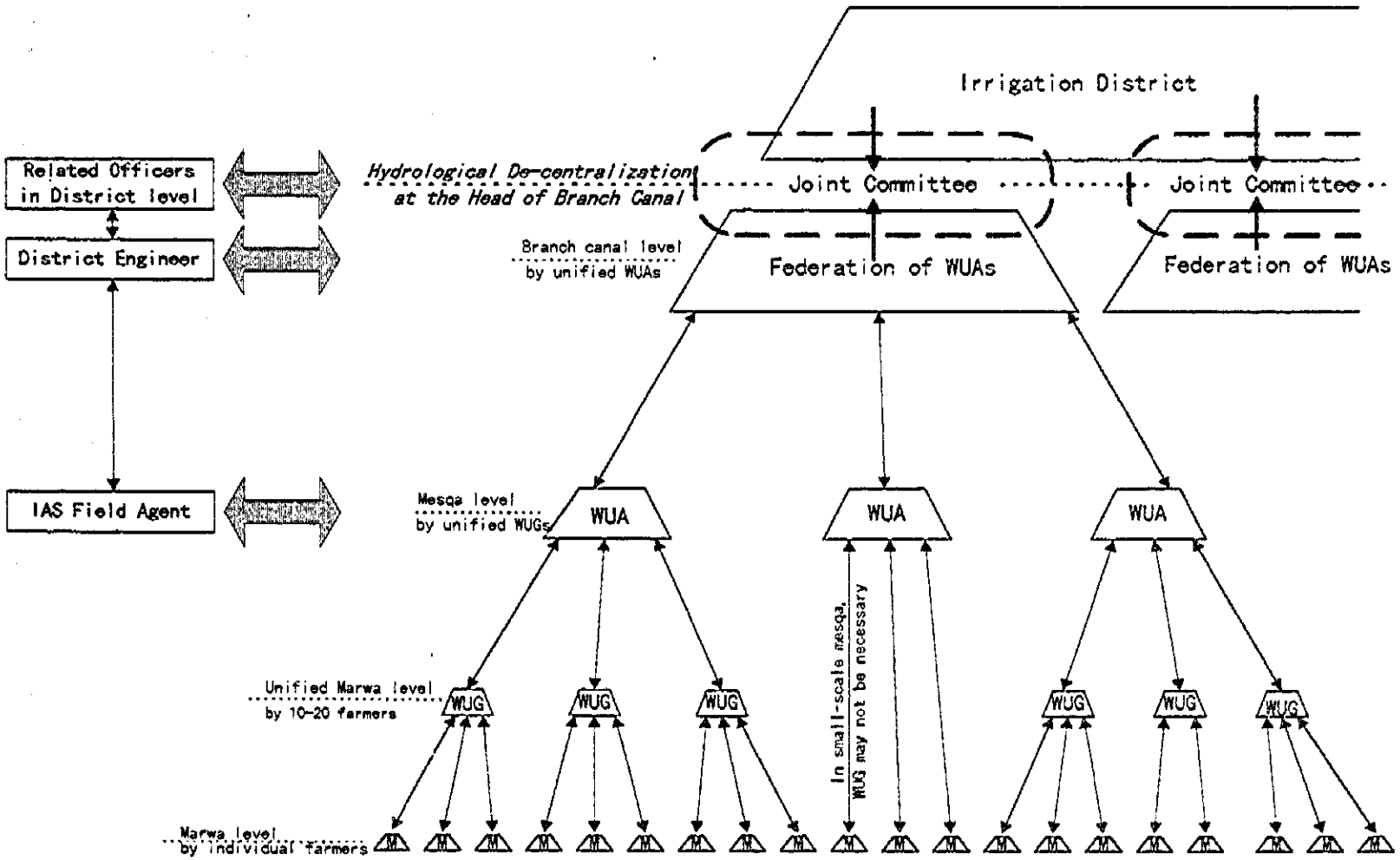
technical staffs to technical-service enterprises, or their step-by-step transfer to the Federation of WUAs. To confirm successfulness of the procedures mentioned above, the government is to apply some alternative measures in parallel throughout a transition periods. For the purpose of dissemination of the said procedures to the whole nation, the government is to provide some special fund necessary for subsidizing farmers, envisaging some possibilities such as "Two-Step Loans" by using external funds etc.

(5) Roles of the IAS

At present, the IAS's activities are mostly shared into training courses and less focussed into listening and analyzing farmers' opinion/ incentives regarding the IIP. Thus, the IAS is to organize more repeating and exhaustive meetings among beneficiary farmers at each branch canal basis to discuss on whether IIP is necessary or not in each domain and, if necessary, to decide the right and optimal ways of IIP by farmers themselves. Through such procedures, farmers would grasp a sense of ownership for water as well as a sense of belonging for facilities, and these senses are deemed by far as the most essential components towards farmers' self-governing irrigation and attendant effective use of water in the future.

To conclude, proposed approaches mentioned above are schematized in Fig.4.6.1(In more detail, see Appendix J.5).

Figure 4.6-1 Schematic Drawing for Proposed Organizations



4.7 Cost Estimate

(1) Conditions of Project Cost Estimation

The project cost has been estimated based on the data on the unit price as of December, 1998 and the related construction cost in the neighboring areas, and a unit rate (1.0 US$=3.40 LE. The project program is divided into three terms, namely short period of 5 years, medium period of 10 years and long period of 20 years, respectively, according to the emergency and necessity. The fiscal year has the duration from 1st June to 31 th May.

(2) Major Projects

The project is divided into several sub-projects which area composed of: (a) Improvement for Major Irrigation and Drainage Facilities Prpjecr, (b) Improvement of Delivery Canal Project, (c) Improvement Meska Irrigation System Project, (d) Water Management System Improvement Project, (e) Execution and Rehabilitation of Subsurface Drainage Project, (f) Pilot Project, (g) Demonstration Farm Project, (h) Monitoring for Environmental Water Quality Conservation Project, (i) Pump and Apparatus Equipment Repair Shop project. (Refer to Appendix M);

a) Improvement for Major Irrigation and Drainage Facilities

The project cost consists of the 1) Establishment of Monofy regulator 2) Improvement of Rahbin regulator 3) Improvement of Demara regulator and miscellaneous 4) Improvement of Bahar Tera intake 5) Improvement of Abshan lock 6) Improvement of Bahr Tera embankment 6) Replacement of Hamoul mixing pumping Station 6) Canal slope protection. This improvement work will be proposed at short and mid term projects from five to ten years.

b) Improvement of Delivery Canals

This project is composed of check structures for the proper control of canal water table and night storage and protection canal slope in the villages. This improvement work will be proposed at medium and long terms.(10 to 20 years).

