JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

MINISTRY OF PUBLIC WORKS AND WATER RESOURCES (MPWWR)
ARAB REPUBLIC OF EGYPT

THE MASTER PLAN STUDY FOR THE IMPROVEMENT OF IRRIGATION WATER MANAGEMENT AND ENVIRONMENTAL CONSERVATION IN THE NORTH-EAST REGION OF THE CENTRAL NILE DELTA

FINAL REPORT

AUGUST, 1999

SANYU CONSULTANTS INC.

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PREFACE

In response to the request from the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct the study on the Study for the Improvement of Irrigation Water Management and Environmental Conservation in the North-East Region of the Central Nile Delta and entrusted the study to the Japan International Cooperation Agency (JICA).

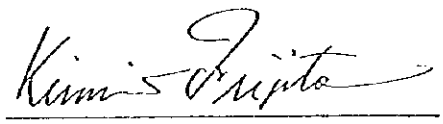
JICA sent to Egypt the study team headed by Mr. Masahiro Iida, Sanyu Consultants Inc., three times between March 1998 and May 1999.

The team held discussions with the officials concerned of the Government of Egypt, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Arab Republic of Egypt for their close cooperation extended to the Team.

August 1999



Kimio Fujita
President
Japan International Cooperation Agency

Mr. Kimio Fujita
President,
Japan International Cooperation Agency (JICA)
Tokyo, Japan

August 1999

Letter of Transmittal

Dear Sir,

We are pleased to submit herewith the Feasibility Study Report on the Master Plan Study for the Improvement of Irrigation Water Management and Environmental Conservation in the North-East Region of the Central Nile Delta.

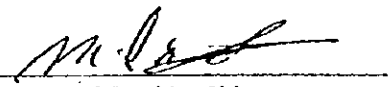
The Report, which describes the proposed plan for improvement of irrigation water management and environmental conservation in the area, is compiled in reflecting the advice and suggestions for the formulation of the above mentioned project by the authorities concerned of the Government of Japan and your Agency. Also comments made by the related agencies of the Government of the Arab Republic of Egypt are incorporated in the Report.

The study had been carried out in the phasing manners, Phase-I and Phase-II. In the courses of the Phase-I study, Master Plan for the study was formulated, and Priority Area was preliminarily selected. In the Phase-II study, the selection of the Priority Area was approved through the discussions with the Egyptian government personnel and Feasibility Study was carried out in the Priority Area.

As the result of the study, the project plan involving a) establishment of Water Users' Association (WUA) and Federation of WUAs to improve and operate the terminal irrigation facilities by beneficiary farmers themselves, b) improvement of main irrigation facilities, c) improvement of water management system, improvement of on-farm irrigation management through estsablishing demonstration farm and tile drainage installment, d) environmental water quality conservation, e) establishment of a pilot scheme to demonstrate the effect and enhance the implementation of the projects, etc. was proposed. Through the implementation of the above-mentioned projects, it will surely be believed that the projects will greatly contribute to the improvement of socio-economic well-being and sustainable regional development of the rural areas in the North-East Region of the Central Nile Delta.

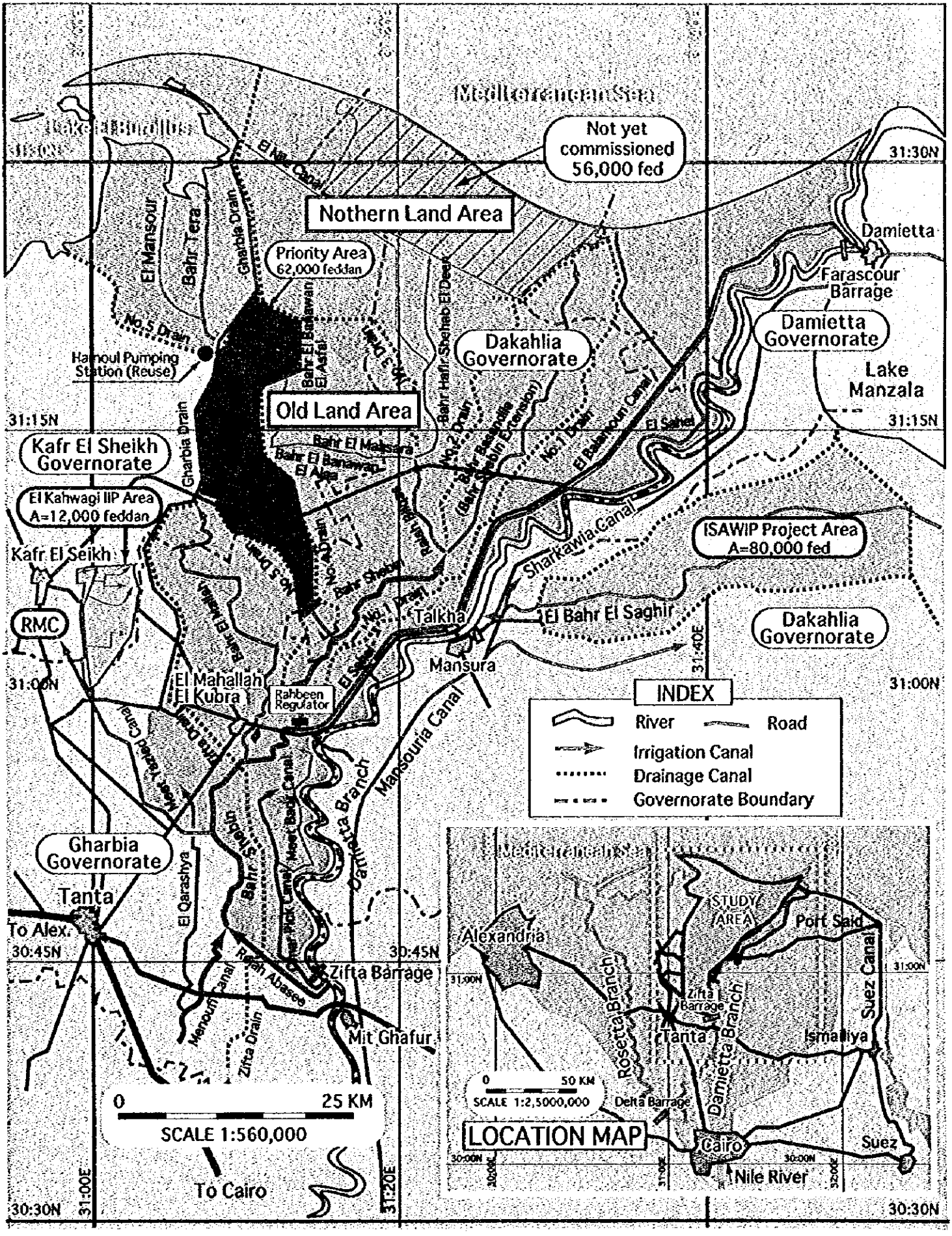
Finally, we take this opportunity to express our sincere gratitude to Ministry of Public Works and Water Resources (MPWWR) of the Government of the Arab Republic of Egypt, Ministry of Foreign Affairs, Ministry of Agriculture, Forestry and Fisheries of the Government of Japan, and Japan International Cooperation Agency, especially for Advisory Committee which gave useful advice to the study team from time to time so as to smoothen the study.

Respectfully yours,

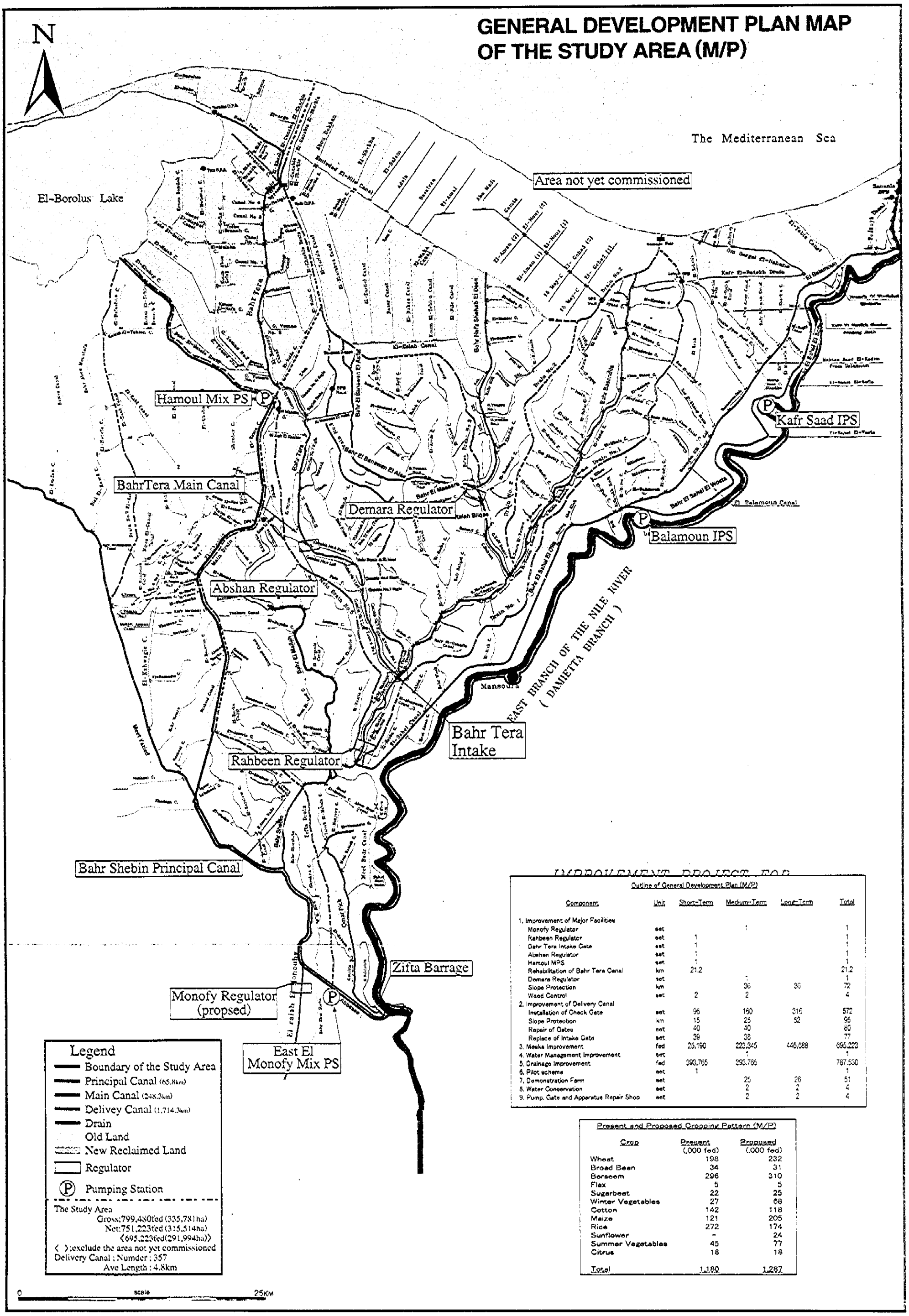


Masahiro Iida
Team Leader of the Study Team

General Map of Study Area



GENERAL DEVELOPMENT PLAN MAP OF THE STUDY AREA (M/P)



