ARAB REPUBLIC OF EGYPT

MINISTRY OF PUBLIC WORKS AND WATER RESOURCES

FEASIBILITY STUDY FOR REHABILITATION AND IMPROVEMENT OF DELIVERY WATER SYSTEM ON BAHR YUSEF CANAL

EXECUTIVE SUMMARY

NOVEMBER 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

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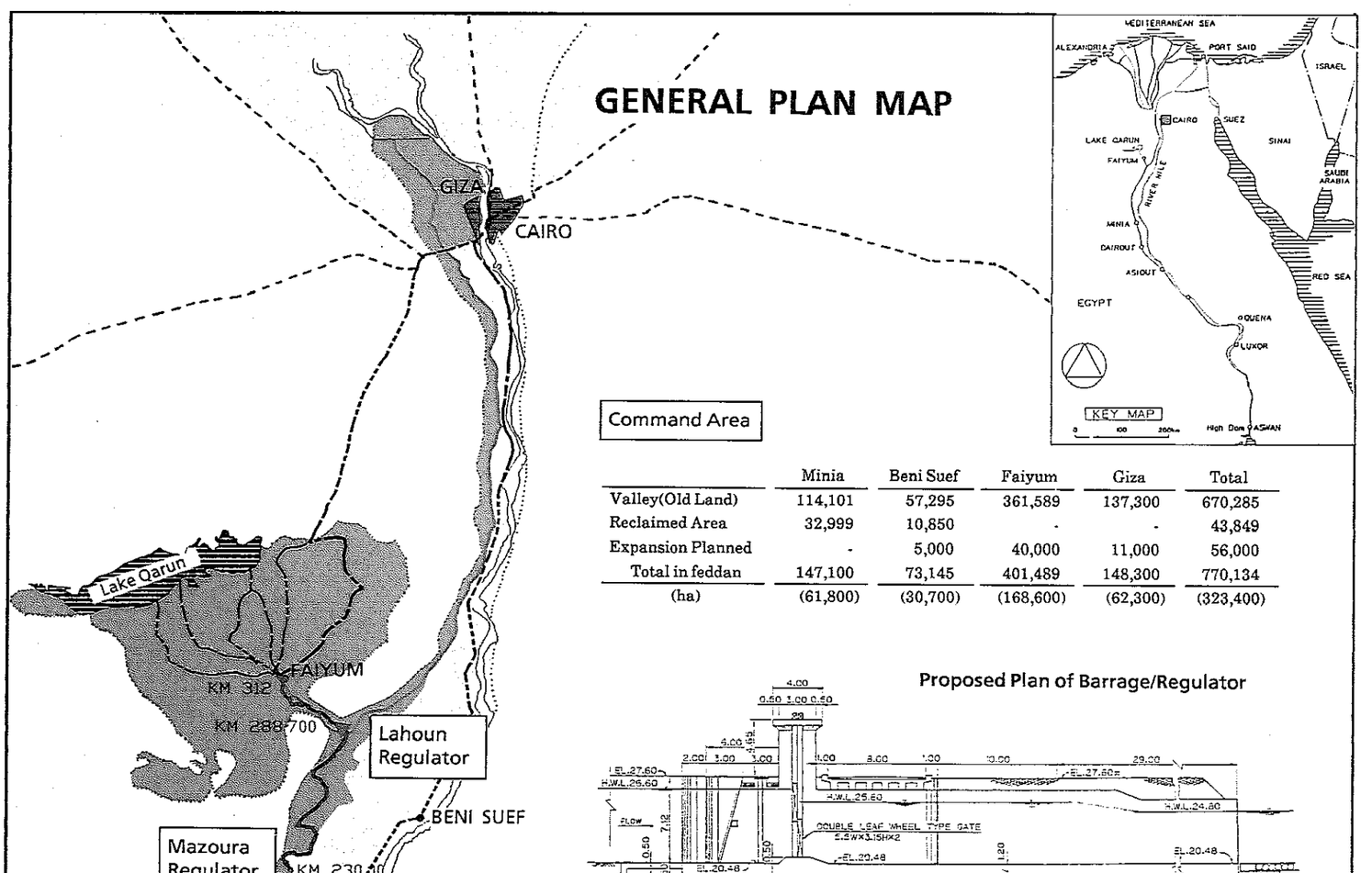
GENERAL PLAN MAP



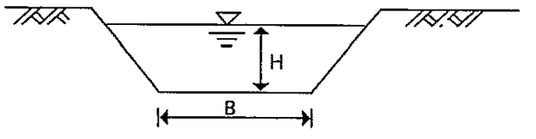
Command Area

	Minia	Beni Suef	Faiyum	Giza	Total
Valley(Old Land)	114,101	57,295	361,589	137,300	670,285
Reclaimed Area	32,999	10,850	-	-	43,849
Expansion Planned	-	5,000	40,000	11,000	56,000
Total in feddan	147,100	73,145	401,489	148,300	770,134
(ha)	(61,800)	(30,700)	(168,600)	(62,300)	(323,400)

Proposed Plan of Barrage/Regulator

Dimensions of Proposed Barrage/Regulator

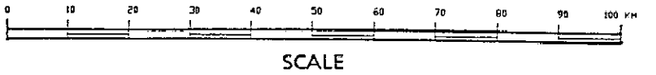
Barrage / Regulator	Weir Width	Vent		Gate	
		No.	Span	Type	Size (W x H x Leaves)
Dairout	34.0 m	4	7.0 m	Double Leaf Wheel Type	7.0 m x 3.30 m x 2
Manshat El. Dahab	43.0	5	7.0		7.0 x 3.25 x 2
Sakoula	38.0	4	8.0		8.0 x 3.20 x 2
Mazoura	38.0	4	8.0		8.0 x 3.05 x 2
Lahoun	12.8	2	5.5		5.5 x 3.15 x 2