c) Improvement of Meska Irrigation System

The cost for Improvement of Meska Irrigation System consists of Meska improvement of the raised Meska, pipeline Meska and other typed Meska and one-point lifting pump. The

generated land from burning Meska will be utilized for the development of farm roads. The program will be implemented during the period of the short to long terms, extending 20 years.

d) Water Management System Improvement Project

The project cost includes a graphic panel on water table, discharge and gate opening meter in the main systems in four Governorates. This cost has the computer, the related apparatus and soft ware withutilizing the existing telemeter. On the other hand, the cost for at the site of regulator includes the gate opening meter, a electric operation gate equipment, which has connection the existing telemeter equipment with the operation panel and its peripheral equipment.

e) Subsurface Drainage

The subsurface drainage systems are not installed in 42 % of the total area where , the subsurface drainage will be executed to accelerate the land improvement of saline in the area. Furthermore in four percent of the total area, the subsurface drainage systems will be renewed for the purpose to recover the drainage capacity.

f) Pilot Project Plan

It is proposed to establish a Pilot Project in 4,000(1,680 ha) feddan of Bahr Nour area, aiming to demonstrate the Meska improvement and the organization of the federation of WUAs and also to have the training activity on irrigation rule for the improved water management and others. The project costs are composed of those for civil works of the improvement of delivery canals and Meska, various test equipment including water quality test, computers an others.

g) Establishment of Demonstration Farms

The Demonstration Farms will be established for three major categories of delivery canals in each water district. The Demonstration Farm shall be consisted of a whole Marwa, which have about 7.8 feddan (3.3 ha) on the average. A total of 51 Demonstration Farms will cover the whole Priority Area.

h) Monitoring for Environmental Water Quality Conservation Project

An establishment of monitoring team for the water quality conservation is proposed from view points of conservation water quality. The team will recommend about water

conservation to the concerned institution with analyzing water samples from the irrigation and drainage canals. A laboratory will be provided with staff in each Governorate, which has a set of testing equipment with a computer and its peripheral equipment and transportation..

i) Pump and Gate Equipment Repair Shop

Considering the increase in farm pump requirement on it is necessary to have proper operation and maintenance of the pumps and peripheral equipment including diesel engines. Also the proper operation and maintenance of motor for gates is needed. For these objectives, an exclusive repair shop is required to repair work of pumps, gates, engine and other peripheral equipment at the work shop in four (4) Governorates. The proposed equipment include lathes, cranes, testing equipment and area tools.

(3) Project Cost and Financial Program

The project cost is summarized as follows;(refer to Appendix M)

Item	Cost			
	Share (,000 LE)		Total	
	Beneficiary	Government	(,000 LE)	(,000 US$)
1. Improvement for Major Irrigation and Drainage Facilities	-	202,797	202,797	59,645
2. Improvement of Delivery Canal	-	59,796	59,796	17,586
3. Improvement of Meska Irrigation System	1,520,243	-	1,520,243	447,130
4. Water Management System Improvement	-	6,327	6,327	1,861
5. Execution and Rehabilitation of Subsurface Drainage	322,993	-	322,993	94,998
6. Establishment of Pilot Scheme	-	9,916	9,916	2,916
7. Demonstration Farm	-	4,149	4,149	1,220
8. Monitoring for Environmental Water Quality Conservation	-	1,026	1,026	302
9. Pump and Apparatus Equipment Repair Shop	1,443	-	1,443	424
Total	1,844,679	284,011	2,128,690	626,082

Note: The project cost do not include the price escalation and physical contingency (Refer to Appendix M)

Cost allocation

Beneficial farmers: Improvement of Meska Irrigation System; Execution and Rehabilitation of Subsurface Drainage; Pump and Apparatus Equipment Repair Shop
Total cost: 1,844,679,000 LE (542,552,000 US$)

Government : Remaining components
Total cost: 284,011,000 LE (83,530 US$)

4.8 Project Implementation Plan and Annual Program

The priority for implementation will be given to the proposed project components that are most needed at present. The disbursement schedule of the proposed project component would be divided into the following three (3) terms, namely, (1) short term development, (2) medium term development, and (3) long term development. The actual implementation period will not be completed within the above schedule period of the proposed components.

a) Short term development

Under the short term development project, components proposed are 1) Rehabilitation of Rahabeen regulator, 2) Rehabilitation of Hamoul pumping station and 3) Rehabilitation of Bahr Tera main irrigation canal. These facilities have important function and role to distribute the irrigation water to the vast beneficial areas at the downstream. After rehabilitation of these facilities, the rotational water distribution and saving waste water at the facility will be possible.

b) Medium term

The medium term development shall include: 1) Introduction of weed control equipment, 2) Improvement of hoist equipment with motor, 3) Tile drainage, 4) Introducing of pilot projects for advance farming and 5) Reinforcement of the work-shop for repair of the pumps and motors.

c) Long term development

The Meska improvement projects will be started at the short term period after organizing WUA and will be completed within 20 years. The check structures on the delivery canals will be implemented at the same period as the Meska improvement projects. For the long term projects, 1) new construction of the El Monofy barrage and 2) improvement of the Demara regulator will be listed up.

The canal slope protection works of the main and delivery canals will be started in the medium term period and be finished within the long term period. The repair and replacement of the intake gates of the delivery canals, and water conservation works will be nominated in this category. As a long term development, improvement of water management system is listed. (refer to Figure 4.8.1)

(2) Executing Body

Since most of the proposed components are related to the irrigation and drainage aspect, MPWWR will act as the chief executing body for most of the above projects. However, some projects as pilot projects, the MALR and other agencies may be nominated as the executing body in cooperation with other agencies.

Figure 4.8.1 Disbursement Schedule of Proposed Component

Project Components	Year																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Short Term Development					Medium Term Development					Long Term Development									
1. Improvement of Major Facilities																				
Monofy Regulator																				
Rahbeen Regulator																				
Bahr Tera Intake Gate																				
Abshan Regulator																				
Hamoul MPS																				
Rehabilitation of Bahr Tera Canal																				
Demara Regulator																				
Slope Protection																				
Weed Control																				
2. Improvement of Delivery Canal																				
Installation of Check Gate																				
Slope Protection																				
Repair of Gates																				
Replace of Intake Gate																				
3. Meska Improvement																				
4. Water Management Improvement																				
5. Drainage Improvement																				
6. Pilot scheme																				
7. Demonstration Farm																				
8. Water Conservation																				
9. Pump, Gate and Apparatus Repair Shop																				

4.9 Project Evaluation

The financial analysis was carried out for the projects planned on the Master Plan. Since the components of the planned-projects contain the improvement of main canals and the barrages which exert the project efficiency to all over the Study Area, the financial analysis was conducted to all the Study Area as a unit.