IMPROVEMENT PROJECT FOR

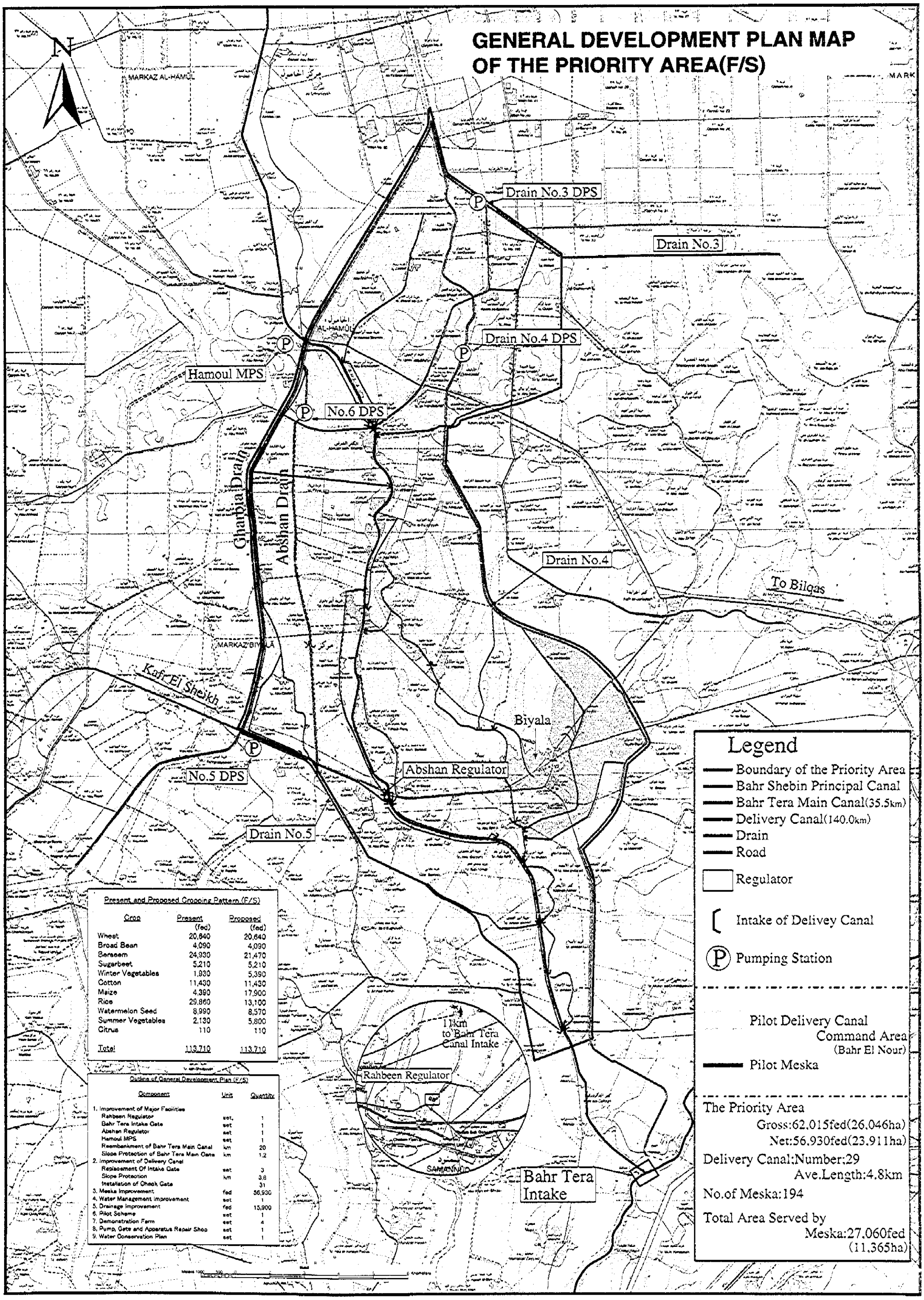
Outline of General Development Plan (M/P)

Component	Unit	Short-Term	Medium-Term	Long-Term	Total
1. Improvement of Major Facilities					
Monofy Regulator	set		1		1
Rahbeen Regulator	set	1			1
Bahr Tera Intake Gate	set	1			1
Abshan Regulator	set	1			1
Hamoul MPS	set	1			1
Rehabilitation of Bahr Tera Canal	km	21.2			21.2
Demara Regulator	set		1		1
Slope Protection	km		36	36	72
Weed Control	set	2	2		4
2. Improvement of Delivery Canal					
Installation of Check Gate	set	96	160	316	572
Slope Protection	km	15	25	52	96
Repair of Gates	set	40	40		80
Replace of Intake Gate	set	39	38		77
3. Meska Improvement	fed	25,190	223,345	446,688	695,223
4. Water Management Improvement	set		1		1
5. Drainage Improvement	fed	393,765	393,765		787,530
6. Pilot scheme	set	1			1
7. Demonstration Farm	set		25	26	51
8. Water Conservation	set		2	2	4
9. Pump, Gate and Apperatus Repair Shop	set		2	2	4

Present and Proposed Cropping Pattern (M/P)

Crop	Present (,000 fed)	Proposed (,000 fed)
Wheat	198	232
Broad Bean	34	31
Berseem	296	310
Flax	5	5
Sugarbeet	22	25
Winter Vegetables	27	68
Cotton	142	118
Maize	121	205
Rice	272	174
Sunflower	-	24
Summer Vegetables	45	77
Citrus	18	18
Total	1,180	1,287

GENERAL DEVELOPMENT PLAN MAP OF THE PRIORITY AREA(F/S)



Present and Proposed Cropping Pattern (F/S)

Crop	Present (fed)	Proposed (fed)
Wheat	20,640	20,640
Broad Bean	4,090	4,090
Berseem	24,930	21,470
Sugarbeet	5,210	5,210
Winter Vegetables	1,930	5,390
Cotton	11,430	11,430
Maize	4,390	17,900
Rice	29,860	13,100
Watermelon Seed	8,990	8,570
Summer Vegetables	2,130	5,800
Citrus	110	110
Total	113,710	113,710

Outline of General Development Plan (F/S)

Component	Unit	Quantity
1. Improvement of Major Facilities		
Rahbeen Regulator	set,	1
Bahr Tera Intake Gate	set	1
Abshan Regulator	set	1
Hamoul MPS	set	1
Reembankment of Bahr Tera Main Canal	km	20
Slope Protection of Bahr Tera Main Cana	km	1:2
2. Improvement of Delivery Canal		
Replacement Of Intake Gate	set	3
Slope Protection	km	3.8
Installation of Check Gate		31
3. Meska Improvement	fed	56,930
4. Water Management Improvement	set	1
5. Drainage Improvement	fed	15,900
6. Pilot Scheme	set	1
7. Demonstration Farm	set	4
8. Pump, Gate and Apparatus Repair Shop	set	1
9. Water Conservation Plan	set	1

Legend

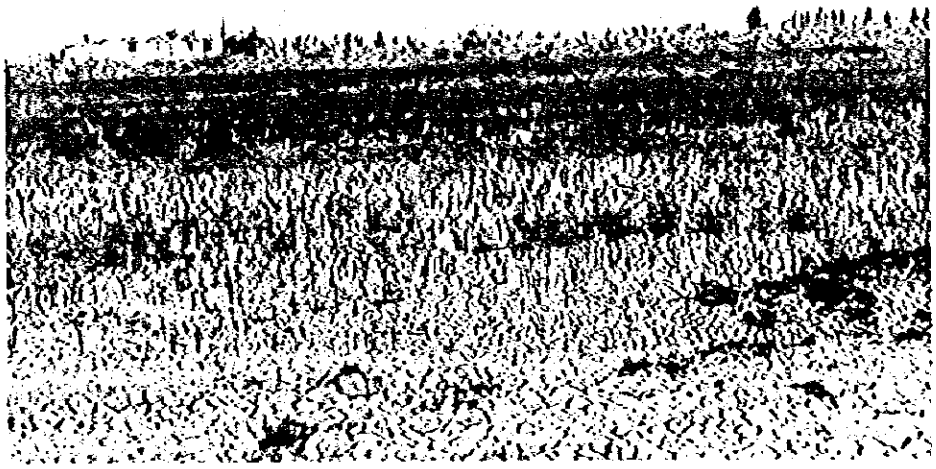
- Boundary of the Priority Area
- Bahr Shebin Principal Canal
- Bahr Tera Main Canal(35.5km)
- Delivery Canal(140.0km)
- Drain
- Road
- Regulator
- Intake of Delivey Canal
- (P) Pumping Station
- Pilot Delivery Canal Command Area (Bahr El Nour)
- Pilot Meska

The Priority Area
Gross:62,015fed(26,046ha)
Net:56,930fed(23,911ha)

Delivery Canal:Number:29
Ave.Length:4.8km

No.of Meska:194

Total Area Served by Meska:27,060fed (11,365ha)