Proposed Typical Cross Section

Dimensions of Proposed Canal

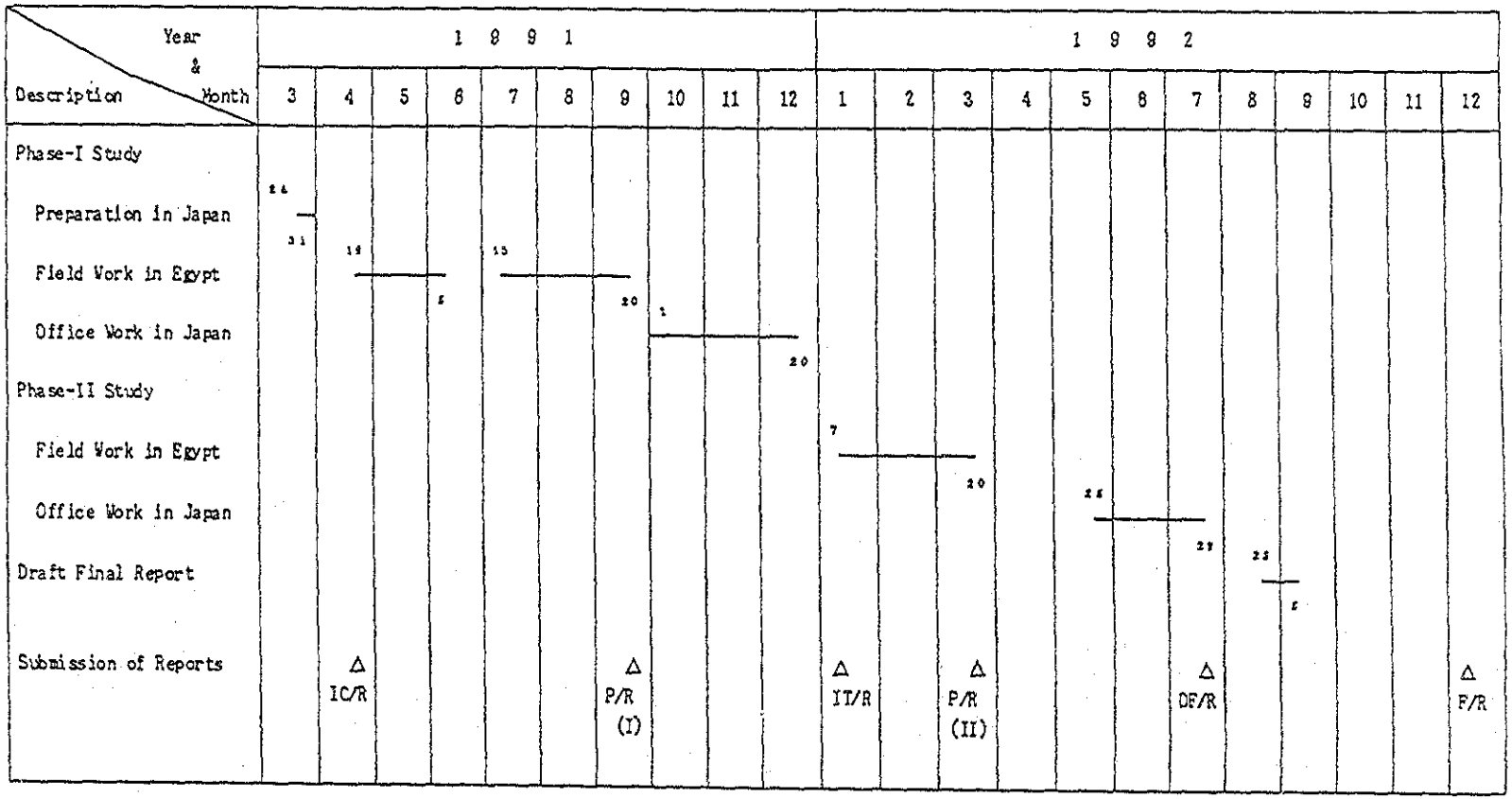
Item		Dairout to Manshat Dahab	M.E. Dahab to Sakoula	Sakoula to Mazoura	Mazoura to Lahoun
Discharge	(m^3/sec)	234.06	209.82	195.26	194.86
Canal Bed Slope	(cm/km)	7.15	6.50	7.00	5.00
C. Bed Width (B)	(m)	43.90	43.9	41.9	41.9
Water Depth (H)	(m)	5.70	5.50	5.29	5.83



SCALE

CONTENTS OF EXECUTIVE SUMMARY

Work Schedule of Feasibility Study



Note: IC/R: Inception Report P/R: Progress Report DF/R: Draft Final Report
IT/R: Interim Report F/R : Final Report

CHAPTER 1. INTRODUCTION

1. In response to the request of the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct the Feasibility Study for Rehabilitation and Improvement of Delivery Water System on Bahr Yusef canal (hereinafter referred to as "the Study"), within the framework of the Agreement of Technical Cooperation between the Government of Japan and the Government of the Arab Republic of Egypt (ARE) signed on June 15th, 1983. The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of technical cooperation programmes of the Government of Japan, dispatched a preliminary survey team and concluded the S/W of the Study between the Ministry of Public Works and Water Resources (hereinafter referred to as "MPWWR") and the JICA on October 22, 1990.

2. The field work of Phase-I for the Study has been conducted from April 21 to June 2, 1991 and from July 15 to September 17, 1991, while the field work of Phase-II has been successively performed from January 9 to March 17, 1992 by the Study Team in compliance with the S/W. The Study Team has conducted the field work to grasp the present problems and constraint of the existing delivery water system for planning the rehabilitation and improvement of the said facilities for effective and equitable distribution of irrigation water in the command area of Bahr Yusef canal. The home office work has been subsequently conducted in Japan. This work comprises observations and findings of the field work as well as various alternative studies undertaken in the formulation of plans for the rehabilitation and improvement of the said system. Draft Final report has been submitted and discussed with officials of MPWWR from August 27 to September 2, 1992.

3. The objectives of the Study is to evaluate the feasibility of the rehabilitation and improvement of delivery water system on Bahr Yusef canal in order to improve the overall efficiency of water use thus contributing optimum crop production in the area. The plan shall be formulated to be technically sound, economically viable and socially acceptable.

4. This Final Report incorporates the results of the analyses, observations and findings and alternative studies on the proposed rehabilitation and improvement plan, as well as the results of various studies and discussions conducted by the officials of MPWWR on the Progress Reports I and II , Interim Report and Draft Final Report.

Table B-1-2 Labour Force by Industrial Sector

(Unit : 1,000)

Sector	1982/83	1983/84	1984/85	1985/86	1986/87
All Sectors	12,270 (100)	12,877 (100)	11,720 (100)	11,981 (100)	12,256 (100)
(1) Commodity Sectors					
Agriculture	4,286 (35)	4,324 (34)	4,392 (37)	4,295 (36)	4,447 (36)
Industry	1,536	1,613	1,675	1,709	1,732
Petroleum	26	28	29	31	33
Electricity	69	74	75	70	77
Construction	697	753	330	554	564
Sub-total	6,614	6,792	6,501	6,659	6,852
(2) Service Sectors					
Transportation & Communication	461	470	558	574	546
Finace & Trade	1,211	1,247	1,200	1,228	1,236
Housing	178	185	202	213	209
Public Utilities	70	73	70	69	75
Other Services	3,736	4,110	3,190	3,237	3,339
Sub-total	5,656	6,085	5,220	5,321	5,404

Source : Statistical Yearbook, 1991, CAPMAS

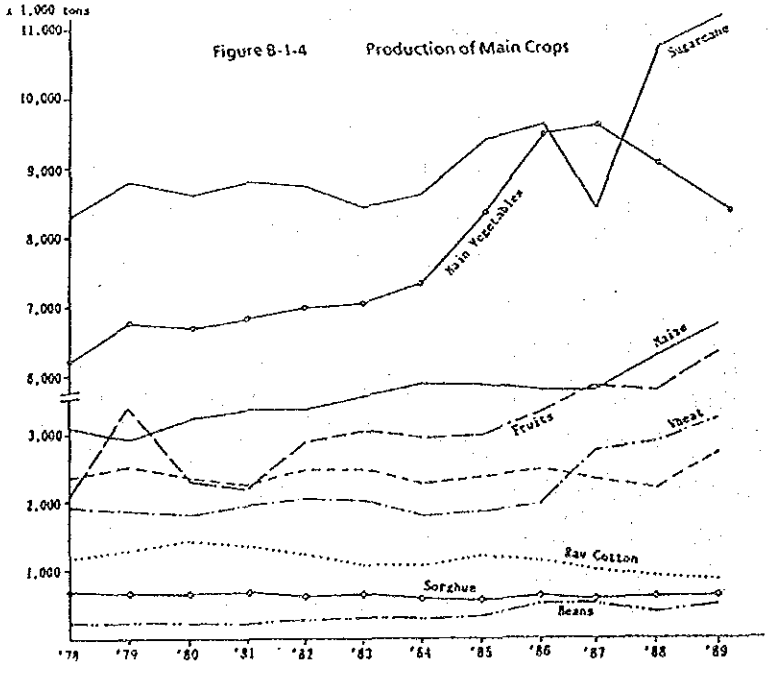
Table B-1-7 Development of GNP at Current Price

(Unit : Million LE)

Items	1982/83	1983/84	1984/85	1985/86	1986/87
Gross National Product :					
All income	26,989.7	33,251.2	38,298.8	41,966.0	50,511.5
GDP	25,772.5	31,246.5	36,617.9	40,819.7	47,743.8
Net revenue from the rest of the year	1,217.2	2,004.7	1,680.7	1,176.3	2,767.7
Consumption and Saving :					
Consumption					
All Consumption	21,588.2	27,605.5	31,772.2	33,669.1	40,803.3
Individual Consumption	17,398.1	22,648.1	26,074.4	27,634.1	34,172.3
Collective Consumption	4,160.1	4,957.4	5,697.8	6,035.0	6,631.0
Saving	5,431.5	5,645.7	6,526.4	8,326.9	9,708.1

Source : Statistical Yearbook, 1991, CAPMAS

Figure B-1-4 Production of Main Crops



CHAPTER 2. BACKGROUND

5. Egypt is an agricultural country having a total area of some one million square kilometers or 238 million feddan and located in the north east Africa. About 96 percent of the nation is desert, and the remaining four percent is concentrated mostly in the valley of the Nile and its delta, which are densely populated and agriculturally productive. The arable area with about 6.4 million feddan covers to only 0.12 feddan per capita, the lowest level in the world.