The planned-project components are distributed into three (3) ranges of the implementation schedule which are short term (implemented with five (5) years), middle term (within ten (10) years), and long term (within 20 years) with regard to urgency, present condition of structures, project scale, economic efficiency and so on.

The benefit of the projects is 1) increment of agricultural net return by the improvement of unit yields by crops, cropping intensity and cropping pattern which has shown at Chapter 4, 4.2 Agricultural Development, 2) increase of cropping intensity in the downstream reaches of the Study Area by supplying the surplus water which will be created after the Meska improvement in up and midstream reaches of the Study Area and 3) deduction of operation and maintenance cost by improving irrigation facilities such as Meska. The financial analysis was carried out under the precondition as follows;

-Evaluation term is 30 years.

-The costs include, the initial investment, operation and maintenance costs as difference between with and without situation and replacement of pumps for Meska at about 10 % of Meska improvement cost every 10 years.

-Benefit will occur according to the progress of Meska improvement

Above the precondition the Financial Internal Rates of Return (FIRR) was calculated at 14.9 %, which is over the rate 12%, the present opportunity cost of capital in Egypt.

Sensitivity Analysis was conducted in case of (1) decrease of benefit at 20%, (2) increase of costs at 20% and (3) combination of (1) and (2). The result of the anlysis are as follows;

	FIRR
(1)decrease of benefit at 20%:	12.2 %
(2)increase of costs at 20%	12.7 %
(3)combination of (1) and (2)	10.1 %

4.10 Environmental Conservation Plan

The elements or parameters of the environment to be considered are the Damietta Branch of the Nile, the irrigation and drainage canals, the agricultural land, urban area, and health environment of the Egyptian community. These parameters are affected by other activities and projects. In this Study, main consideration for the preservation of water environment are follows.

(1) Prevention of water quality pollution in the irrigation and drainage canals

Monitoring of canal's water should be required through the operation of water quality sampling station at each of the water districts. Monitoring of wastewater discharges is usually done by requiring owners or operators to take samples, analyze them and submit the results to the responsible authorities.

Next point to be noted is re-use of bottom sediments in drainage canal. It should be done carefully. The use of sediments which contain heavy metals(Cadmium, Copper, Lead, Zinc, Iron) must not exceed the standard guideline of Egypt.

(2) Prevention of salts accumulation in the soils

The amount of crop yield reduction depends on such factors as crop growth, salt content of soil, climatic conditions, etc. In extreme cases where the concentration of salts in the root zone is very high, crop growth may entirely be prevented. To improve crop growth in such soils, the excess salts must be removed from the root zone. The term reclamation of saline soils refers to the methods used to remove soluble salts from the root zone. Methods commonly adopted or proposed includes the following:

- Removing the salts that have accumulated on the soil surface by mechanical means
- As crop rotation rice cultivation is suitable for salt-affected soils, it should be considered in the cropping pattern, especially downstream area of clayey soils
- Improvement of rhizosphere environment for correction of salt-affected soils, by direct supply of soil amendment materials such as gypsum
- Investment of organic fertilizer such as compost or manure, to decrease amount of chemical fertilizer

(3) Maintenance Management around watercourses

It is necessary to attempt effective use between a road with canal by tree-planting and break amenities to maintain clean environment, especially town areas beside the canal. Moreover, it should continuously promote enlightenment of the human health being on diseases, as schistosomiasis and malaria.

(4) Water quality of drainage and reuse

Water quality of drain water and reuse water could be avoided to some degree. However, surplus irrigation water are highly utilized for other purposes. Therefore, in case of drainage reuse for future, it should examine various factors, such as, mixture ratio of fresh water and sodium adsorption ratio which influences crop growth, and security of reuse water. (Refer to Chapter 4.4.3).

4.11 Initial Environmental Examination (IEE)

(1) Implementation of Initial environmental Examination (IEE)

The purpose of the IEE is to ensure environmentally sound and sustainable development through the timely incorporation of environmental issues into the project design. This study was carried out based on the " Guideline of Environmental Assessment " prepared by JICA. The check list was composed of 47 items on social and natural environment. During the study, the Study Team discussed with the counterpart and local staff of MPWWR on the 47 items of check list. (Refer to Appendix K).

(2) Items of Impact on Environment

As results of the investigation, several points were noted. (refer to Appendix K).

- There is no significant negative environment impact to be generated by the project (evaluated class A).
- The identified items that would create environment impact to be generated by the project (evaluated class B), are:
    - Conflict among communities and people
    - Adjustment and regulation of water or fishing rights
    - Changes in social and institutional structures
    - Changes in existing institutions and customs
    - Soil salinization
    - Soil contamination by agrochemicals and others
    - Water contamination and deterioration of water quality

(3) Conclusion

Based on results of IEE the following conclusion were made:.

- The project have no significant environmental impact.
- Negative impacts identified were related to social issues, institutional and custom related issues. There is a need therefore to examine the influence of rural district society of farmers' organization proposed according to water environment improvement and the embodiment of a resolution policy related to these problems.
- The negative impact on natural environmental items were related to salinization of soils and water quality. There is a need to introduce appropriate cropping systems by irrigation-drainage and soil improvement-preservation activities.

CHAPTER 5 SELECTION OF THE PRIORITY AREA

CHAPTER 5 SELECTION OF THE PRIORITY AREA

5.1 Segmentation of the Study Area

On the premise of implementation of the Priority Area, the Study Area would be divided into eleven (11) candidate blocks for selection of a priority area, based on the present command area by main canal. This will be done because the Study Area is very wide. Also, it is rather very difficult to implement all projects in the area at one time.

5.2 Candidate Area of the Priority Area

The result on categorization analysis of the Study Area by delivery canal unit could not show the definite result to select the Priority Area because the result showed a patch and/or mosaic pattern as mentioned before. It is therefore, difficult to select the Priority Area by using only this result. However, the command area boundary by major irrigation canal was layered over the categorized result. Consequently, special features for each block were clearly shown using a set of criteria.