1. Drought in the downstream reaches of the Study Area

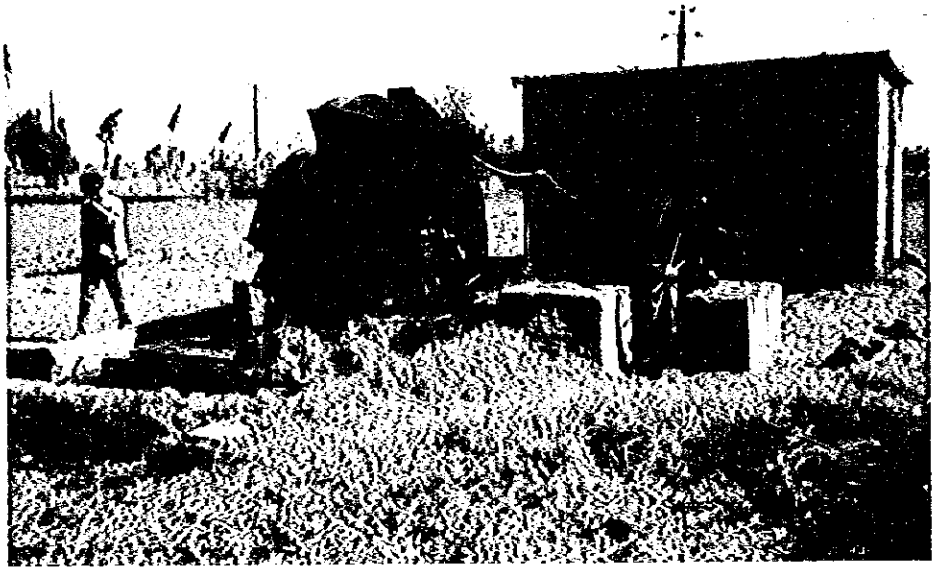
2. Meska at the center and Marwa at right hand side along the field

3. Direct pumping from the delivery canal

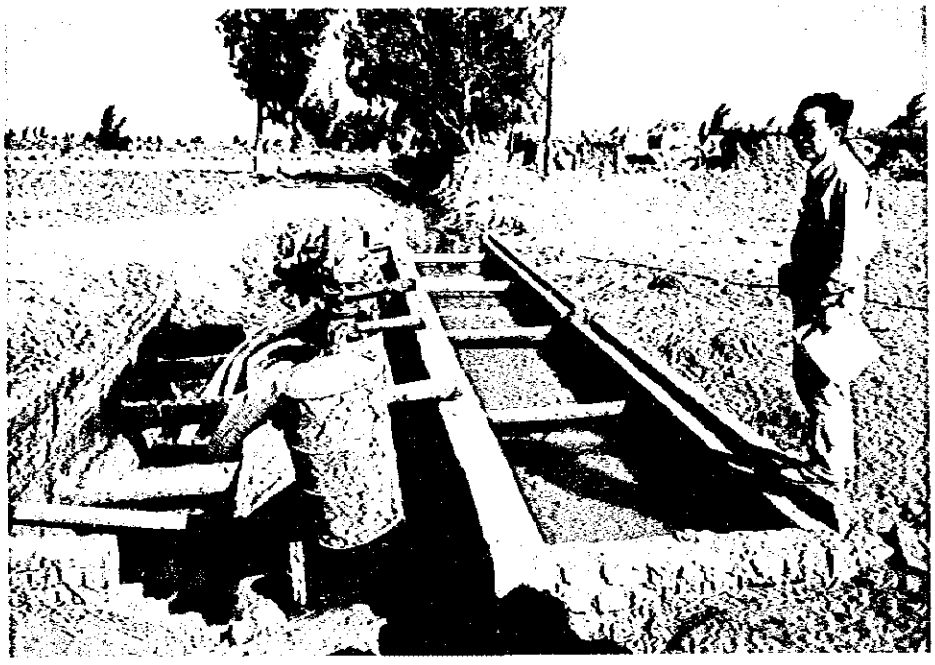
4. Regulator in the main canal. The function has been lowered due to age.

5. Canal is used for washing, watering by livestock etc. Water quality through villages is specially a problem

6. The lower part of the canal is covered with weeds causing water loss.



7. Irrigation by a large Sakia.



8. Irrigation by a pumping facility constructed by two farmers in cooperation.

9. Discharge chamber constructed by farmers.

10. Group meeting for farmers in Bahr Nour delivery canal command area.

11. Group meeting for women group

12. Group meeting for Gate Keepers.

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PART 2 FEASIBILITY STUDY OF THE PRIORITY AREA

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CHAPTER 2 DEVELOPMENT PLAN OF THE PRIORITY AREA

SUMMARY, CONCLUSION AND RECOMMENDATION

OUTLINE OF IMPROVEMENT OF IRRIGATION WATER MANAGEMENT AND ENVIRONMENTAL CONSERVATION IN THE NORTH-EAST REGION OF THE CENTRAL NILE DELTA

		Master Plan Study		Feasibility Study	
1 Study Area/Project Area					
Location	:	Gahrbia, Dakahlia, Kafr El Sheikh, Damietta Gavernorates		Kafr El Sheikh(Biyala, Hamoul Districts)、Gharbia (El Mahhalla El Kubra District)、Dakahlia (Talkha District)	
No. of Households	:		663,000		41200
No. of Farm Households	:		465000		24800
Population	:		3100000 (920人/sq km)		214000 (820人
2 Area					
Gross Area	:	799,500 fed	335,800 ha	62,000 fed	26,000 ha
Cultivated Area	:	695,200 fed	292,000 ha	56,900 fed	23,900 ha
3 Major Crops					
Winter Crops	:	Wheat, Berseem, Sugarbeet, Vegetables		Wheat, Berseem, Sugarbeet, Vegetables	
Summer Crops	:	Miaze, Cotton, Rice, Vegetables		Miaze, Cotton, Rice, Water Melon Seeds, Vegetables	
4 Cropping Intensssity	:	Upstream and Midstream	200%	Throghout Priority Area	200%
		Downstream	170%		
5 Irrigation Improvement Plan					
(1) Major Facilities	:	Monofy Regulator	one regulator		
		Rahbeen Regulator	one regulator	Rahbeen Regulator	one
	:	Demara Regulator	2 regulators		
	:	Bahr Tera and Abshan Regulators(Motorization)	2 regulators	Bahr Tera and Abshan Regulators(Motorization)	2 regulators
	:	Hamoul MPS	one regulator	Hamoul MPS	one
	:	Slope Protection	154,000m^3	Slope Protection	11,000m^3
	:	Weed Conrol	LS	Weed Conrol	LS
(2) Delivery Canal	:	Check gates and others	572 gates and others	Check gates and others	4 gates and
(3) Meska	:	695,200 fed	292,000 ha	56,900 fed	23,900
(4) Water Management	:		1 LS		1 LS
(5) Subsurface Drainaage		337,000 fed	140,200 ha	13,350 fed	5,610 ha
(6)Pilot Project	:		one location		one location
(7)Demonstration Farm	:		51 locations		4 locations
(8)Reapair Shop	:		4 locations		2 locations
(9)Water Conservation Plan	:		4 locations		one location
6 Project Cost(million LE)					
Master Plan	:		2,129.0		-
Priority Area	:		-		270.0
7 Project Implementation					
Master Plan	:		20 years		-
Priority Area	:		-		10 years
8 Project Evaluation (EIRR,%)	:		-		17.2
(FIRR%)	:		14.9		14.1

Note: The price escalation and contigency are not included in the project cost.

SUMMARY

PART 1. MASTER PLAN OF THE STUDY AREA

CHAPTER 1 INTRODUCTION

(National Economy and Agriculture Sector)

1.1.1 The Arab Republic of Egypt (hereinafter call as to Egypt) has a population of 59.3 million in 1996. The cultivated and residential areas occupying about four (4) % (35,000 sq. km) of the national land, are located in the Nile delta and the narrow Nile valley.

1.1.2 In the Fourth Five-Year Plan for Economic and Social Development (1997/98 - 2001/02) the Government of Egypt (GOE) intends to enhance to cut high-water-consumption crops, reduce irrigation cost, introduce widespread mechanization, develop and extent new variety and technology, etc. in order to raise GDP of agricultural sector to the level of the industry sector.

(Present Condition of Water Resources)

1.1.3 The 1959 Nile Water Agreement between Egypt and Sudan provided that Egypt could use the annual amount of 55.5 billion cu.m of water from the Nile River. Water requirement by land reclamation projects, population growth and industries, however, is predicted to increase in the near future. To cope with this, effective use of exceedingly limited water resource is necessary and essential. However, due to the presence of old irrigation canals and structures, the present situation of irrigation and drainage system can not solve the problem on effective use of water resources. Also, on the matter of farmland, ineffective individual water management still remains unchanged.

(Progress and Objectives of the Study)

1.1.4 To solve the present problems in the Central Delta, the MPWWR requested the Government of Japan to extend technical cooperation in the conduct of the Master Plan Study for the Improvement of Irrigation Water Management and Environmental Conservation in the North-east Region of the Central Nile Delta in April 1996. In response to the request, the Japan International Cooperation Agency (JICA) dispatched the Preliminary Study Team to the Study Area in August 1997 and signed the Scope of Work (S/W) for the study. According to the S/W, the JICA dispatched the Study Team for the field survey and the study in the field and Japan from March 1998 to March 1999.

1.1.5 The Study consists of Phase 1 and Phase 2 study. In the Phase 1 Study, the Master Plan was formulated to improve irrigation and drainage facilities and water management in the Study Area of 800,000 feddan (336,000 ha) with the overall goal of achieving more

efficient use of limited water resources and raise farm household income as well as agricultural productivity regarding water quality in the Nile delta. In the course of the Study, the Priority Area was selected for the feasibility study. In the Phase 2 Study, the feasibility study of the Priority Area was formulated to justify the project implementation of the Priority Area and proposed a pilot scheme. The technology transfer relevant to the Study was also carried out to the counterpart personnel through on-the-job training in the course of the Study.

CHAPTER 2 BACKGROUND

(National Level)

1.2.1 In Egypt, 7,800 thousand feddan (3,280 thousand ha) are being utilized for agricultural land. The irrigated agricultural land per capita is very small as only 0.14 feddan (0.06 ha). In 1996, Egypt has a total population of about 59,272 thousand, 57 % of which are living in the rural areas. The population density in the inhabited land is 1,686 people/sq.km. The annual average growth rate from 1986 to 1996 was 2.08 %.