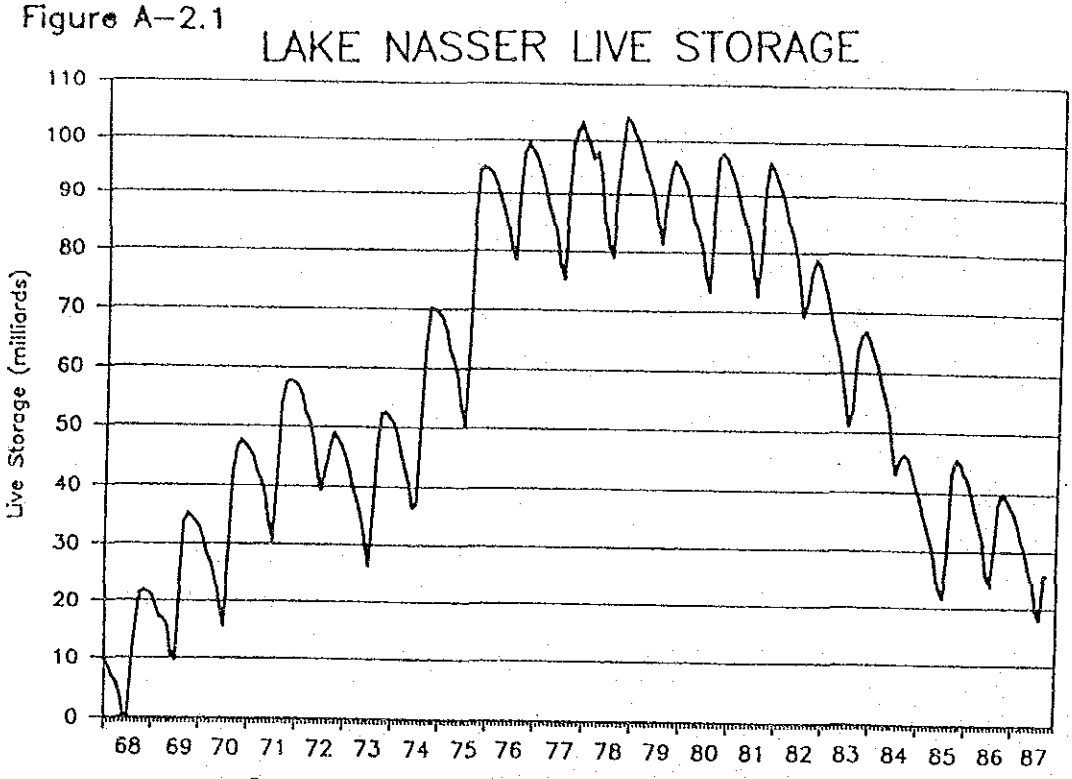
6. The mid-year population in 1990 was about 55.5 million and has increased at a rate of 2.8% per year since 1979. Food supply for the people, concentration of population into urban areas and unemployment are the major social problems of the country.

7. Egyptian economy has been seriously affected due to financial and trade deficiet, cumulative external debt, etc. The GDP showed a growth of 5.0 percent in 1988/1989 and GDP per capita in 1990 was 630 US dollars. Presently, the government of Egypt has supplied stable foods such as wheat, and public utility charges at a subsidized price to support the low income people. However, this subsidy system has been considered as cause of budget deficit and reduction of production efficiency, therefore, IMF requested the government of Egypt to immediately remove this system.

8. Agriculture is the most important sector in Egypt supplying foods and contributing labour force up to rate of 36 percent. The share of the agricultural sector in GDP has been reduced, but foreign exchange earnings through exports of agricultural production. From the viewpoint of national economy, self-sufficiency of wheat must be increased some from the present 33 percent (1987/88). In this concern, a study whether the area for berseem can be reduced and converted to wheat.

9. In March 1992, cotton and sugarcane are still listed as quota crops, however, farmers can choose productive crops after two years when the crop control policy are abolished. It has been observed on the field level that many farmers planted broadbean in winter due to high price in the last season, but agricultural office forecasts a slump of the broadbean price. According to the field observation, there has not been remarkable change in crops planted when compared to the previous cropping pattern in which berseem occupies a wide area, followed by wheat and broadbean. Crop selection is free, and production of cotton and sugarcane shall be secured to earn foreign exchange. Therefore, the government would like to insure the planted area and production for those two crops by raising the price.

Figure A–2.1



Source: Rehabilitation and Improvement
of Water Delivery Systems in Old Lands
(Project Nr. EGY/85/012)
Annex A-Water Resources

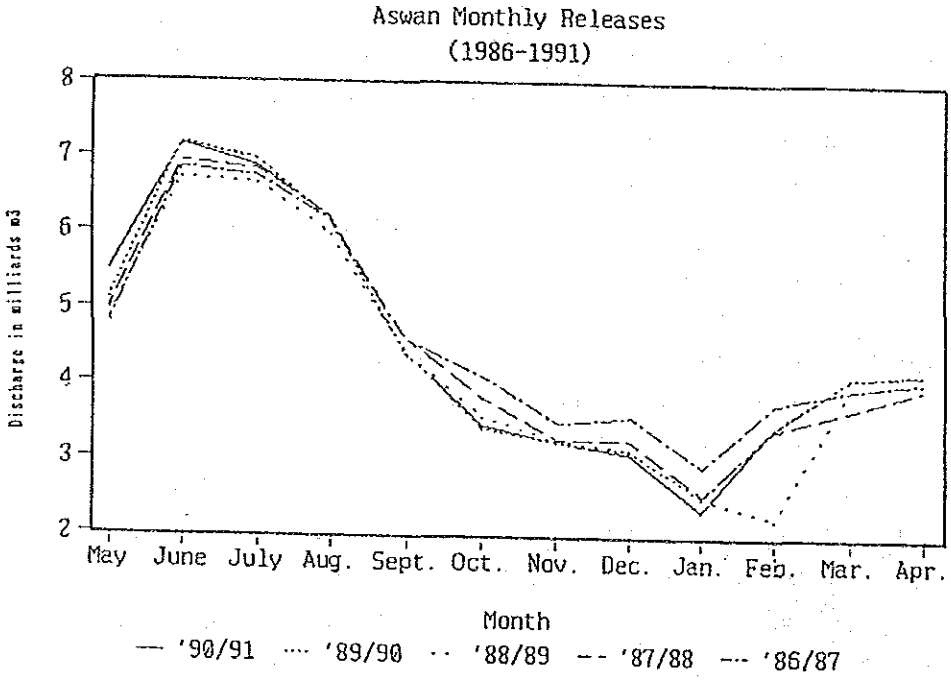


Figure C-2-1 Aswan Mean Monthly Releases for the Past 5 Years

10. The productivity of agriculture depends upon irrigation. Virtually all the water available for the irrigation use comes from the Nile river which passes through Lake Nasser. A reservoirs is now utilized after by the construction of the High Aswan Dam (HAD). Following completion of the HAD and the consequent provision of perennial water supplies from 1968 to all irrigated areas, the cropping intensity, yields and water use per unit of area have sharply increased resulting to drastic changes of agriculture and irrigation system in the country.