5.3 Criteria to Select the Priority Area

(1) Area with tile drainage area or with programmed area

All areas to be selected should be covered by a tile drainage implementation area and/or the area should have a programme of implementation within a four (4) to five (5) year period. The areas proposed are implemented by tile drainage system, because it has no serious salinity problem due to lower groundwater table. The implementation period of the proposed components in the Priority Area will be implemented for a period of about 4 to 5 years. Within the Study Area, the areas under these criteria are five (5) blocks, such as No. 1 to 5 that are located at the upper and mid stream areas. (No.1 to No.5 blocks)

(2) Area close to the IIP area

Within the Study Area, there is no block with organized WUA by IAS, IIS. The preceding IIP area, such as, Kahwagi IIP area have received financial assistance from USAID and others. It is located near the proposed area to give incentive to the beneficial farmers. No.2 and No.3 areas are near the Kahwagi IIP area where the on-farm facilities under the IIP have been already constructed. However, when the pilot scheme project will be executed within the Priority Area, this item is not so important. (No. 2 and No.3 blocks)

(3) Less environmental impact

It is desirable to select the Priority Area with less environmental impact when the proposed project is implemented. The proposed area has less environment impact to the present natural conditions because most of the lands has been reclaimed. According to the IEE assessment of study, the Area has no serious problem on environment. Therefore all blocks correspond to this condition. (all blocks)

(4) Simple water distribution system

The proposed area has a simple water distribution system and can execute the proposed cropping pattern with adequate amount of irrigation water. The present water distribution of the seven (7) blocks which are located upstream and midstream areas have no complicated water distribution system because of no re-use of drain water. On the other hand, since the downstream areas are re-using the drainage water, these areas have lower priority. No.11 block is using re-use drainage water when the inflow from upstream is less. (No. 1 to No.7 blocks)

(5) Problems to be solved in the block on water distribution

There are some blocks with facilities such as a barrage/regulator(s) and a pump station, etc. that requires rehabilitation to effect water management. The major facilities of the upper Tera block, the Rahbeen Regulator located at the upstream and the Hamoul MPS located at the downstream needs urgent rehabilitation. Only No.5 has the most serious problem due to old age and not functioning water distribution facilities. The other blocks having many serious delivery canal problem based on the analyzed result of categorization mentioned in the previous chapter, accord with these criteria. (former No.5 block and latter No. 6, 9, and 10 blocks)

(6) Effort affects not only within the block but also downstream area

The benefit of minimizing water shortage to apply the surplus water brought by the project will be affected not only to the proposed area but also at the downstream area. Only No.5 block, the upper Tera block, has a vast cultivated area at the downstream. The block will give much benefit of water saving to the downstream block without any rearrangement of water distribution rate between major canals. (No. 5 block)

(7) Meska to be improved

The selected area has Meska to be improved for saving water loss and raising irrigation water application efficiency. Meska to be improved are scatted in the upper and midstream blocks and even in the downstream area. There are many farmers who intake irrigation water

directly from a delivery canal. To execute better management of irrigation system on the delivery canal level, the direct intake system should be limited and integrated with the improved Meska system. (all blocks are corresponded to)

(8) Over intake water

The selected area is using more amount of water than the programmed water requirement. Based on the water balance study, No.1, No.3 and No.5 blocks intake more water than the programmed amount of irrigation water. (No.1, 3 and 5 blocks)

(9) Water quality problem in the future

The selected area has no serious problem at present. However, the area will have some problems on water quality and quantity in the future. No.8 block will have some problem in the supply of water for the new reclaimed northern area (project under going) in the future. (No. 8 block)

(10) Suitable project scale

The project scale is suitable for implementation as one package. Considering the present IIP, the project size from 25,000 feddan (about 10,000 ha) to 83,000 feddan (about 35,000 ha) is suitable for project implementation. (No.2 to No.5 , No. 9 and No. 11 blocks)

(11) Better traffic condition

It is required that the selected area be provided with good access to demonstrate the project benefits. No.1 to No.5 blocks have suitable access from the center of the town of Tanta, that is, as the center of water management in the central delta. No. 5 block has branch offices related to agricultural development and water management. (No. 1 to No. 5 blocks)

5.4 Evaluation Matrix and Selection Method

The matrix table for evaluation is made applying the study results for categorization by block. Applying the above section criteria, the matrix would be screened in order to select the Priority Area. (Refer to Table 5.4.1)

5.5 Selection of the Priority Area

The above analysis is summarized in the flowing matrix table.

Condition	No.1	2	3	4	5	6	7	8	9	10	11
(1)	◎	◎	◎	◎	◎						
(2)		O	O								
(3)	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
(4)	◎	◎	◎	◎	◎	◎	◎				
(5)					◎						
(6)					◎						
(7)	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
(8)	◎		◎		◎						
(9)								◎			
(10)		◎	◎	◎	◎		◎		◎		◎
(11)	◎	O	O	◎	◎	◎			◎	◎	
Point	6	6	7	6	9	4	4	3	4	3	3
Justification	3	3	2	3	1	4	4	5	4	5	5

Note: ◎ fit

O slightly fit

Based on the above analysis, the Upper Tera Command area of 62,015 feddan (about 26,046 ha) would be selected as the Priority Area including the Rahbeen regulator and the Hamoul MPS.