1.2.2 In 1996/97, Egypt has a nominal GDP of 239,500 million LE, of which 42,325 million LE (17.7 %) belong to agricultural sector. In the last five years, the annual average growth rate of real GDP is 4.3 %, while the rate of the agricultural sector remains at a lower rate of 3.1 %. The food self-sufficiency ratio is 87.7 % and the cereal imports extend to 4,910 thousand metric tons in 1993. Specifically, the self-sufficiency ratio of wheat is decreasing with only 47.9 % during the 1995/96

(Provincial Level)

1.2.3 The Study Area consists of four (4) governorates including Gharbia, Dakhalia, Kafr El Sheikh and Damietta. The existing agricultural land with irrigation is 2,017 thousand feddan (847 thousand ha). The irrigated agricultural land per capita is 0.188 feddan (0.079 ha). In 1996, the four (4) Governorates have a total population of 10,766 thousand, 72 % of which are living in the rural area. The population density is 1,141 people/sq.km and the annual average growth rate from 1986 to 1996 is 1.90 %.

(National Development Plan on Agriculture Sector)

1.2.4 There is a need to decrease the cropping area of high-water-consumption crops like rice to maximize the use of limited water resources. The Fourth Five-Year Plan for Economic and Social Development (1997/98-2001/02) has a plan to cut rice cultivation area of 0.9 million feddan (0.38 million ha).

(National Development Plan on Irrigation and Drainage)

1.2.5 The available water resources in Egypt are the Aswan High Dam with allocation of 55.5

billion cu.m, supplementary re-use of drainage water, groundwater from Nile aquifer, improvements of irrigation efficiencies (IIP), limitation of high-consumption crops like sugarcane and rice, re-use of wastewater and non-renewable groundwater. The total amount of water is estimated at 63.9 billion cu.m in 1996 and 79.5 billion in 2017.

1.2.6 According to the latest plan proposed in 1998, about 3,480 thousand feddan (1,460 thousand ha) of old land is to be improved until year 2017, with an annual water saving of about 2.5 billion cu.m. Limitation of rice cultivation is also planned to be from 1.6 million feddan (0.67 million ha) to 0.7 million feddan (0.29 million ha), thereby creating new amount of 3.0 billion cu.m annually.

1.2.7 The Fourth Five-Year Plan for Economic and Social Development states the policies and direction for irrigation and drainage development. The policies related to the objectives of this Study are; 1) to encourage the contribution of self efforts and individual initiatives in operation costs and the maintenance of irrigation networks, 2) to improve the management and efficiency of using irrigation water, 3) to rehabilitate old irrigation facilities such as pumping stations and intake structures as well as lining canals and weed control, and so on.

(Outline of Preceding IIP in the Central Delta)

1.2.8 There are two (2) preceding projects in the central delta, namely the Irrigation Improvement Projects (IIPs) of the Kahwagi and the Bahr El Saidi project completed in 1998. On these areas, the average area served by a Meska is 64 feddan (about 26.9 ha), with an average length of about 720 m and canal density of 26.7 m/ha. Besides the above projects, the Bahr El Wasat and Monaifa IIP areas are now under construction since April 1998 with financial assistance from the World Bank, KFW and GOE.

(Farmers' Organization of Preceding IIP)

1.2.9 Present Project inauguration is determined by IIS according to the annual implementation plan. Under Law No. 12, 1984, with a consensus of more than 1/3 of related farmers and/or of more than 30 % of the total service area, the IIP will be executed. Preparatory work for explanation to farmers and establishment of a WUA normally takes from three (3) to six (6) months. The WUA is organized with the selection of a chairman, four (4) councilors and several representatives of Marwa. Farmers expectations to IIP is high, according to a questionnaire survey, especially most of the farmers expected increase of water supply by IIP.

(Technical Support to Farmers' Organization in Preceding IIP)

1.2.10 The technical support to the farmers' organization is carried out by the IAS staff. The IAS staff in-charge of guidance of IIP, etc., consist of four (4) field agents and an

agricultural engineer. The IAS staff are trained and educated to up-grade their knowledge and technique using various manuals and textbooks. The major jobs of IAS staff are training of farmers in IIP areas, checking ledgers, and dealing with farmers' complaints. The IAS staff conduct training course of 5 to 10 days or a total 40 to 80 man/day to representatives of WUA.

1.2.11 The responsible acreage of an IAS staff is about 914 feddan (about 380 ha) in Kahwagi area. However, this is wider acreage than national average, accordingly less number of the staff. The duration to train an IAS staff is about 40 days (equivalent to 4,600 LE) at the national average. However, 41 staff out of all IAS staff were transferred to other sections after training, during the period 1989 to 1996.

(Financial Support to Farmers' Organization in Preceding IIP)

1.2.12 On performance of O & M cost collection by WUA in the IIPs above, it is reported that one-fourth of WUAs has collected full payment of necessary O&M cost. The major reason for non-payment is the fact that farmers do not feel the necessity of having one-point lifting pump by IIP since they have their own pumps. As for 40 WUAs in upper Egypt, their payment collection is good as they collect 70 LE/fed/year, totally about 3,000 LE/year. The expenditure items indicated are 15 % for personnel, 40 % for pump operation, 5 % for canal maintenance and 40 % for contingency.

(Government Commitment and Legal Framework in Preceding IIP)

1.2.13 According to the Law Decree No.263 in 1997, LWB (Local Water Board), a farmers' self-organization, was established and started functioning by each delivery canal in Fayom governorate. The LWB is being managed through a joint committee organized by farmers and the Government. Present duty of LWB is to contract with the Government for the maintenance of a delivery canal, such as, weed control and dredging.

(M/E of Preceding IIP)

1.2.14 Monitoring and Evaluation (M/E) after the implementation of IIP has been conducted in upper Egypt from 1992 to 1995. However, the M/E has not been continuously carried out, especially information on M/E in the Nile delta appears only in Kahwagi area fragmentarily.

(Water Management of Preceding IIP)

1.2.15 It is a general practice in the preceding IIP that project starts from the downstream area of the delivery canal, then extended sequentially toward the midstream and upstream areas. It is ironic that the farmers along the midstream and upstream sections of the delivery canal can easily pump illegal water directly from the delivery canal where the continuous flow has been already practiced.

(Agriculture of Preceding IIP)

1.2.16 The Kahwagi and Bahr El Saidi areas have about 200 % of the annual cropping intensities that comprise about 60 % of rice and small areas of vegetables. Unit yields increase of major crops in the IIP area range from 0 % to 10 %. In the conditions that the farmers did not participate in IIP fully, they have difficulties to operate and manage the IIP facilities properly for improvement of cropping pattern as well as increase of crop yield.

(Irrigation Facilities of Preceding IIP)

1.2.17 The precast concrete block and /or other forms are not in good quality. About 70 % of improved Meska are partially operated, because of 1) high cost of pump operation, 2) small pump capacity etc.. Existing WUAs have been organized within one Meska unit only and there is no communication between WUAs at the upstream and downstream reaches. Consequently, water distribution problems will likely occur among WUAs on the delivery canal in the future. Since there is no maintenance workshop for one-point lifting pump equipment, broken pump equipment is left unattended.

CHAPTER 3 THE STUDY AREA

(Natural Condition)

1.3.1 The Study Area, having coordinates of 31°15'N and 31 °15'E at the center, is located at the north-east corner of the Central Delta. The Area is bounded by the Mediterranean Sea on the North, by the Gharbia drain on the West, by the Meet Yazied canal on the South and the Damietta Branch on the East. The Study Area is about 799,500 feddan (about 335,800 ha). The Area consists of two (2) types of farmland, such as, old land and newly reclaimed land. The old land occupies about 503,100 feddan (about 211,300 ha), equivalent to 63 % of the total Area. The reclaimed area occupies about 296,400 feddan (about 124,500 ha), equivalent to 37 %.

1.3.2 The land of the Study Area inclines to north from south with a gentle slope of 1/7,000 to 1/8,000. The elevation of the Area ranges between nine (9) m MSL at the intake point of the Bahr Shebin Canal and zero (0) m MSL at the northern edge of the old land. The delta area, where the Study Area lies, is predominantly characterized by Mediterranean climate. The cool season is between October and April. Summer begins as early as May, accompanied by high humidity. The annual mean temperature is 20°C and the annual mean relative humidity is 67 %. Annual rainfall is negligible or almost zero.

1.3.3 Generally, the proportion of sand decreases while that of clay increases northwards the Central Nile Delta. The Study Area shows different soil types, where the alluvium varies from light to heavy clay, with the heavier clay occurring towards the north. Most of the

soils is of recent alluvial origin and, when adequately drained and managed, is highly productive.

(Socio-Eonomic Condition)

1.3.4 The population in the Study Area in 1996 is about 3.1 million. About 72% of the population live in the rural area. The population density is about 920 people/sq. km. The labor force population (15 years to 60 years old) in 1996 is about 61% of the total population. The number of households is 663 thousand households. The average family size is calculated at 4.8 persons in rural area.

1.3.5 Gharbia governorate having 60 % of farm households, who manage their own land, has a big ratio of tenant farmers, while the other governorates have about 80 %. The category of farm households who own more than 2.0 feddan, occupies 34 % in Gharbia governorate and 64 % in Kafr El Sheikh governorate.

1.3.6 According to the Expenditure and Consumption survey of 1995-1996, the average annual expenditure of the sample households in the rural area is 6,600LE. The expenditure per capita in the rural area is highest in Damietta with 1,369LE and lowest in Kafr El Sheikh with 1,159 LE. The unemployment rate in 1995 is 11.7 % in the Study Area. In 1996, about 60 % of the people in rural area can read and write, but the basic and secondary enrollment in 1994/95 is around 90%. The educational condition has been improving.

(Strata of Rural Society)

1.3.7 There are some conventional and influential conceptions, such as Umda, Aila, Shaykh al balad, Mosharka regarding the strata of rural society in Egypt. The Umda is usually considered as a leader of unified Aila societies (and at the same time assigned by the government) and rules a village with mutual support from several Shaykh all balads as representatives from each Aila. Mosharaka means a small and mutual that helps and supports each member. Regulations as per tenant farming systems have been changed drastically into rather enthusiastic system in overcoming conventional fixation of rental contracts in 1992, and have been promulgated in the late 1997 after the 5 years' buffer periods.