11. In the past 20 years, whilst much of Africa has suffered as a result of the widespread Sahalian drought, Egypt has been insulated against its effects by the water storage provided by Lake Nasser. The reduced Nile flow has resulted the volume of water stored in reserve in Lake Nasser fall substantially. There was very little water stored before the 1988 flood. And if the Sahalian drought will prolong and inflow of 84 milliard at Aswan would be reduced to some 70 milliard, the secure yield available to Egypt would then be reduced to some 49 milliard against the allocated 55.5 milliard under the Nile Water Agreement.

12. MPWWR aims at immediate implementation of the rehabilitation and improvement for the existing water distribution systems covering about 6.0 million feddan in old lands. It was projected to reach to 1.0 million feddan within present Five-Year Plan for Socio-economic Development. It, however, will need 30 years, if a progress will be so, to improve all irrigation systems in the old lands. MPWWR desires to accelerate the execution for rehabilitation and improvement project after obtaining economic and technical cooperation from the Japanese Government and other developed countries. Toward this end, MPWWR requested Japanese Government to conduct the feasibility study for the Rehabilitation and Improvement of Delivery Water System on Bahr Yusef Canal for the urgent rehabilitation and improvement of the said system.

Table C-1-6 Meteorological Data of Middle Egypt

Month	Faiyum *			Beni Suef **			Minia ***		
	Rain-fall (mm)	Tempe-rature (℃)	Relative Humidity (%)	Rain-fall (mm)	Tempe-rature (℃)	Relative Humidity (%)	Rain-fall (mm)	Tempe-rature (℃)	Relative Humidity (%)
Jan.	0	12.8	68	0.5	11.8	64	0.3	11.9	58
Feb.	2	14.3	65	2.7	13.8	57	1.4	13.3	53
Mar.	1	17.6	59	1.8	16.6	52	0.4	16.6	48
Apr.	1	21.6	55	1.3	20.7	47	0.5	21.2	41
May	1	25.6	52	0.0	25.6	41	0.7	25.6	36
Jun.	0	28.0	53	0.0	27.8	44	0.0	27.3	40
Jul.	0	29.6	55	0.0	28.6	50	0.0	28.5	45
Aug.	0	30.0	56	0.0	28.3	55	0.0	28.3	50
Sept.	0	27.5	61	0.0	26.6	60	0.1	25.6	55
Oct.	0	24.6	63	0.1	24.4	60	0.7	23.2	55
Nov.	1	20.0	67	0.2	18.4	66	0.2	18.4	60
Dec.	3	14.6	70	4.7	13.2	70	0.8	14.5	62
Mean	9	22.2	60	11.3	21.3	56	5.1	21.2	50

Source: * S/Y Report, 1990.

** Irrigation Pumping Study in Middle and Upper Egypt, May 1977.

*** Hydrology of the Nile Basin, 1985, The Netherlands.

Table H-1-2 Crop Composition in Old Land under Command

(unit: 1,000 feddan)

Crop / Season	Whole Governorates				Bahr Yusef Command Area				
	Minia	B. Suef	Faiyum	Giza	Minia	B. Suef	Faiyum	Giza	Total
Winter Crop	352.8	190.3	263.3	127.8	51.4	44.4	263.3	80.5	439.6
Wheat	134.4	61.5	77.6	12.1	19.0	15.6	77.6	7.6	119.8
Berseem *	98.3	66.9	124.4	57.0	10.0	11.3	124.4	72.8	188.5
Broadbean	78.6	41.4	21.5	2.2	13.4	10.4	21.5	1.4	46.7
Vegetables	5.6	6.8	6.6	39.5	2.0	1.8	6.6	24.9	35.3
Others	35.9	13.7	33.2	17.0	7.0	5.3	33.2	3.8	49.3
Summer Crop	319.8	187.3	178.0	144.7	48.7	32.3	178.0	91.2	350.2
Maize	169.2	59.9	43.1	60.4	23.4	12.0	43.1	38.1	116.6
Cotton	77.8	55.2	39.7	-	16.7	13.2	39.7	-	69.6
Soybean	43.1	11.3	-	(3.6)	1.6	-	-	{17.1}	{18.7}
Sorghum	3.8	-	37.2	1.2	-	-	37.2	0.8	38.0
Vegetables	11.0	37.7	29.3	44.7	1.0	4.2	29.3	28.1	62.6
Others	14.9	23.2	28.7	34.8	6.0	2.9	28.7	7.1	44.7
Nili Crop	57.7	91.9	102.2	88.2	7.7	18.4	102.5	55.6	183.9
Maize	45.2	76.3	51.8	43.4	7.1	14.1	51.8	27.3	100.3
Vegetables	3.1	7.8	37.0	36.9	0.6	2.0	37.0	23.2	62.8
Others	9.4	7.8	13.4	7.9	0.0	2.3	13.1	5.1	20.8
Perennial Crop**	58.7	10.3	19.5	28.4	3.8	1.0	19.5	17.0	41.3
Total	789.4	479.8	563.0	389.1	111.6	96.1	563.0	244.3	1,015.0

Source : MALR

Note. ( ) groundnut, { } fodder but total { } includes it. B Suef : Beni Suef

* berseem includes long and short crops. ** including sugarcane

CHAPTER 3. THE PROJECT AREA

(Location and Climate)

13. The whole country of Egypt lies in the temperate zone between 22 degrees and 32 degrees of north latitude. The Project Area is between 27 degrees and 30 degrees north latitude, therefore, the climate in the Project Area belongs to desert or Sahalian climate. Average annual rainfall was recorded only 9.2 mm in Faiyum and 5.0 mm in Minia, therefore, rainfall is not of any value for irrigation use.

(Bahr Yusef Canal Command Area)

14. Bahr Yusef canal serves the command area of about 770 thousand feddan, which are spread over 147 thousand feddan in Minia governorate, 73 thousand feddan in Beni Suef governorate, 402 thousand feddan in Faiyum governorate, and 148 thousand feddan in Giza governorate.

(Present Agriculture)

15. Crop composition and cropping pattern differ from governorate to governorate and those in Bahr Yusef canal command area are also different, reflecting local conditions. As a whole, maize, cotton, sorghum and vegetables are the dominant crops in summer, meanwhile, wheat, broadbean, berseem and vegetables in winter, maize and vegetables in Nili season, respectively. The present cropping intensities in the (Bahr Yusef canal command area are 171% in Minia, 187% in Beni Suef, 179% in Faiyum and 225% in Giza.

(Bahr Yusef Canal)

16. Bahr Yusef canal, branched off from Ibrahimia principal canal at Dairout barrage, is a main canal with a length of 312.7 kilometers and ends at Faiyum town. The unlined meandering canal has certain cross sections to meet required discharge and has many facilities such as regulators, intake structures of branch canals and pump stations. Regulators of Sakoula and Lahoun control discharge by a downstream water level, while Manshat El Dahab and Mazoura regulators control upstream water level.

17. Discharge measurement of Bahr Yusef and Ibrahimia canals were carried out. Accordingly, the maximum daily intake discharge for the past five years was recorded at 18.8 MCM/day which is smaller than 19.5 MCM/day of the maximum design discharge. It is confirmed based on the observed data that the existing canal capacity of Bahr Yusef canal equals to about 80 percent of the original design capacity. It is presumed that will be due to the limited water resources and application error of "n" value of roughness coefficient on the Manning's formula.