Table 5.4.1 Matrix of Priority Areas

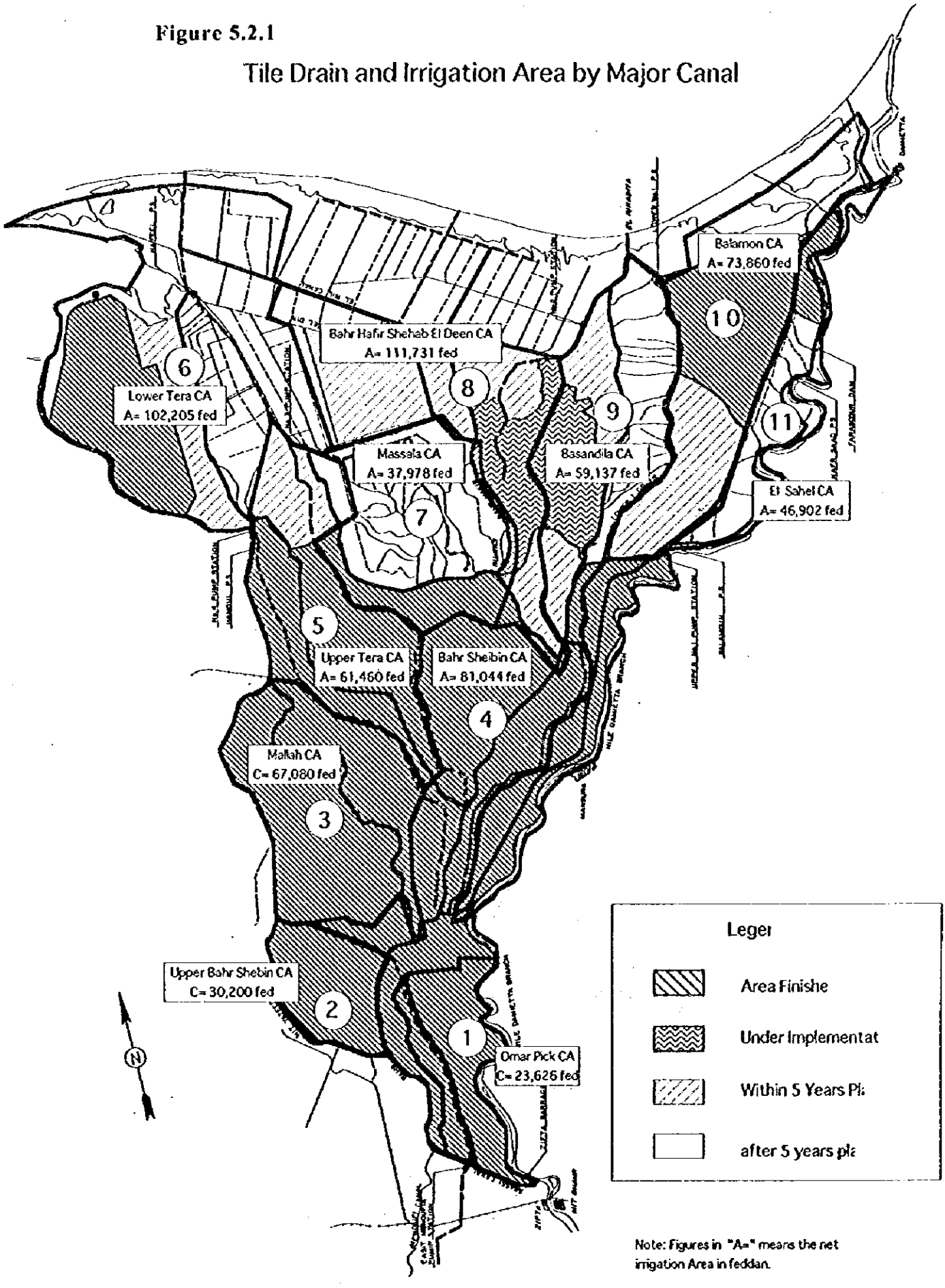
Items	Block Name											
	1	2	3	4	5	6	7	8	9	10	11	
	Omar Pick CA	Upper Bahr Shebin CA	Maltah CA	Bahr Shebin Direct CA	Upper Tera CA	Lower Tera CA	Masaala CA	Shehab Deen CA	Basandila CA	Balamoun CA	El Sahel CA	Total Evaluation
A. Indices of Structures												
a.1) Aged Degree, Operation, Function and Damage												
- do by Intake Condition (phase)	16	8	29	55	29	58	32	32	41	38	19	357
good	11	7	28	21	24	27	25	11	22	16	10	200
repair	5	1	0	17	2	19	1	12	7	15	3	80
replacement	2	0	1	17	3	12	6	9	12	7	6	77
a.2) Delivery Canal Condition by Category												
Category A	14	8	23	32	19	0	15	29	25	12	12	183
Category B	2	0	0	16	0	0	5	9	10	2	6	50
Category C	0	0	0	0	3	23	6	0	0	15	0	47
Category D	0	0	5	3	4	10	3	0	2	3	1	31
Category E	0	0	1	4	1	18	0	0	4	2	0	30
Category F	0	0	0	0	2	7	3	0	0	4	0	16
a.3) Total Length of Delivery (km)	70.50	69.18	167.40	234.36	154.70	271.32	177.27	136.92	192.96	192.73	68.72	1706.05
a.4) Necessary Cost (project cost Only LE)	45,769	57,607	128,395	157,742	260,051	231,051	90,211	252,538	136,278	163,300	97,707	1,620,639
a.5) Payed Cost (per feddan	1,937	1,908	1,914	1,946	4,231	2,261	2,975	2,260	2,304	2,211	2,063	2,331
B. Indices of Benefit												
b.1) Command Area (feddan)	23,626	30,200	67,080	81,044	61,460	102,205	37,978	111,731	59,137	73,860	46,902	695,223
-do- (fm)	9,923	12,684	28,174	34,038	25,813	42,926	15,951	46,927	24,838	31,021	19,699	291,994
b.2) Tile Drainage implemented ratio												
- Tile Drain implemented Area Ratio	100%	100%	100%	100%	75%	30%	20%	20%	25%	40%	60%	
- Tile Drain Programmed Area Ratio	0%	0%	0%	0%	25%	10%	0%	70%	25%	30%	0%	
Ratio of(2 + 3 to total area	100%	100%	100%	100%	100%	40%	20%	90%	50%	70%	60%	
b.3) Location of Area	Upper	Upper	Upper	Middle	Middle	Lower	Middle	Lower	Lower	Lower	Lower	
b.4) Water Source												
- Excess Water Intake	yes	no	yes	no	yes	no	no	no	no	no	no	
- Summer Water Shortage												
rare	10	8	10	28	19	15	13	28	26	19	15	201
often	6	0	13	10	5	15	16	4	9	14	3	95
very often	0	0	6	2	3	17	3	0	6	5	1	95
always	0	0	0	5	2	11	0	0	0	0	0	95
b.5) Existence of Downstream Beneficial Area (fed)	0	0	0	0	102,205	0	0	0	0	0	0	
b.6) Water Shortage during Summer (feddan)												
rare	14,091	40,200	38,520	43,884	25,297	37,684	14,882	29,281	23,870	35,966	13,691	317,366
often	7,245	0	34,200	21,525	14,110	26,080	65,510	14,766	19,694	24,671	4,163	231,964
very often	0	0	16,920	5,450	3,550	26,100	9,008	0	11,341	12,065	1,530	85,964
always	0	0	0	10,440	9,220	74,500	0	0	0	0	0	94,160
Total	21,336	40,200	89,640	81,299	52,177	164,364	89,400	44,047	54,905	72,702	19,384	729,454
b.7) Water Quality Problems												