(Crop Production)

1.3.8 The total cultivable area is 695,200 feddan (291,900 ha) which occupy 94 % of the Study Area.. The area is divided into three (3) areas, namely upstream, midstream and downstream areas according to irrigation boundary. The cropping intensities of the upstream, midstream and downstream area are estimated at 200 %, 185 % and 148 %, respectively. There is a lower crop unit yield at the downstream area as compared to the

upstream and midstream area. The inputs used almost meet the standard requirement on fertilizer for the Nile delta area.

1.3.9 The average yields of major crops per feddan for wheat, sugarbeet, berseem, cotton and rice are estimated at 16.40 arbab (5.86 ton/ha), 17.53 ton (41.73 ton/ha), 15.85 ton (37.73 ton/ha), 5.52 kantar (2.07 ton/ha) and 3.16ton (7.52 ton/ha), respectively. Their total productions are estimated at 487, 384, 4,682, 123 and 860 thousand tons, respectively. The unit yields in the upstream and the midstream areas are almost at the same level as the national average. However, the unit yield in the downstream area is lower than the national average for almost all crops.

(Agricultural Supporting Services)

1.3.10 The Rice Research and Training Center (RRTC) under SARC play important role on breeding and research on rice cultivation. Although there are no research institution on horticulture, farmers themselves introduce the production technology on onion, potato and green house cucumber.

(Marketing and Agro-processing)

1.3.11 Rice, wheat, and maize are supplied to small-scale and large-scale milling factories in the villages and cities. The price of grains is based on free market. About 30 to 50% of these grains are self-consumed by farmers. The price of cotton is still determined by the government. Sugar beet is grown under contract arrangement between farmers and a sugar company. The livestock market is held once a week in a major city of each district. Buffaloes and cows share more than 90 % of the market. These are mostly distributed for local consumption.

(Agricultural Credit)

1.3.12 The major type of loans by the Principal Bank for Development and Agricultural Credit (PBDAC) is agricultural loan (70 % of production cost by crops), short term and medium term loan for green-house production, irrigation system development etc., and long term loan for large projects such as land reclamation project. The interest is from 11 to 13 %. PBDAC keeps a strong demand from clients and the amount of each loan shows steady increase.

(Animal Husbandry)

1.3.13 On average, one each of cattle, water buffalo, sheep and donkey is raised by a farmer. The majority of farmers raise cattle and water buffaloes not only for draft but also for meat and milk purposes. The main sources of feed are berseem and straw of wheat. Other by-products are also other important feeding source.

(Water Resources)

1.3.14 Available water for Bahr Shebin command area reaches an annual amount of 4,169 MCM that 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. There are municipal and industrial usage's of about 143 MCM within the area. Subtracting the usage, 4,026 MCM is worked out as the amount available for irrigation water only.

(Irrigation Conditions)

1.3.15 The Study Area has a large extent of irrigation network composed of principal, main, branch and delivery canals. The total length of principal canals in the Study Area is 65.8 km. The total length of the main canal is 248.3 km, while the total length of the branch canal is 94.8 km. The total number of delivery canals is 357 with a total length of 1,714 km. The average length and area per delivery canal are 4.8 km and 1,728 feddan (726 ha), respectively.

1.3.16 In the Study Area, most water district engineers have not reported any considerable waste spillage. They have notified that some canals from the tail have excessive water that goes into the drainage. However, this is limited during winter season only and the number of the canals is only 26 (7% to the total 357). For the summer season, no delivery canal was reported to have any waste spillage.

1.3.17 The total area served in the Study Area is about 751,233 feddan (315,514 ha). With respect to areas served by principal and main canals, Bahar Shebin commands a total area of 641,397 feddan (269,387 ha), supplemented by drainage reuse and irrigation pumping stations. This area occupies 92 % of the total area served excluding new reclamation area.

1.3.18 The water distribution is carried out by the relevant directorates in a complex framework of rotation based on a certain extent of delivery canal system. The rotation practiced in the Study Area is five (5) days-on and five (5) days-off during summer season and four (4) days-on and eight (8) days-off during winter season. According to the rotation schedule, intake gates of the delivery canals are opened and closed by gate keepers at sunset.

(Drainage Conditions)

1.3.19 The Study Area is divided into 15 drainage centers that are called "Drainage District". The open drains are merged into two major drainage systems; namely, Drain No.1 & No.2 system and Gharbia drain system. The drainage water is finally discharged into either the Mediterranean Sea or Burullus Lake by pumping. Annual average drainage rate in the southern part of the Study Area is relatively small, ranging from 1.1 mm/day

to 1.5 mm/day. The stations located at the most northern part of the Study Area give an annual average rate of 3.48 mm/day at Lower DPS No.1.

1.3.20 Subsurface drainage implemented in the Study Area is 380,514 feddan (159,800 ha) and under-implementation is 32,700 feddan (13,700 ha). The subsurface drainage already covered almost the entire area of the lower half of the Study Area, West El Mansour Drainage District, and part of the Kafr Saad Drainage District. The under-implementation area is East Bilqas Drainage District that is located between Bahr Hafir Shehab El Deen and Basandila Canals.

(Overall Inflow & Outflow Balance on Bahr Shebin Command Area)

1.3.21 Overall inflow is about 4,099 MCM, while overall outflow is 1,948 MCM. The ratio between outflow and inflow comes to 48 %. Taking into consideration the present irrigation practice, it is reasonable that a certain amount of groundwater return and/or sea water intrusion contributes to the outflow. An amount of 414 MCM is worked out as the probable minimum return and sea water intrusion.

(Condition of Irrigation Facilities)

1.3.22 The canal type in the Study Area is distinguished with trapezoidal form with long width and shallow depth and the normal water surface elevations in the canal have been operated at about 1.0 m below the ground level. Hence, the irrigation water is lifted with a personal mobile small pump set.

(Condition of Pumping Stations)

1.3.23 There are 15 pumping stations in the Study Area releasing ground water or pumping drain water for re-use and finally releasing the drain water into the Mediterranean sea. Hamoul MPS, old and poor function with the high suction head causes the operation suspended. For this the downstream command area was placed in a serious water shortage condition.

(Water Management)

1.3.24 MPWWR manages canals up to the delivery canal while farmer's group manages Meska and Marwa. At present organizational O & M by farmers has not been practiced. The water management issue in Egypt is the information management. The present management system is insufficient, hence it would be difficult to systematically execute water management in the delta area. Accordingly, the management system would be improved with the introduction of the results of the modern technique on water management.

(Present Situation of Farmers' Organization)

1.3.25 Historical precedents of farmers' grouping activities in irrigation such as "Sakia Rings"

has almost disappeared at present due to the rapid mechanization of lifting devices to the popular diesel power. In this context, the Egyptian government has been quite eager in developing new systems for farmers' water use through the establishment of WUAs. It should be noted that the total number of IAS local staff at the national is 278 and 914 feddan/person (380 ha/person) for Kahwagi and Bahar El Saidi area. This number is not a sufficient allocation to promote effective implementation of IIP.

(Women in Development, WID)

1.3.26 From 1956 onwards, Egyptian women have gained the right to vote and to stand for political office. However, actual situation surrounding Egyptian women is not necessarily equal to men. Also, the census shows that women's participation in the wage labor force was one of the lowest in the world. Some sectors like poultry raising, milking and the processing, and vegetable productions and selling are indeed "women's dominant sectors". Nevertheless, women may be marginalized from decision making processes, and by contrast men generally control such processes more freely than women.

(Agricultural Income and Non-Farm Income)

1.3.27 As the result of the Farm Economy Survey for 240 farm households, agricultural income per farm household was estimated at 3,668 LE, 4,439 LE, and 5,531 LE for the average farm size of 2.0, 2.7 and 4.2 feddan, respectively in the upstream, midstream and downstream area. Although the upstream households get a lower income due to the smaller farming size, the income per feddan is the highest because of the higher productivity for each crop. As the area goes downstream, the productivity per land is decreasing in contrast to the farming size that is increasing. Therefore the potential to increase agricultural income by unit yield increase will be higher in the downstream reaches. The minimum farm size for earning a living is estimated at three (3) to four (4) feddan in the upstream and the midstream area and five (5) feddan in the downstream area.

1.3.28 The average annual household expenditure for the sample farm households is 6,801 to 7,277 LE. To earn such amount of income, it is required for farmers to get another income source such as working on other farm and non-farm jobs. 60 % of the surveyed farm households have family members who have non-farm job. The average annual non-farm income is 494 LE to 2,178 LE. In the downstream area most of farmers do without non-farm job and are there more dependent on farm income.

(Water Duty by Crops and Income)

1.3.29 In terms of income per water duty, potato and tomato are the most profitable crops.

Although cotton and maize require about the same amount at 3,600 cu.m/feddan to grow, cotton is more profitable with 0.6 LE/cu.m to 0.1 LE/cu.m of Maize. The net income per water duty for maize is about the same as rice. However rice consumes twice as much water to maize.

(Environment)

1.3.30 In this study period, TDS is questionless about half longitudinal northern area from Zifta Barrage to the Mediterranean Sea coast. The downstream areas of Bahr Tera, Bahr El Banawan and Bahr Basandila canals, and irrigation areas of El Mansour canal were shown to have slight to moderate levels, between 450 to 2,000 mg/l TDS. On the other hand, the electric conductivity in the drainage canals ranged from 1.19 to 2.05 dS/m, 1.25 to 2.32 dS/m, at the upstream end and midstream, respectively. This maximum electric conductivity ranges from 760 to 1,500 mg/l TDS

1.3.31 By increasing sodium concentration and its proportion to calcium plus magnesium content in the irrigation water, the soils become alkaline and/or salt-affected. At present, salt-affected soil is improved by providing investment of gypsum in the Study Area.

(Methodology of Categorization)

1.3.32 Categorization of the 357 delivery canals in the Study Area was conducted to grasp the problems and constraints on the present irrigation and drainage system by collected data such as canal length, canal command area, degree of water shortage, water quality, facility condition, farming condition and so on. A case study with the variables of water shortage, intake condition, and salinity and six (6) cluster was adopted for the categorization finally. The major feature by category is as follows;

Category A: No serious problem on water quality and quantity and so on. (183 delivery canals)

Category B: Need rehabilitation and/or repair on facilities. (50 delivery canals).