Table F-1-14 Present Conditions of Existing Regulator

Name of Regulator		Base	Aprons	Up-streame		Dw.-streame		Road	Lock		
				Bed	Slope	Bed	Slope				
Dairout			C	C	D	D	D	B	B		
		Gate No. 1	Gate No. 2	Gate No. 3	Gate No. 4	Gate No. 5	Gate No. 6	Gate No. 7	Gate No. 8	Gate No. 9	Gate No. 10
(1) Piers	+20										
	+10	C	C	C	C	C					
(2) Arches	+20										
	+10	C	C	C	C	C					
(3) Gates	+20										
	+10	B B B	B B B	B B B	B B B	D B B					

Name of Regulator		Base	Aprons	Up-streame		Dw.-streame		Road	Lock		
				Bed	Slope	Bed	Slope				
Manshat El Dahb			B	B	C	D	D	B	B		
		Gate No. 1	Gate No. 2	Gate No. 3	Gate No. 4	Gate No. 5	Gate No. 6	Gate No. 7	Gate No. 8	Gate No. 9	Gate No. 10
(1) Piers	+20										
	+10	B C	C C	B C	B C	B C	B C	B C	B C	B C	B C
(2) Arches	+20										
	+10	B B	B B	B B	B B	B B	B B	B B	B B	B B	B B
(3) Gates	+20										
	+10	B B B B	B B B B	B B C B	B B B B	B B B B	B B C B	B B C B	B B B B	B B B B	B B B B

Name of Regulator		Base	Aprons	Up-streame		Dw.-streame		Road	Lock		
				Bed	Slope	Bed	Slope				
Sokoula			B	B	C	D	D	D	B		
		Gate No. 1	Gate No. 2	Gate No. 3	Gate No. 4	Gate No. 5	Gate No. 6	Gate No. 7	Gate No. 8	Gate No. 9	Gate No. 10
(1) Piers	+20										
	+10	B B	B B	B B	B B	B B	C B	C B	C B	D B	D B
(2) Arches	+20										
	+10	C C	C C	C C	C C	C C	C C	C C	C C	C C	C C
(3) Gates	+20										
	+10	B B C B	B B B B	C B D B	C B D B	C B B B	D B C B	D B B B	D B B B	D B D B	D B B B

Name of Regulator		Base	Aprons	Up-streame		Dw.-streame		Road	Lock		
				Bed	Slope	Bed	Slope				
Mazoura			C	B	C	D	D	B	B		
		Gate No. 1	Gate No. 2	Gate No. 3	Gate No. 4	Gate No. 5	Gate No. 6	Gate No. 7	Gate No. 8	Gate No. 9	Gate No. 10
(1) Piers	+20	B	B	B	B	B					
	+10	B B	C B	B B	C C	C C	B C	B C	B B	B B	B B
(2) Arches	+20	B	B	B	B	B					
	+10	B B	B B	B B	B B	B B	B B	B B	B B	B B	C B
(3) Gates	+20	D B	D C	D B	D C	D C					
	+10	D B D B	B B D B	B C D B	B B B B	D B D B	D C D B	D C D B	D C D B	D C D B	D C D B

Name of Regulator		Base	Aprons	Up-streame		Dw.-streame		Road	Lock		
				Bed	Slope	Bed	Slope				
Lahoun			D	—	D	D	B	C	B		
		Gate No. 1	Gate No. 2	Gate No. 3	Gate No. 4	Gate No. 5	Gate No. 6	Gate No. 7	Gate No. 8	Gate No. 9	Gate No. 10
(1) Piers	+20										
	+10	D	D	D							
(2) Arches	+20										
	+10	C	C	C							
(3) Gates	+20										
	+10	D	C	C							

Remark

A B C
Up Mid Low
Gate

Grade	Descriptions
A :	No necessity of repairing
B :	The necesitylies of repairring partly
C :	The nesesitylies of rehabilitation : can not oprate
D :	The nesesitylies of reconstruction : broken

(Existing Principal Canal)

18. Bahr Yusef canal is a meandering, rather flat and unlined earth canal forming like a natural river. A meandering form of the canal gives not so serious hydraulic conditions in flowing discharge, hydraulic lost head, etc. due to slow velocity of about 0.60 to 0.80 m/sec. However, this meandering course provides non-uniform flow in the canal section and it will foster erosion of the canal side slope and scouring of the canal bed. The existing trapezoidal design section of the canal was changed to nearly an elliptic section by erosion of the canal side slope and sediment occurred at the foot of the side slope, but most of the canal sections are being kept the flow area as same as the original designed area.

(Existing Barrage/Regulators)

19. The structure's body of the existing barrage and regulators of Bahr Yusef canal seems to be already overage according to the investigation report for Dairout barrage and Lahoun regulator made by the MPWWR and the results of drilling investigation on Manshat El Dahab, Sakoula and Mazoura regulators conducted by the JICA Study Team. Most of gates installed with barrage/regulators are hardly operated or deteriorated and would be replaced by the new type for proper operation and management of the delivery water system. Large scale scouring at the downstream of the barrage/regulators were found which is presumed to be occurred by the turbulent flow or non-uniform flow to be provided improper gate operation or closure of the gates. The downstream of the barrage/regulator would be protected by construction of a riprap with concrete blocks instead of the present boulder riprap.

(Existing Intake Works)

20. The existing intake works for branch canals were equipped with steel regulating gates. The gates can be classified into three types by canal scale. The small scale gates with less than 1.20 meters vent, spindle winding sluice gates are applied, while for medium and large scale gates with 2.0 m to 3.0 m vent, gear winding Fahmy Henen gates were equipped. For large scale gates with 3.0 m vent and large leaf height, chain winding double leaf gate was commonly used. The Fahmy Henen gates for medium and large scale intake works was commonly used in Egypt.

(Branch Canals)

21. Among many branch canals of the Bahr Yusef canal, Harika branch canal has been taken up as a representative of the canals for planning the improvement of water distribution system. The Harika branch canal, an earth canal, branches off at Km 177.23 of Bahr Yusef canal, in the immediate upstream of the Sakoula regulator.