Table 5.4.1 cont'd

Items	Block Name											
	1	2	3	4	5	6	7	8	9	10	11	
	Omar Pick CA	Upper Bahr Shebin CA	Mallah CA	Bahr Shebin Direct CA	Upper Tera CA	Lower Tera CA	Masaala CA	Shehab Deen CA	Basendila CA	Balamoun CA	El Sahel CA	Total Evaluation
none	16	8	29	55	27	0	22	32	28	37	19	273
slight	0	0	0	0	1	38	10	0	0	0	0	49
moderate	0	0	0	0	1	20	0	0	13	0	0	34
(a8) Salinity Problem												
none	13	2	0	18	13	0	0	0	0	0	0	46
slight	3	6	29	37	8	0	22	32	41	19	19	216
moderate to strong	0	0	0	0	8	58	10	0	0	19	0	95
c. Indices of Project Implementation												
c.1) Accessibility through Road												
- National Road	possible	possible	near	Possible	Possible	near	no	no	no	possible	possible	
- Provincial Road	possible	possible	possible	possible	possible	possible	possible	possible	possible	possible	possible	
- Old Mail Road	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible	
c.2) Distance from Tanta to Center of Area (km)	22	18	36	55	55	77	64	77	77	91	64	572
c.3) Farming Conditions												
- Cropping Intensity (%) of 3 summer Crops	99.7	99.7	96.1	93.6	93.0	81.3	82.8	91.7	92.8	80.5	97.0	892
- do of Cotton	17.0	24.4	23.3	21.8	24.5	29.3	27.3	31.7	26.5	21.2	21.9	249
- do of Maize	31.8	26.4	24.5	26.8	13.9	12.9	11.7	14.2	15.0	12.0	21.7	192
- do of Rice	49.9	48.9	48.1	45.0	44.5	39.1	43.8	45.9	51.3	47.3	53.4	462
- Crop Unit Yield of Cotton	0.8	0.8	0.8	0.8	0.8	0.7	0.8	0.7	0.7	0.7	0.7	0.7
- Crop Unit Yield of Maize	2.6	2.7	2.7	2.5	2.4	1.8	2.4	2.2	2.2	2.1	2.5	24
- Crop Unit Yield of Rice	3.2	3.2	3.2	3.2	3.0	2.8	3.0	3.0	2.9	2.6	3.2	30
d) Others												
d.1) IIP near the CA (yes or no)	no	yes	yes	no	yes	no	no	no	no	no	no	
d.2) Environmental Impact	no	no	no	no	no	no	no	no	no	no	no	
d.3) Simple Water Distribution System	yes	yes	yes	yes	yes	yes	yes	no	no	no	yes	
d.4) Problem to be solved on Water Delivery System	no	no	no	no	yes	yes	yes	yes	yes	yes	yes	
d.5) Existence of Banks	16,224	13,095	33,812	27,963	15,275	51,355	4,350	9,500	7,670	9,778	4,760	194,702
- do - ratio to total area	69	46	50	35	25	50	11	9	13	13	10	28
d.6) Traffic Convenience	good	bad	fair	yes	yes	fair/bad	bad	bad	bad	fair	good	
d.7) Domestic Waste												
little	6	2	22	40	19	32	31	31	14	34	10	241
considerable	10	6	6	11	9	26	1	1	27	3	8	108
much	0	0	1	4	1	0	0	0	0	1	1	8
- do by Wastes												
cars	15	3	14	45	23	26	10	32	25	27	16	236
other	1	5	15	10	6	32	22	0	16	11	3	121

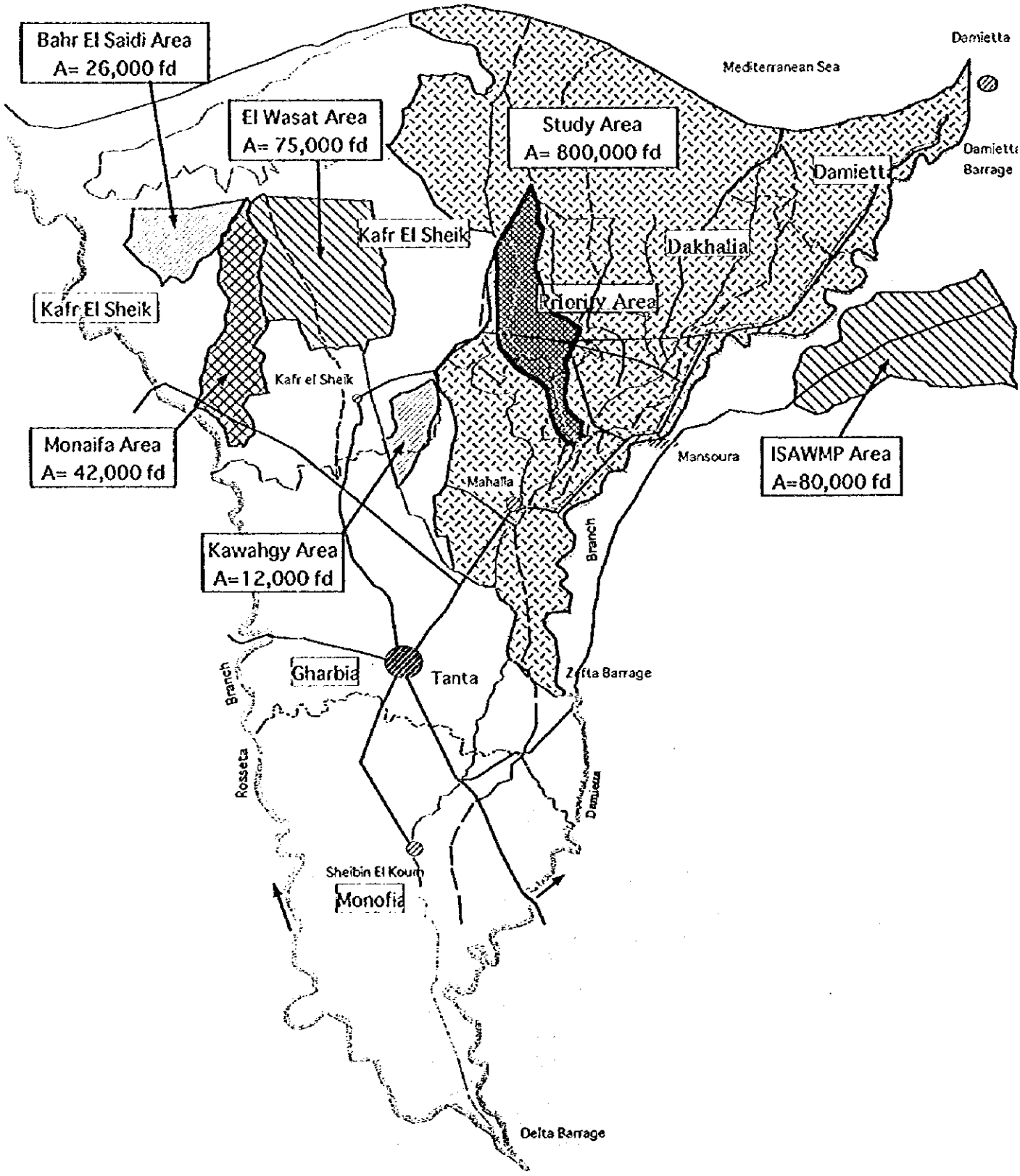
Figure 5.2.1

Tile Drain and Irrigation Area by Major Canal



Note: Figures in "A=" means the net irrigation Area in feddan.