Category C: Serious problem on water quality. (47 delivery canals)

Category D: Serious problems on water quality and quantity. (31 delivery canals)

Category E: Water shortage is the major problem and water quality and facilities are also poor. (30 delivery canals)

Category F: Serious problem on water quality and facilities need rehabilitation and/or repair. (16 delivery canals)

(Constraints, Problems and Potential)

1.3.33 Although no severe water shortage in the upstream area, partially the water shortage in the tail portion of the irrigation systems occurs where the canal length is long and it causes low productivity and limited crop diversion. From the midstream to the downstream areas, the

degree of crop selection becomes narrower with decrease of unit yields due to the shortage of irrigation water as well as the poor quality of water. Moreover, the prevailing saline soils hamper the agricultural development in the downstream areas.

1.3.34 There are a large number of farmers that grows crops with re-used or drainage water. The water irrigation is not only in short supply but also poor in quality due to salt contents and pollution. Moreover, salinity problems is aggravated when the salts accumulate in the crop-root zone with low quality water. However the downstream area has a large potential to grow vegetable and industrial crops because there are large area of suitable land for growing these vegetables.

1.3.35 Water shortages at the tails of delivery canals during summer season due especially to illegal rice cultivation are observed. This sometimes shows up even at delivery canal located in the up and midstream of the Study Area. Also domestic wastes and garbage disposal thrown into canals causes not only environmental problems but also additional losses especially in the section lessened by the wastes.

1.3.36 As diesel engine driven pump becomes popular, illegal direct pumping also becomes common (it is estimated at 50 % of intake). This leads to excessive water dosage especially at upstream reaches thereby lessening of the water to be conveyed at the downstream. The water shortage in the downstream area is accelerated by inequitable water distribution under the present rotational irrigation system.

1.3.37 Waste spillage from the tails of the terminal and delivery canals is not considerable. However there are some excessive irrigation dosages that go to drain, or returned to canal/Meska. This leads to low on-farm irrigation efficiency. Therefore the irrigation efficiency on farm level would be improved with the introduction of less water sensitive crops and the rehabilitation of the on-farm facilities for saving water.

1.3.38 Some regulators and intake gates are very old making it difficult to keep necessary water levels of canals downstream. Some portions of canal slopes have collapsed and giving losses in section. Domestic wastes and garbage disposal thrown into canals also give additional losses and difficulty in operation and maintenance.

1.3.39 In order to reach the goal of water saving, it is necessary to consider the hydrological dimensions such as water requirement, irrigation efficiency, etc. However the basic data on those issues are not well prepared. Furthermore, the present information on management is not sufficient for meeting the modern water management.

1.3.40 Irrigation canal waters are utilized for washing, tableware wash, and bathe of cattle. There is an increase in nutrient levels, especially nitrogen and phosphorous. Many canals are major sources of drinking water, so certain health aspects should be

considered. It is also very important to remove water plant inside watercourses and maintain the design water flow and/or water quantity in order to eliminate snails, the intermediate hosts of Schistosomiasis.

1.3.41 Most of the farmers in the Study Area are small-scale farmers based on the traditional inheritance system. The liberalization of input and output agriculture prices is not beneficial yet because of the weakness of purchasing and marketing capabilities of most of the farm households. It is estimated that more three (3) to four (4) feddan is the minimum requirement for farm households to support their living from farming. The share of farm households with less than above farm size is 70 to 80 %. Farmers are filling their expenditure by non-farm job or renting lands. But the other measure would be improvement of the productivity of land to cope with the small-scale farmland.

1.3.42 Although most of the farmers consider the necessity of irrigation improvement, they have not been satisfied with the present IIP. The content of farmers' expectation for IIP is different among each delivery canal. Therefore subsequent to the decision of each IIP direction and its component, the differences in expectations of farmers in each delivery canal should be carefully studied.

1.3.43 The theme of PIM implicates comprehensive key components not only from technical but financial and socio-economic viewpoints. So it was envisaged that following 2 key conceptions are important to realize more active involvement of farmers. They are 1) "Ergonomics Consideration", in deciding ideal sizes of water users unit in terms of number of farmers and 2) "Hydrological De-centralization", for clear-cut separation of water divide and in encouraging farmers in effectuating water use

CHAPTER 4 DEVELOPMENT PLAN

(Basic Concept of Development Plan)

1.4.1 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, inequitable water distribution between up and down stream reaches, old irrigation and drainage facilities, aggravating water environment and so on.

1.4.2 With respect to the MPWWR plans to meet the water demand for new reclaimed lands and future water use in the old land, the following strategies would be proposed for the Study Area. They are 1) to respond to the future water policy including rationalization of water management and water saving farming, 2) to shift water management to farmer's initiative

including partial water management on water control by WUA, 3) to minimize the gap between the upstream and downstream including equality of farm income and creation of job opportunity, and 4) water environmental conservation including treatment of wasted water in and out of the Study Area, protection of hinge line intrusion and reduction of salt accumulation.

(Basic Strategy of Agricultural Development)

1.4.3 The agricultural development plan will be formulated to raise the ratio of agricultural income to the total household income of farm households in the Study Area, especially areas belonging to category C, E and F where income levels are lower. The target income is aimed at 7,900 LE. It is also envisioned to decrease the ratio of food expenditure to the total household expenditure to about 45%, to approximate the current average urban level of Egypt.

(Improvement Plan of Farming)

1.4.4 It is proposed to select such vegetables as onion, potato, water melon, tomato for domestic and over sea markets especially in the downstream area besides the traditional crops. Also, protected horticulture will be expanded for cucumber, rose, chrysanthemum, vegetables and flower. The proposed cropping intensity in the upstream and mid stream area is 200 %, while 170 % in the downstream area.

1.4.5 Short duration rice will be grown with reduction of rice area by 36 %. The rice area in the downstream area will be maintained without any reduction, considering rice as reclamation crop for the improvement of saline soils. As a result, rice area in both areas of the upstream and midstream will be reduced by 57 % of the present. Vegetables will be increased both in summer and winter seasons by using one-third of the rice deduction area. The remaining area will be covered mainly by maize. Also, sunflower will be introduced in the downstream because of the rather large farm size in the area.

1.4.6 According to the present average difference in yields between upper part and tail portion of canals, the unit yield increase is proposed from 8 to 35 % by crops through midstream and downstream area. The average proposed yields of major crops per feddan for wheat, sugarbeet, berseem, cotton and rice are estimated at 19.00 arbab (6.79 ton/ha), 22.74 ton (54.14 ton/ha), 28.85 ton (68.69 ton/ha), 15.85 ton (37.73 ton/ha), 7.62 kantar (2.86 ton/ha) and 4.07ton (9.69 ton/ha), respectively.

1.4.7 The total production is estimated at 662 thousand ton (increased by 36 % from the present production) for wheat, 567 thousand ton (48 %) for sugarbeet, 5,951 thousand ton (27 %) for berseem, 141 thousand ton (15 %)for cotton and 708 thousand ton (decreased by 18 % from the present production) for rice.

(Improvement Plan of On-Farm Water and Soil Conditions)

1.4.8 For saving water and raising crop yield, the precise land leveling will be effective. Due to the prevalent small scale land ownership in the Study Area, the introduction of land leveling equipment improved in Japan for a tractor mounted type suitable for the small scaled plots will be proposed.

(Improvement Plan of Agricultural Marketing)

1.4.9 Improvement of shipping condition at the point of origin will be planned. The improvement plan will be conducted by utilizing the benefits of Meska improvement planning and organization planning of WUA. The benefits are 1) feeder road improvement to prevent the products from damaging, 2) introduction of continuous flow on delivery canal that will provide better condition to expand vegetable cropping and so on.

(Improvement Plan of Agricultural Supporting Services)

1.4.10 The close cooperation between MPWWR and MALR from the national to the governorate/district level is indispensable to improve farming with IIP. For this purpose, concerned agencies such as Soil, Water and Environment Research Institute under MALR shall be involved to demonstrate improved farming at the proposed demonstration farms. The proposed demonstration farms will be established at Marwa along delivery canals of the above mentioned three (3) categories (C, E, and F) in each water district. The Federation of WUAs will have Farm Management Section to extend improved farming to individual farmers through farmers' organizations.

(Irrigation Efficiencies and Irrigation Requirement)

1.4.11 Irrigation efficiencies in the Study Area are proposed as 0.56 for without project situation and 0.66 for with project situation based on the present field condition, irrigation practices and results of the preceding IIP projects.

1.4.12 Modified Penman method is employed in estimating the reference crop evapotranspiration. Annual ETo are 1,695mm for Damietta and 1,748 mm for Mansoura. The crop coefficients (Kc) 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.

(Irrigation and Drainage Development)

1.4.13 For areas of 61,644 feddan, currently irrigated by drainage water only, supplemental irrigation water will be provided, without exceeding the annual available water, which is commensurate to about half the irrigation requirement, giving improvement of water quality. Hamoul pumping station feeds about 84,755 feddan 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. A supplement of 64 MCM (20 % of 321) annually will be transferred from Bahr Tera without exceeding the annual available water.

(Improvement Plan of Irrigation and Drainage Facilities)

1.4.14 The major facilities of main canal network that are old and rotten, therefore decreasing efficiency are required to be improved or rehabilitated. Also, the facilities such as check gate, barrage which have telemeter system at both upper and lower parts are proposed to be motorized to observe water level and discharge.

1.4.15 To rationalize water distribution, improvement of the major old and rotten facilities of the delivery canals and new construction of check gates to stabilize the suction levels for pumping onto Meska are proposed. Also linings of Meska and/or pipeline system are proposed to deduct water conveyance loss.

(Development Plan on Water Management and O&M)

1.4.16 It is proposed through improvements in information management, to effect consequently institutional improvement with three (3) stages. The first stage proposed is the application of personal computer (PC) to daily works. The second stage is to build up an inter-agency LAN (Local Area Network) and the third stage is a networking of the LAN to build up WAN (Wide Area Network).

(Development plan on farmers' organization)

1.4.17 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. Considering 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.

1.4.18 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" that is to be

organized and managed by representatives from both the government officials and farmers' groups.