Table F-1-17 Out Line of Existing Pump Stations

Location (km)	Name of Station	Inst. Year	Type of Pump	Diameter (mm)	No. of Pump	Pump Ca (m3/s)	Shaft Position	Acutal Head (m	Design W.L (EL.m) Section High	Section Low	Discharge High	Discharge Low	Power (kw)	Area (1000 fed	History of Repair
1. Drainage	Pump Stations														
20.00	EL BADRAM	1937	Sulgur, Swissry	1.000	3	2.0	Horizontal	2.4	-	40.60	43.00	-	137	85	Last Repair in
			ASCPT, Swissry	1.000	4	2.5	Horizontal	2.4	-	40.60	43.00	-	137		Unit No.1 11/86
															Unit No.2 5/87
			(37-74) Diesel												Unit No.3 11/87
			(74-91) Elect.												Unit No.4 9/89
															Unit No.5 5/86
															Unit No.6 1/86
56.50	KAB KAB	1983	J.M.Voith, AUSTRIA	900	5	2.9	Inclined Angle 45	4.36	39.00	38.00	42.40	41.00	170	63	NO Repair
58.40	TONA EL G	1973	EL-Masbee,Swis	500	4	0.6	Horizonal	3.00	38.50	38.00	41.80	41.50	55	12	No.1 12/87
															No.2 under repair
															No.3 7/86,No.4 4/91
116.70	MANSHAT	1986	J.M.Voith, AUSTRIA	900	3	1.63	Inclined Angle 45	1.27	-	23.87	35.07	34.91	30	2	NO Repair
162.50	BENI MAZA	1984	J.M.Voith, AUSTRIA	1.500	4	3.0	Inclined Angle 45	3.00	-	31.00	35.00	-	170	53	NO Repair
164.50	DIER EL SANKUR	1983	MEZ.BRND	1.300	4	3.5	Inclined Angle 45	2.9	32.50	31.00	34.50	-	150	50	Data: 3/91
(195.0)	ABU RAHEB	1980	J.M.Voith, AUSTRIA	1.300	4	3.8	Inclined Angle 45	2.1	30.000	28.90	31.00	29.90	116	67	NO Repair
219.00	SAKOULA	1978	SORSP72 CZECHO.	1.400	4	4.5	Inclined Angle 45	2.9	30.00	27.50	33.00	29.50	200	40	NO Repair
274.30	MAZOURA	1980	AG11 BB-4SP CZECHO.	1.100	3	3.57	Inclined Angle 45	2.9	30.00	23.95	31.60	27.30	200	32	NO Repair
2. Irrigation Pump Stations															
45.00	ARAB BANI KHALID	1973	MR-50 U.S.A (73-85) Diesel (85-91) Elect.	500	2	0.8	Horizontal	3.0	38.3	38.25	41.30	41.25	76	3.5	Date: 6/91
48.50	BENI KHAL	1973	MR-50 U.S.A (73-85) Diesel (85-91) Elect.	500	2	0.8	Horizonal	3.0	38.3	38.25	41.30	41.25	76	3.5	Date: 6/91
104.60	KAMADIR(S	1969	PEZ-700 GERM	700	4	1.34	Vertical	1.6	-	36.70	38.70	38.30	70 HP	8.72	Date: 11/86, 2/88, 1/91
143.90	TERFA(1)	1968	EV-750 ITALY	800	6	1.472	Vertical	2.2	34.80	34.50	36.70	36.55	73.5	14.64	Date: 11/85, 3-6/88,
143.90	TERFA(1) N	1984	CLZ-700 MAG	800	4	1.9	Vertical	2.95	34.80	34.40	36.70	36.55	132	14.64	NO Repair
184.90	SAKOULA(4)	1967	PEZ-700 GERM	700	4	1.225	Vertical	2.75	32.00	29.40	33.85	-	66	-	3/83, 6/87, 8/90,
219.50	MAZOURA(0	1967	PEZ-700 GERMANY	700	4	1.47	Vertical	1.99	30.50	29.25	31.24	30.00	81	22	No.1:12/83No.2:5/86 No.3:2/89,No.4:1/90
219.50	MAZOURA(0	1984	CLZ-800 MAGR	700	4	2.00	Vertical	2.6	30.00	29.00	31.90	30.90	145	50	Date: 5/90

(Existing Drainage Facilities)

22. The major drainage facilities consist of drainage channels and drainage pump stations. Drainage channels with side slope of 1 :1 are unlined earth canal and certain bottom width determined based on the drainage area. In order to keep low water level for tile drainage system, canal depth has about four to five meters deep from the field surface. According to a result of study on discharge records and drainage area, unit drainage discharge is analysed to range from 1.1 to 1.5 mm/day (0.12 to 0.17 lit/sec/ha) at large scale drainage pump stations and from 0.3 to 2.0 mm/day (0.03 to 0.23 lit/sec/ha) at small scale drainage pump stations.

(Existing drainage Pump Station)

23. Out of nine drainage pump stations, both Badraman and Tona El Gabel Stations have equipped with horizontal shaft type pump, while the other seven drainage pump stations have a 45 degree inclined shaft type pump.

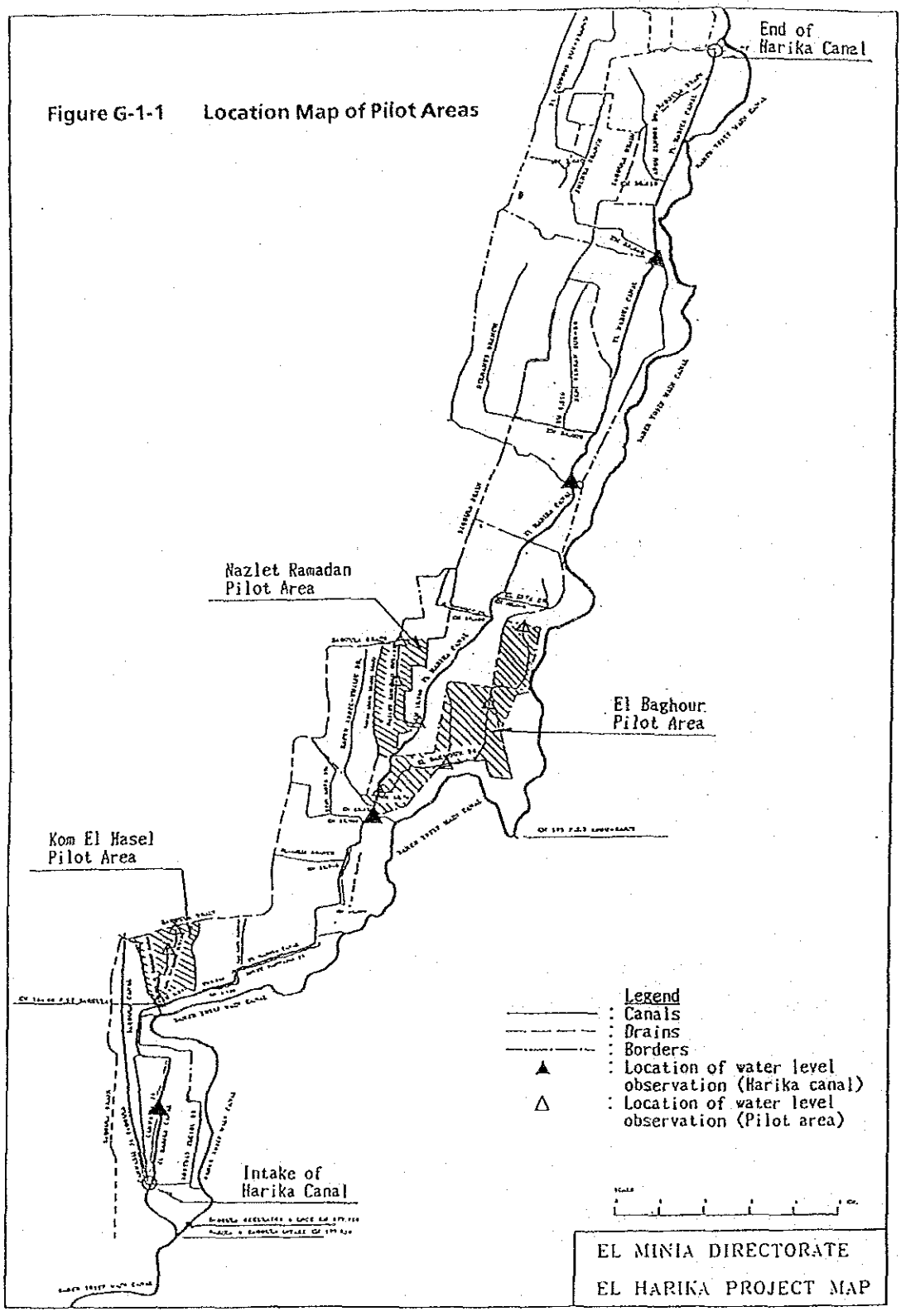
Pump equipment of El Badraman with over 55 years old has become extremely low for total renewal of all the equipment. On the other hand, pumps of the other eight stations were only 6 to 19 years old and functioned sufficiently.

Each station provided for a stand-by unit of pump equipment. The side canal for gavity drainage for maintenance of the pump facilities was provided at only Abu Raheb station, but the other eight stations have no side canal.