Figure 5.5.1 Location Map of Priority Area



CONCLUSION AND RECOMMENDTATION

Conclusions

In the Study Area, in the North-East Region of the Central Nile Delta, mainly in the Bahr Shebin command area of about 800,000 feddan (about 336,000 ha), there are many old and inefficient irrigation, drainage and on-farm facilities. From the viewpoint of effective use of limited water resources, these facilities impede the improvement of irrigation efficiency. These facilities should be improved and/or rehabilitated for effective water management. It is proposed, therefore, that the following project activities/components be implemented to improved conditions in the project area as follows: (a) rehabilitation/improvement of the eight major irrigation facilities, delivery canals and on-farm facilities such as Meska, (b) early implementation of the Pilot Scheme, (c) implementation of water management improvement plan and agricultural development plan, (d) water conservation plan etc.

The major components of the development plan should be handled by the MPWWR, which has the experiences and expertise in irrigation administration. It is proposed that the upstream command area of Bahr Tera be selected as the Priority Area for early implementation. The projects proposed in the Priority Area consists of many components such as the Meska improvement, the Pilot Scheme, improvement of water management system, improvement/rehabilitation of major irrigation facilities, renewal of the Hamoul Mix pump station, improvement of delivery canals, new construction and rehabilitation of sub-surface drainage facilities, agricultural demonstration farm, the water conservation plan etc. For the management of these facilities, the farmers' organizations of WUA that is composed of many WUGs, and the Federation of WUAs would be proposed. Since the proposed projects are found to be feasible, it is recommended that the proposed components be immediately implemented.

Recommendation

1. There is no farmer's organization that is collecting and renewing the basic data for water management such as the irrigation area by crops at Meska and delivery canal levels. It is, therefore recommended that concerned data be prepared/collected on a delivery and Meska basis from the present data collection at the village level. The WUA has to be established/organized and do the function of collection and renewal of these basic data.

2. In line with the importance of farmers' incentive which is used to be ignored in unsuccessful examples of PIM in many countries, it is recommended that the following key conceptions should be taken into consideration to realize final targets of more active involvement of farmers, thus the greater and more successful performance of IIP.

   *Key conception 1: "Ergonomics Consideration", in deciding ideal sizes of water users unit in terms of number of farmers

   *Key conception 2: "Hydrological De-centralization", for clear-cut separation of water divide and in encouraging farmers in effectuating water use

3. Prior to the implementation of the proposed project, WUA organized by farmer beneficiaries should be established. The WUA are very crucial to the improvement of project implementation of on-farm facilities. The establishment of WUAs should be undertaken not only in the priority project area but also all over the Study Area without delay. Also, it is necessary to strengthen the quality and quantity of the IAS staff.

4. Dumping of garbage by rural people into the canals will deteriorate water quality in the canal. This will affect people living at the downstream and may cause the occurrence of disease in future due to the use of polluted water. The water from factories at the upstream, which may affect peoples' health due to the polluted elements etc., should be treated. Also, laws and policies related to environmental pollution should be vigorously performed.

5. Since there are no discharge data at present, water saving amount between before and after IIP will not be examined. Taking into consideration limited water resources at present, the continuos flow system to increase water intake volume will be introduced instead of the present water distribution system of rotational irrigation. However, because the farmers are not familiar with the new system, it will be difficult to introduce

the new system at the beginning stage. The farmers will have to be given the proper guidance, motivation and training on the continuos flow system. Also, prior to the implementation of the IIP, it is necessary that the seasonal intake amount at the objective canal be measured.

6. Project improvement should be started at the upstream and/or midstream areas. The surplus water produced by the project would be presented to the downstream command areas and would mitigate the water shortage at the downstream areas. The crop intensity of the downstream area will be increased from 148 % (present) to 170 % (proposed) with the use of surplus water. In the future the crop intensity is expected to further increase to 200 %.

PART 2 FEASIBILITY STUDY OF THE PRIORITY AREA

CHAPTER 1 PRESENT CONDITION OF THE PRIORITY AREA

CHAPTER 1 PRESENT CONDITIONS OF THE PRIORITY AREA

1.1 Natural Condition

(1) Location

The Priority Area, upstream reaches of Bahr Tera command area, is located in the eastern most part of Kafr El Sheikh Irrigation Directorate. At the south-western part is the Gharbia Irrigation Directorate, while the north-eastern part is demarcated by West Dakahlia Irrigation Directorate. The area is oblong-shaped and lies from south-eastern to north-western direction. The longitude and latitude at the south-eastern edge are 31°16'E and 31°03'N, while those at the north-western side are 31°10'E and 31°20'N, respectively.

(2) Area and Topography

The gross area is 62,015 feddan (about 26,000 ha), while the net irrigation area is 56,930 feddan (about 23,900 ha). The gross area was identified with reference to the latest topographic maps with a scale of 1/50,000 produced in 1992 and 1993, while the net irrigation area was given by the Irrigation Directorate of Kafr El Sheikh. The net irrigation area of 56,930 feddan occupies about 92 % of the gross area. The land is broadly very flat as the Nile Delta is, and the elevation ranges from 5 m MSL to 0 m MSL.

(3) Meteorological Conditions

With reference to the meteorology at Mansoura, located at almost same latitude of the south-eastern corner of the Priority Area but about 12 km away toward east, the weather is predominantly characterized by a Mediterranean climate. The mean monthly temperature ranges between 12°C and 27°C with on annual mean of 20°C. Mean monthly relative humidity falls in a relatively small range between 56 % and 74 %. Mean annual evaporation measured in pitch tube is 1,420 mm and mean annual rainfall is 53 mm, mostly falling during winter.

(4) Soil

Most of the soils are of recent clay alluvial origin, and classified to Vertisols with rich swelled clay minerals and generally soil color of dark red and/or dark brown. These soils have high clay contents, high cation exchangeable capacity, and characterized by the ability to absorb water according to montmorillonite with 2:1 layer silicate mineral of crystal structure. Most distinguishing feature of Vertisols is their shrinking/swelling activities with wetting and drying cycles, deep cracks unless the soil is irrigated.

Subsurface layer has slickenslides and clay accumulation at some depth between 25 cm and 1m. The soil water holding capacity is very high and its permeability is low. The pH of the saturation extract is generally between 7.8 and 8.4, and the exchangeable sodium percentage (ESP) is well below 15 % in the surface soil.