1.4.19 Beneficiary farmers of each branch canal are to be organized in a "Federation of WUAs". The Federation of WUAs is to be composed of representatives from each WUA, and a part of them is to be members in the Joint Committee. Meanwhile, a rather large-scale WUA, comprising of 50 and more farmers, is to be recommended to organize sub-groups named "WUG (Water Users Group)s" in each WUA.

1.4.20 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. The government is to test and demonstrate probably feasible technologies at pilot farms introducing several new ideas. To confirm success of the procedures mentioned above, the government is to apply some alternative measures in parallel throughout a transition period. 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.

(Project Cost)

1.4.21 The Project cost is estimated based on the cost of the projects in the neighboring areas as well as the projects under construction. The project cost does not include the price escalation and the physical contingency. The costs by items are asfollows;

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

(Project Implementation Plan and Work Schedule)

1.4.22 The project implementation plan is divided into short term plan (implemented within five

years), middle term plan (within ten years) and long term plan (within twenty years). Each of the proposed sub-projects are classified according to implementation plan as follows;

Short term plan: 1) rehabilitation of Rahbeen regulator, 2) rehabilitation of Hamol MPS; 3) rehabilitation of Bahr Tera main canal; 4) weed control equipment; 5) motorization of intake gate; 6) sub-surface drainage and; 7) pilot scheme etc..

Middle term plans: 1) construction of El Monofy regulator, 2) renewal of Demara regulator, 3) slop protection of main canals and delivery canals etc.. 4) environmental water quality conservation

Long term plan: 1) slope protection of delivery canals, 2) graphic panel of water level monitoring

(Project Evaluation)

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

(Environmental Conservation Plan)

1.4.24 Monitoring of waste analyzing water discharges will be done by requesting owners or operators to take samples and analyzing and submitting the results to the responsible authorities. For the soil improvement, the following are considered: 1) as crop rotation, rice cultivation is suitable for salt-affected soils and 2) improvement of rhizosphere environment for correction of salt-affected soils, by direct supply of soil amendment materials such as gypsum. Monitoring of water canal should be required through the operation of water quality sampling station at the each of the water districts.

(Initial Environmental Examination, IEE)

1.4.25 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 soil salinization, Soil contamination by agrochemical and others, water contamination and deterioration of water quality and so on.

CHAPTER 5 SELECTION OF THE PRIORITY AREA

(Criteria to Select the Priority Area and Candidate Areas)

1.5.1 Taking into consideration the objectives of the development plan and present conditions, the following criteria was applied for selecting the priority development area: 1) area covered by a tile drainage implementation and its program area within four (4) to five (5) years, 2) area near the implemented IIP area to give some incentive to the beneficial farmers in the proposed area, 3) area with less environment impact to the present conditions, and 4) better access on transport, and so on. On the premise of implementation of the priority area, the Study Area was divided into eleven (11) candidate blocks for selection of a priority area, based on the present irrigation area by main canal.

(Evaluation Matrix and Selection Method)

1.5.2 The evaluation matrix was made using the survey results for categorization by block. Applying the above section criteria, the matrix was screened in order to select the priority area. The Upper Tera Command area of about 62,000 feddan (about 26,000 ha) was selected as the priority area including the Rahbeen regulator and Hamoul MPS.

Conclusion

The Study Area for the Improvement of Irrigation Water Management and Environmental Conservation in the North-East Region of the Central Nile Delta, is mainly located at the Bahr Shebin command area with 800,000 feddan (336,000 ha). There are many old facilities and terminal facilities with low irrigation efficiency, which constrain the improvement of irrigation efficiency. The following improvements are proposed to be implemented urgently to solve the constraints, as: a) improvement of eight (8) main facilities to enable effective water management, b) improvement of delivery canals, c) improvement of Meska, d) conducting a pilot scheme to support and prevail the improvement of Meska, e) improvement of water management, f) improvement of agricultural extension services, g) improvement of water quality environment.

The proposed development plan will be executed by MPWWR, the administrative body of irrigation in Egypt with abundant experiences and technology. Upper Tera command area is selected as the Priority Area from the extensive Study Area to propose prior improvement of irrigation facilities in the area. The proposed development plan consists of Meska improvement and a pilot scheme as the main components, including water management improvement, improvements of main irrigation facilities, replacement of Hamoul MPS and so on. It is also proposed that the operation and maintenance of improved Meska and delivery canals should be undertaken by WUAs comprised WUGs or Federations of WUAs.

Recommendation

1. Prior to the implementation of the project, WUA by farmer beneficiaries should be established. It is the key to the successful implementation of this project type of improved the on-farm facilities. The activity of establishing WUA should not only be in the project area but should also be implemented all over the Study Area. It should start without delay simultaneous with the demonstration of show case of improved facilities. The IAS staff quality and quantity should also be strengthened.

2. Dumping of garbage into the canals will deteriorate water quality in the canal and would cause the possible occurrence of diseases in the future due to the use of polluted water. Necessary measures should be undertaken to prevent dumping of garbage and waste. The wastewater from factories at the upstream, which affects peoples' health due to heavy metals, etc. should be treated. A law related to environmental pollution should be vigorously performed.

3. At present, no discharge data for delivery canal envisaged with IIP is available, making it difficult to evaluate the water saving to be expected. Taking into consideration current tight water availability over the Study Area, an increase of water usage might show up, under continuous flow, rather than water saving envisaged. Therefore, discharge measurement shall be done prior to the commencement of IIP.

PART 2 FEASIBILITY STUDY OF THE PRIORITY AREA

CHAPTER 1 THE PRIORITY AREA

(Natural Condition)

2.1.1 The Priority Area, upstream of Bahr Tera command area, is located in the eastern most part of Kafr El Sheikh Irrigation Directorate. 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 net irrigation area occupies about 92 % of the gross area. The land is very flat as the Nile delta is, and the elevation ranges from five (5) m MSL to 0 m MSL. The annual means temperature is 20°C. Mean monthly relative humidity falls in a relatively small range between 56 % and 74 %.

2.1.2 Most of the soils is 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. The soil water holding capacity is very high while its permeability is low.

(Socio-Economic Condition)

2.1.3 The Priority Area covers three (3) governorates, namely, Kafr ElSheikh, Gharbia, and Dakhlia. Kafr El Sheikh occupies 88 % of the total area. The Priority Area also consists of four (4) districts, eight (8) local units and 17 mother villages.

2.1.4 The total population in the Priority Area in 1996 is 214,000. The population density is calculated at 820 per sq. km. The average growth rate during the recent decade is 2.23 %. The total number of households in 1996 is 41,200 with an average family size of 5.2 persons. According to the farm economy survey, the average annual household expenditure per capita is 1,070 LE. The average size family therefore in the Priority Area spends the amount of 5,570 LE. Out of 5,570 LE, the amount spent for food is 2,830 LE. The ratio of food expenditure to the total expenditure is about 51 %.

(Farmers' opinions gathered through Group Meetings)

2.1.5 The PP (Participatory Planning) methodology was applied aimed at verifying its applicability in the selecting of the most desirable sites for IIP and in prioritizing the most suitable means of improving core problems in each delivery canal domain with 10 groups (7 delivery canal groups, 1 Government staff group, 1 influential person group and 1 women group). The results obtained were problems on inadequate water distribution with rotational flow, low crop price and high input price, poor

communication between the government and farmers, poor social infrastructure such as medical units, phone lines etc.

(Land Holding and Farm Size)

2.1.6 The number of farm households in the Priority Area is 24,790 with an average land holding size per farm household of 2.1 feddan. The number of farm households with more than 2.0 feddan is 15,380. This is about 62 % of the total farm households. Small-scale farmers are renting lands, working on non-farm jobs or sometimes leasing their small land and fully attending to non-farm jobs.

(Population and labor force of farm household)

2.1.7 The population of farm households is estimated at 128,500 with a labor force population (from 15 to 60 years old) of 73,800. The number of labor force per farm household is 3.2 persons, 84% (2.7 persons) of which are actually working in agriculture and agriculture related works.

(Land Use)

2.1.8 The Priority Area is divided into three (3) areas, namely upstream, midstream and downstream areas, approximately bounded by the Biyala-Hamoul national road and the district boundary of Biyala and Hamoul districts. A large number of farmers grow vegetables in the upstream area, where soils are less heavy. In the downstream areas few farmers grow vegetables and fruit trees, due to the saline soils. The midstream land has an intermediate land property and use between the upstream and the downstream.

(Crops and Cropping Pattern)

2.1.9 Cropping pattern in the Area is three (3) years rotation with rice, cotton and maize in summer, while berseem and wheat are cropped during winter season. Rice has grown the largest area with cropping intensity of 45 to 60 %. The second largest area is planted to watermelon for seeds during summer. The combined area of long and short-term berseem has an intensity of more than 40 %. Potato, onion, carrot, and cabbage are grown in the midstream and downstream areas with an area of less than three (3) % in each season.

(Farm Input)

2.1.10 At present, nitrogen of 75 kg/feddan (179 kg/ha) and 65 kg/feddan (155kg/ha) are applied to grow wheat and rice, according to farm input survey in the Priority Area. The level of input used is the same level of the fertilizer recommended by MALR survey.

(Crop Yield and Production)

2.1.11 Crop yield is lower in the downstream of the Priority Area. The yield difference between

the upstream and downstream area ranges from five (5) to 25 %. The average yields per feddan for wheat, sugarbeet, berseem, cotton and rice are estimated at 15.60 arbab (5.57 ton/ha), 16.95ton (40.36 ton/ha), 16.63ton(39.63ton/ha), 5.40 kantar (2.02 ton/ha) and 3.14ton (7.48 ton/ha), respectively. The total productions are 48,300 ton, 88,300 ton, 414.500 ton, 9,600 ton and 93,800, respectively.

(Animal Husbandry)

2.1.12 An average farmer raises two or three heads of water buffalo and cow. These are mostly female, for milk production. The buffaloes and cows produce baby buffalo and calf almost every year. Farmers sell fattened buffaloes and cattle. A buffalo or cow needs 6.0 kirot (0.25 feddan, 0.1 ha) of fodder.