(Existing Irrigation Pump Station)

24. Out of eight irrigation pump stations, both Arab Beni Khalid and Beni Khalid Stations have provided with horizontal shaft type pump, and operated during the low water level period in October to May. The other six stations have provided with vertical shaft type pump. Pump stations of both Terfa (1) New and Mazoura (1) New were newly constructed in 1984, while the other six pump stations were already 19 to 25 years old and have low lifting efficiency. Terfa (1) provides two stand-by pumps, while the others have one each.

Figure G-1-1 Location Map of Pilot Areas



(Pilot Irrigation Area)

25. The pilot areas, namely Kom El Hasel, Nazlet Ramadan and El Baghour, with total command area of 3,130 feddan were selected in the Harika branch canal command area, then various field measurement, monitoring and tests were carried out.

(1) Kom El Hasel pilot area is located at the upper reaches (km 5.14) of the Harika canal, while Nazlet Ramadan (km 15.75) and El Baghour (km 13.75) are at the middle reaches. The land is flat with field elevation ranging between El.32.8 m and El. 3.7 m, El.31.0 m and 32.1 m, and El.31.1 m and El.325 m, respectively. Sub-surface drainage have been laid at most crop fields. Major crops being cultivated in the pilot areas are cotton and maize in summer and wheat, beans and berseem in winter. Soil texture originated from the Nile River deposit is silty clay.

(2) The on-farm irrigation system consists of sub-branch canals, Meskas and Marwas. Sub-branch canals belong to MPWWR while Meskas/Marwas are to farmers. One Meska covers 10 to 120 feddan and irrigation water is taken from sub-branch canals by farmers' individual pumps.

(3) According to water level observation, water shortage at sub-branch canal tail was frequently occurred in summer period, thus irrigation from drainage canals by pump was widely practiced. However, water shortage was not found in winter, on the contrary water levels became so high that downstream farmers could irrigate by gravity sometimes. As the result of on-farm water balance analysis, it could be stated that field efficiencies are generally high at the downstream and low at the upstream. Such high efficiencies, average 80.1% and 90 to 110% as major range at the downstream area, would be due to unavoidable condition considerably frequent tail shortage. On the other hand low efficiency at the upstream area, 60 to 70% as major range with an average of 65.6%, would be possible actual field efficiency in consideration of the present on-farm water distribution management particularly pump works by farmers.

(4) Major problems on the present on-farm irrigation system are summarized below:
- tail water shortage due to over irrigation at the upstream,
- farmers' trend of over irrigation caused by the present rotation,
- shortage of night storage capacity and much ineffective outflow, and
- inadequate water level control at the branch canal intake or regulator of the principal canal.

Table G-2-2 Identification of Problems and Solutions on On-farm Irrigation System Improvement

(Problems) \ (Causes)	1) Over irrigation by pumps (upstream priority)	2) Many direct intakes to Meskas	3) Inadequate present irrigation rotation & farmers unreliability	4) No cooperation among farmers (individual pump operation)	5) Main canal water levels not well maintained	6) Shortage of night storage capacity	7) On-farm delivery inconveniency	8) Poor land leveling	9) Improper structure conditions (tail escapes, etc)	10) lack of canal maintenance
1) Water shortage in sub-branch canals	☆	☆	☆	☆	☆				☆	
2) Much water level fluctuation					☆					
3) Irrigation from drainage canals	☆					☆				
4) Low irrigation efficiency	☆	☆	☆				☆	☆		
5) Inequitable distribution (tail water shortage)	☆			☆						
6) Much ineffective outflow			☆		☆	☆			☆	
7) Thickly growing of water plants/weeds										☆

(Solutions)										
1) Irrigation rotation system improvement	★		★			★				
2) Distribution system improve.(main system)			★		★					
3) Establishment of WUAs (on-farm system)	★	★		★						
4) Sub-branch canal improvement						★			★	
5) Meska intake & on-farm improvement	★	★					★	★		
6) Strengthening of maintanance									★	★

(Present Problems and Constraint of Irrigation Water Distribution)

26. According to the review of problems and constraint on the existing water delivery system, the following conclusions are summarized:

(1) The water management in Egypt is conducted by governorate basis. Water level and discharge of Bahr Yusef canal are controlled at Dairout barrage as an intake, and Sakoula and Lahoun regulators near the governorate boundary by using rating tables. Other two regulators, Manshat El Dahab and Mazoura, have function of water level control.

(2) The gate operation of those barrage/regulators is carried out based on water level instructed by the Irrigation Directorate. The gate is manually operated by several labourers. Leakage water from the gate of barrage/regulators is observed and is effectively utilized at the downstream command area, thus it is not a waste of water.

(3) Irrigation water of Bahr Yusef canal system is delivered from the Nile River based on the calculated amount of water by application of the standard unit water requirement of MPWWR and scheduled cropping area of MALR. Irrigation water of the principal canal is distributed to the branch canals on the proportional basis of the command area. In a period of low irrigation efficiency in April and October, at Sakoula regulator, branch canals are used as spillway to drain the excess water from the main canal. Such ineffective operation will be caused by inadequate application of standard unit water requirement and cropping pattern.

(4) The studies and analysis of the present water requirement are conducted by applying the Modified Penman method, which shows the middle value of evapotranspiration in comparison with Blaney-Criddle and Radiation methods. It is estimated the annual net water requirement of 3,053 MCM. Considering amount of intake water, reuse water and contribution of groundwater, the present overall irrigation efficiency is observed at 60.5 percent. The maximum monthly efficiency of 76.9% is appeared during the present water Shortage in July, while the minimum monthly efficiency of 28.3% during the excess water in October. For reference, the net water requirement based on the present standard unit water requirement of MPWWR equals to 3,179 MCM, about 104 percent of the above calculation.

(5) The drain water with salinity contents of 2,000 to 3,000 ppm is utilized as irrigation water during the peak water demand period. To prevent salt accumulation at the surface layer of the old lands, tile drain projects were generally implemented.

Table E-3-2 Command Area of Bahr Yusef Canal
(by Governorate and Regulator)

(unit: feddan)

Governorate	Item	Intake to M. Dahab	M. Dahab to Sakoula	Sakoula to Mazoura	Mazoura to Lahoun	U. S of Lahoun Regulator	D. S of Lahoun Regulator	Total
Minia	Old land	72, 926	39, 175	2, 000	0	0	0	114, 101
	(%)	10. 9	5. 8	0. 3	0. 0	0. 0	0. 0	17. 0
	Reclaimed A.	8, 722	24, 277	0	0	0	0	32, 999
	(%)	19. 9	55. 4	0. 0	0. 0	0. 0	0. 0	75. 3
	Expansion A.	0	0	0	0	0	0	0
	(%)	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0
	Total	81, 648	63, 452	2, 000	0	0	0	147, 100
	(%)	10. 6	8. 2	0. 3	0. 0	0. 0	0. 0	19. 1
B. Suef	Old land	0	5, 000	15, 686	17, 839	18, 770	0	57, 295
	(%)	0. 0	0. 7	2. 3	2. 7	2. 8	0. 0	8. 5
	Reclaimed A.	0	0	10, 850	0	0	0	10, 850
	(%)	0. 0	0. 0	24. 7	0. 0	0. 0	0. 0	24. 7
	Expansion A.	0	0	0	5, 000	0	0	5, 000
	(%)	0. 0	0. 0	0. 0	8. 9	0. 0	0. 0	8. 9
	Total	0	5, 000	26, 536	22, 839	18, 770	0	73, 145
	(%)	0. 0	0. 6	3. 4	3. 0	2. 4	0. 0	9. 5
Faiyum	Old land	0	0	0	0	121, 017	240, 572	361, 589
	(%)	0. 0	0. 0	0. 0	0. 0	18. 1	35. 9	53. 9
	Reclaimed A.	0	0	0	0	0	0	0
	(%)	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0
	Expansion A.	0	0	0	0	17, 500	22, 500	40, 000
	(%)	0. 0	0. 0	0. 0	0. 0	31. 3	40. 2	71. 4
	Total	0	0	0	0	138, 517	263, 072	401, 589
	(%)	0. 0	0. 0	0. 0	0. 0	18. 0	34. 2	52. 1
Giza	Old land	0	0	0	0	137, 300	0	137, 300
	(%)	0. 0	0. 0	0. 0	0. 0	20. 5	0. 0	20. 5
	Reclaimed A.	0	0	0	0	0	0	0
	(%)	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0	0. 0
	Expansion A.	0	0	0	0	11, 000	0	11, 000
	(%)	0. 0	0. 0	0. 0	0. 0	19. 6	0. 0	19. 6
	Total	0	0	0	0	148, 300	0	148, 300
	(%)	0. 0	0. 0	0. 0	0. 0	19. 3	0. 0	19. 3
Total	Old land	72, 926	44, 175	17, 686	17, 839	277, 087	240, 572	670, 285
	(%)	10. 9	6. 6	2. 6	2. 7	41. 3	35. 9	(100%)
	Reclaimed A.	8, 722	24, 277	10, 850	0	0	0	43, 849
	(%)	19. 9	55. 4	24. 7	0	0	0	(100%)
	Expansion A.	0	0	0	5, 000	28, 500	22, 500	56, 000
	(%)	0	0	0	8. 9	50. 9	40. 2	(100%)
	Total	81, 648	68, 452	28, 536	22, 839	305, 587	263, 072	770, 134
	(%)	10. 6	8. 9	3. 7	3	39. 7	34. 2	(100%)