Biyala Water District situated south of the Study Area have less salt affected soil and more areas below 120 cm underground water level compared with the northern part of Hamoul Water District (refer to Appendix K).

(5) Geology

Underneath the Priority Area, a deposit geologically called "the Quaternary Nile deposits" lies. The deposit, composed of sand and clay, forms the main aquifer in the Delta, thickness of which ranges from about 100 m at Cairo to as much as 1,000 m along the Mediterranean coast. The thickness at the priority area is about 800 m. The deposit is covered by a clay/silt layer (so called Nile silt) with a thickness of about 10 m in the south of the Delta and increasing to more than 100 m along the Mediterranean Sea.

The groundwater is continuously recharged by the infiltration of irrigation water. The drainage system extensively networked in and around the Study Area intercepts this groundwater recharge. The irrigation and drainage network therefore controls an important local groundwater flow system especially at its shallow depth.

1.2 Socio-Economic Condition of the Priority Area

1.2.1 Administrative Boundary

The Priority Area has a total of 62,015 feddan covering three (3) governorates, namely, Kafr ElSheikh, Gharbia, and Dakhlia. The proportion of each governorate is 88 % (about 54,350 feddan) for Kafr El Sheikh, 9 % (about 5,570 feddan) for Gharbia and 3 % (about 2,080 feddan) for Dakhlia. The Priority Area consists of four (4) districts, eight (8) local units and 17 mother villages under the three (3) governorates. There are 114 sub villages scattered throughout the area under the administrative units. (Refer to Appendix B.4, Table B.4.1)

1.2.2 Population and Household

The total population in the Priority Area in 1996 is 214,000 distributed as 70,800 in Hamoul district, 105,500 in Biyala district, 20,000 in El Mahalla El Kubra district and 17,700 in Talkha district. The average growth rate from 1986 to 1996 is calculated at 2.23 % which is above the average growth rate of the total Egypt at 2.08 %. The proportion between male and female in 1996 is about 1.01:1.00 (107,300 and 106,600). The total number of households in 1996 is 41,200 and the average family size is 5.2 persons (Refer to Appendix B.4, Table 4.2)

1.2.3 Labor Force

The population of workers (from 15 to 60 years old) in 1996 is 123,300 which comprises 58 % of the total population. In the region which include the big cities such as El Mahalla El Kubra city, Tanta city and Damietta city, the population of workers ranges from 64 % to 69 %. The data implies that workers moved into these cities from the rural areas. (Refer to Appendix B, B.3.1 and B.4.2)

1.2.4 Standard of Living

The average annual household expenditure per capita is 1,070 LE and for the average size family in the Priority Area is calculated at 5,570 LE according to the result of the farm economy survey. Out of 5,570 LE, the food expenditure is 2,830 LE. The ratio of food expenditure to the total expenditure is about 51%. Comparably, the result of expenditure survey in 1995/96 by governorate level shows the higher amount with 6,670 LE (1,220 LE per capita) in the rural area of Gharbia, Dakahlia and Kafr El Sheikh. (Refer to Appendix B, Table B.3.5 and L, Table L.2.4)

1.3 Rural sociology and farmers' organization

1.3.1 Farmers' opinions gathered through Group Meetings

(1) Background and justification:

As a result of the Rural Sociology Survey and the Farm Economy Survey both executed in the phase -I period of the JICA study, following points were clarified.

a) In the group of delivery canals where the reported water shortage is not so serious, a majority of beneficiary farmers anticipates irrigation improvement through rather soft-type measures such as participation to WUAs and self-governing of water by themselves than through a hard-type measures like structural improvement. By contrast, in the other group of delivery canals where the reported water shortage is quite serious throughout a year, a majority of farmers anticipates irrigation improvement by means of hard-type works. Prior to the decision of each IIP direction and its component, therefore, such differences encompassed in each canal domain have to be studied.

b) According to the responses from farmers, the most desirable supports of which farmers anticipate in IIP and WUA (such as stable water supply, lightening/elongation in IIP repayment, and establishment of permanent field service offices etc.) are not necessarily satisfied. Meanwhile, the official activities by the government have not likely been focussed into gathering and analyzing such opinion/ requests from farmers, prior to the IIP implementation. If so, more repeating and exhaustive meetings should be organized among beneficiary farmers at each delivery canal to discuss on whether IIP is necessary or not in each domain and, if necessary, to decide a right and optimal way of IIP by farmers themselves, under the mutual consultation with IAS.

c) When considering a premise of which a Federation of WUAs is established in each delivery canal (or even in a large-scale meska level), a IIP should start its function from finding out delivery canals where almost farmers are strongly requesting IIP implementation (Until otherwise, farmers may not feel satisfaction but feel unjustified over-intervention by the government in being involved in the IIP, accordingly the IIP itself will not be successful).

In this context, an application of PP(Participatory Planning) methodology is quite meaningful to organize several group meetings aiming at collection of farmers' requests most effectual in improving socio-economic and technical circumstances of each delivery canal

domain, and also such trials in the phase II study period may be worthwhile in reinforcing the result obtained through "a Seven Question Survey" executed by IAS in 1998 against the 162 stakeholders and in paving a way for the future expansion and dissemination of IIP. A final target of adoption of the PP methodology in the phase II study is to verify its applicability to select the most desirable sites for IIP and to prioritize the most suitable means in improving core problems hampering effective irrigation and water use currently in each delivery canal domain.

(2) Methodology applied in Group Meeting and its results

Firstly, participation analysis, i.e. selection of 10 groups (7 delivery canal groups, 1 Gov't staff group, 1 influential person group and 1 women group) was executed at the early stage of the phase II study at the F/S area under mutual consultation with MPWWR, and each group was composed by around 10 participants who represented each group(In more detail, see Appendix J.6).

Secondly, each group discussed about core problems, means to solve them, prioritization of means etc. by applying PP methodology under the guidance of IAS staffs, to consolidate its opinion by using a simplified PDM (Project Design Matrix) method because PDM itself was too complicated to be mastered by IAS staffs within the limited period.

Thirdly, the results obtained in each group meeting were gathered and discussed each other in a round-up meeting which was composed by representatives from each group. (It is noted that an overall conclusion was not necessary needed in this round-up meeting because absorption and understanding of different ideas submitted from other groups are meaningful, and such differences will give several enlightening ideas to other participants, especially to MPWWR toward greater and more successful implementation of IIP). For reference, core problems selected by individual participants at the group meetings were also categorized into some components although the main purpose of the group meeting is not an analysis of individual opinions but of group opinions.(Above procedures adopted and overall results are shown in Appendix J.6) .