(Agricultural Supporting Services)

2.1.13 The agricultural cooperatives generally provide services to farmers for various activities including preparation of crop rotation plan and arrangement of farm input supply. Agricultural extension office and agricultural cooperatives have minimal opportunity to training on water management at farmer's level.

(Agricultural Credit)

2.1.14 There are seven (7) village banks under the jurisdictions of the Priority Area. The number of loan in 1997/98 is 31,000 for agricultural investment loan, 36,000 for short-term investment loan, and 10,000 for medium term investment loan. The amount of loans for short and medium term investment loan has been increasing. In terms of purpose, the loan for livestock (animal wealth) is the biggest, about as 80 % of short term and 54 % of medium term investment loan.

(Farm Economy)

2.1.15 According to the Farm Economy Survey, gross return and farm income for the average farm size (2.1 feddan) in the Priority Area is estimated at 7,260 LE and 3,890 LE, respectively. Farm income per feddan is calculated at 1,850 LE/feddan. Among the sample farmers, 15 % of family members working on other farm would earn about 500 LE per year. Also, 58 % of the sample respondents have non-farm income with an average earning of 2,000 LE per household.

(Available Water Resources)

2.1.16 The average discharge at Bahr Tera intake and the mixing volume by Hamoul MPS for the last five years are 830 MCM and 321 MCM, respectively. Subtracting the municipality usage of 17 MCM, the annual average available for Bahr Tera is 1,133 MCM.

(Canal Features and Area Served)

2.1.17 There are 29 delivery canals being operated under rotational irrigation. The area served by the delivery ranges between 300 and 5,470 feddan (130 and 2,300 ha) with an average of 1,700 feddan (720 ha). The average length of delivery canals is 4.85 km. It is concluded that there is no noticeable waste spillage but only minor leakage from the tails.

(Meska General Information)

2.1.18 There are 194 Meska, with a total service area of 27,060 feddan (11,400 ha) occupying 48 % of the whole irrigation area. The area served by a Meska ranges from 13 to 1,000 feddan (5 to 420 ha). The average area per Meska is 139 feddan (58 ha). Summing up, the length of the 194 Meska is about 246 km, giving an average length per Meska of 1.3 km. Though one (1) Meska was reported to have very often waste spillage, it can be, concluded as a whole that wastes spillage from Meska tail is very minimal.

(Water Shortage)

2.1.19 The Bahr Biyala and Abshan canals, both located in the Biyala Water District, suffer the most serious water shortage. During summer season, water shortage for the canals always prevails because of the long reach and illegal rice cultivation occupying as much as 70 % of the area.

(Excessive Irrigation and it's Return Flow)

2.1.20 Based in the result of the Meska survey, though about 20 to 60 % of farmers reported to have no excessive irrigation dosages, 13 to 23 % and 6 to 10 % farmers at "near Meska" and "away from Meska", respectively, recognized some excessive dosages going back to canal and/or Meska. Also, 31 to 56 % farmers had reported that excessive dosages went to drain, giving possibility of on-farm irrigation improvement.

(Drainage Condition)

2.1.21 Drain No.4 demarcates the area's most eastern boundary, while Drain No.3 and its branch of El Banawan Drain demarcate the northern part of the eastern boundary. Drain No.5 that merges into Gharbia Drain demarcates the Priority Area's southwestern boundary. Gharbia Drain demarcates western boundary of the priority area. There are four (4) drainage pumping stations such as No.3 DPS, No.4 DPS, No.5 DPS, and No.6 DPS. Subsurface drain has been installed for the last ten years extensively over the Priority Area except for the northern part.

(Instruction of Water Distribution)

2.1.22 Water distribution plan and operation in ordinary case are entrusted to the under

secretary of the Central Department of Water Distribution. The estimated amount of water in the distribution plan is used only for reference because the canal diversion ratios are fixed according to the actual discharge of the previous year since 1992. This refers only to the distribution plan and not to the distribution operation that is conducted with due considerations of the local conditions.

(Water Distribution System)

2.1.23 The Abshan Regulator is situated at KM 17.6 km that corresponds to the boundary point of the rotational irrigation area in the Bahr Tera canal system. The continuous flow is being practiced throughout the Bahr Tera main canal itself, while the delivery canals branching off the Bahr Tera are under rotational flow through on-off gate operation at the diversion sites.

(O&M of Facilities)

2.1.24 Canals cleaning by weed cutting and dredging are executed once or twice a year. The cost of the work is born by the Government. However, the O&M costs of the Meska down to Marwa are born by the local farmers themselves. The average O&M cost in the area is about 70 LE/feddan in which pumping up cost is as high as 80%.

(Irrigation Facilities)

2.1.25 Rahbeen regulator consists of main regulator (six (6) Fahmy Henien gates with 5.0 m width and a navigation lock with 8.0 m width) and sub-regulator (three (3) FH gates with 5.0 m width). Since it was built over 60 years ago, the riverbed at the downstream of the regulator has been scoured 4.1 m deep under the original level.

2.1.26 There are two (2) intakes for Bahr Tera main canal. One consists of four (4) FH gates with 3.0 m width and a navigation lock with 8.0 m width. Another intake, which is located 62.5 m away from the other, consists of four (4) same type of gates with 3.0 m width. Bahr Tera main canal with design discharge of 50 cu.m/sec is an earth canal with a wide and a shallow depth and the design water level is under the ground level.

2.1.27 Riverbed gradient of the delivery canals is gentle with around 1: 10,000. Side slope of the delivery canals is 1:1 or 1:1.5. However, it is observed that the slopes of the canals inside the villages are severely damaged. The canal beds have a 1.5 m to 3.0 m width with water depths of about 2.0 m. There are few check gates to maintain the water level for Meska intake. Manual FH gates with 1.5 to 3.0 m widths are set at the head of the delivery canals.

2.1.28 Meska is an earth canal, a private property and maintained by farmers themselves. However due to poor maintenance the slope collapsed causing poor water flow. There is no certain rule for intake since individual pumping has been generally practiced.

(Drainage Facilities)

2.1.29 The main drains as well as tributaries in the Priority Area are earth canals. The water level of the main and tributary drains is designed at 50 cm below the bottom of the outlet of a subsurface drain pipe.

(Drainage Facilities on Farm Level)

2.1.30 The sub-surface drainage, which consists of collecting drains and sub-lateral drains, is 1.3 m deep from the ground level. The collecting drains are set at 40 to 60 m intervals according to the soil condition. Likewise, the sub-lateral drains are set at 20 to 30 m interval. Due to the lack of relief well, it is impossible to control the groundwater table. The sub-surface drainage is set according to land form without considering field lot boundary, hence, it is difficult to manage groundwater table by field lot. Also sub-surface drainage facilities in some areas are ineffective and worn out..

(Water Quality Environment)

2.1.31 In the upper part of Bahr Tera canal and the south of Biyala town, TDS is less than 450mg/l and less than three (3) SAR level. On the other hand, the polluted area is located at the eastern side about eight (8) km from Bahr Tera canals as the command area of Bahr Biyala downstream. The area is considered as moderately polluted since the TDS of the drainage water ranged between 450 to 2,000 mg/l. TDS level with three (3) to nine (9) SAR levels. However, some areas are considered as seriously polluted with more than 2000 mg/l. Salt-affected soils are improved by the application of gypsum in the Study Area.

(Constraints on Rural sociology and farmers' organization)

2.1.32 IIP inauguration and its implementation have actually been derived from scheduled IIP implementation by the government signed by the minister of MPWWR. This "top-down" decision is conveyed to the farmers of each delivery canal through directorate offices. A WUA is established regardless of maturity among farmers. For these procedures, it takes usually 3-6 months only. This rough-and-ready procedure inevitably causes the poor performance in IIP because farmers hardly have chances to exchange views about the necessity of IIP.

2.1.33 At present, IAS staffs for councilors of WUAs after its establishment execute a series of training course. This activity has been the pre-occupation of majority of the IAS staff working time. As the result the activity for advertisement to planned IIP areas by the staff has not been spared. Another problem on technical support to WUAs is the lack of permanent service measures for the pump equipment after the completion of the IIP.

(Constraints on Agriculture)

2.1.34 Lower crop unit yields are found in the downstream area of canals, where there are problems of inadequate and untimely irrigation. To encourage farmers to grow more vegetables that require frequent water supply with little amount, it is required to equalize the condition of irrigation in terms of time and adequacy.

(Constraints on Irrigation, Drainage and Water Management)

2.1.35 Water shortages prevail in the Priority Area, because of illegal rice cultivation, long reach of some canals associating with rotational irrigation, weeds and domestic wastes, decreasing designed capacity, congestion of daytime irrigation forcing night irrigation, and so on.

2.1.36 There is inequitable water distribution in terms of deliveries, locations along delivery, among Meska, and locations along Meska. Farmers located downstream of Meska strongly feel inequitable water distribution since they suffer the most water shortage because of upstream reaches' frequent pumping.

(Constraints on Irrigation and Drainage Facilities)

2.1.37 The downstream of the Rahbeen barrage is remarkably scoured. Since the gate operation system is aged, more time for operation is needed. The gate operation of the Bahr Tera intake and the Abshan lock are not smooth. Communications between the water distribution sectors in Tanta and Kafr El Sheik and the barrage site are not good. Since the height difference of 1.0 to 2.0 m between the right and left banks of Bahr Tera canal is observed, the canal does not have enough capacity to flow supplemental discharge.

2.1.38 The aged Hamoul MPS is being used for the last of 36 years and the low efficiency of pumps, and occurrences of cavitation when lowering the intake water are reported. To avoid cavitation, MED stops the pump operation, and the farmer, who receives it's mixed water at the downstream of the Bahr Tera canal, suffers from water shortage.

2.1.39 There are many portions with canal side sliding. Canals running across the village areas are dumped with garbage obstructing the smooth flow. Earth Meska is in poor condition without periodic maintenance. On the long Meska, irrigation water also does not reach the end of Meska causing water shortage at the end. There is no governing rule to take water from Meska when water flows into Meska, and no communication between farmers at the upstream and downstream area.

2.1.40 The main and branch drainage canals including drainage pump stations are not in so serious condition in the Priority Area. However, in the northern part of the Area there is still no sub-surface drainage facility to improve soil. Sub surface drainage facilities in some areas are ineffective and worn out due to time.