Note: M. Dahab = Manshat El Dahab, U. S = Upstream, D. S = Downstream, A. = Area
Source: ID, MPWWR

CHAPTER 4. THE PROJECT

(Objectives of the Project)

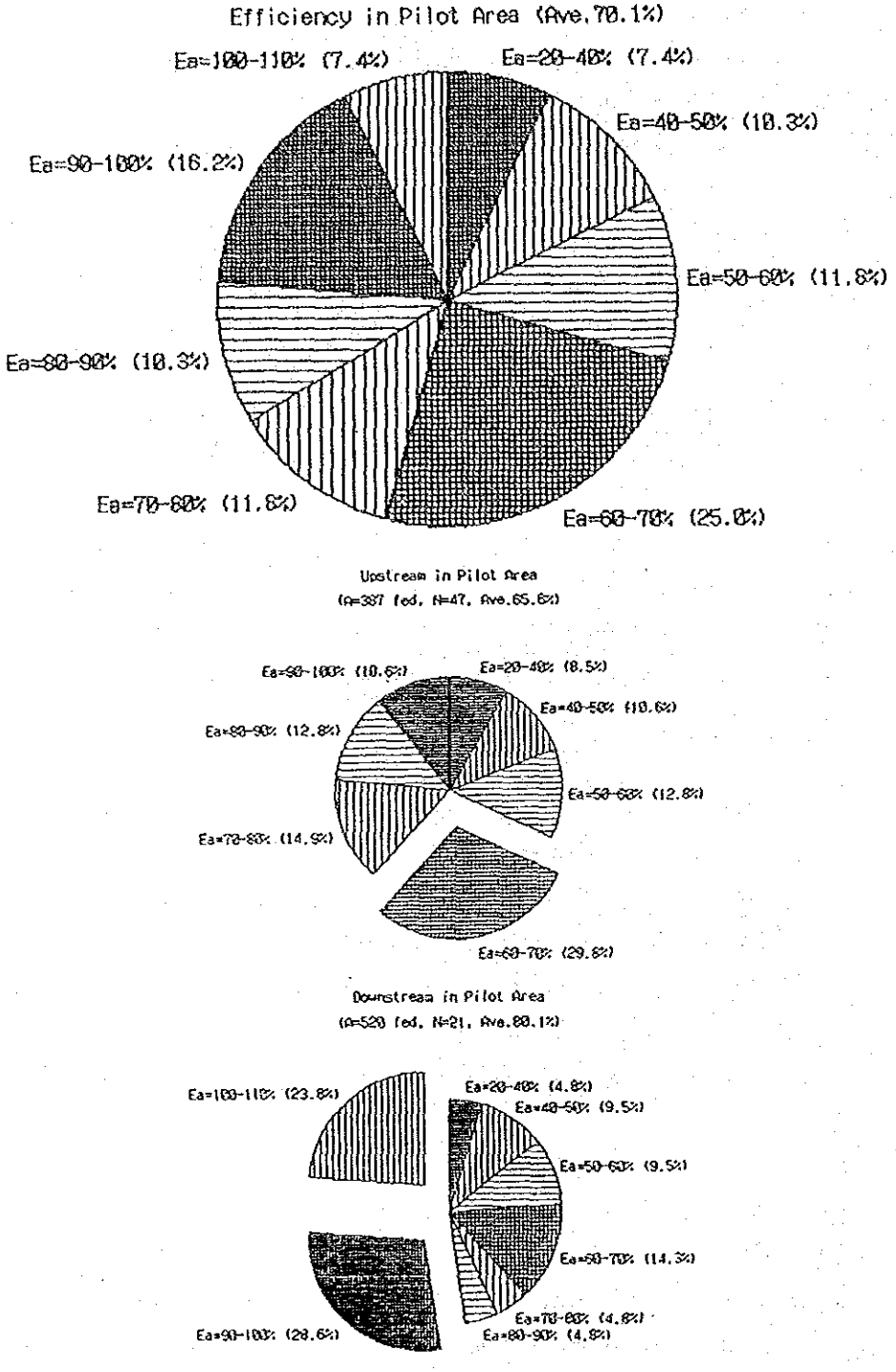
27. The Rehabilitation and Improvement Project of Bahr Yusef Canal (hereinafter referred to as "the Project" or "RIPBY") aims at eliminating the present problems and constraint of the existing delivery water system on the basis of equitable supply of water, improving the overall efficiency of water use by reduction of water losses, and improving the irrigation application to achieve the optimum crop production, and contribution to the revitalization of regional economy as well as sharing a part of the national strategy on the adjustment of economic structure of the country.

28. Agriculture is the most important sector in Egypt in supplying foods and creating employment opportunity with 36 percent of the labour force as well as contributing the country in terms of foreign exchange earnings by export. Agriculture in Egypt depends only on the limited water resources of Lake Nasser supplied through the Nile River. The available annual water resources of 55.5 milliard cubic meters is allocated to Egypt under the Nile Water Agreement 1959, however, due to prolonged Sahalian drought, inflows to Lake Nasser will be reduced and thus be difficult to get the allocated water resources for Egypt.

29. MPWWR aims at immediate implementation of the rehabilitation and improvement of the existing water distribution systems covering about 6.0 million feddan in the old lands, and has a schedule for improving 1.0 million feddan within five years. It, however, will need 30 years, if a progress will be so, to improve all irrigation systems in the old lands. MPWWR desires to accelerat the execution of the rehabilitation and improvement projects. The command area of Bahr Yusef canal covers about 770 thousand feddan and, shares about 13% of the total agricultural lands and on of the biggest irrigation system in Egypt.

30. There exist various problems and constraint of the existing facilities on Bahr Yusef canal to be solved and improved. Major problems are low structural stability due to superannuated structures, lack of irrigation water distribution facilities, and poor maintenance of canal and facilities. Most of the facilities are already obsolete giving rather low irrigation efficiency and unequal water distribution. Aside from the distribution of irrigation water at the principal and branch canals, improvement of on-farm irrigation method is an important task in this regard.

Figure G-1-10 Present Water Application Efficiency in Pilot Area



(Project Formulation)

31. The RIPBY is formulated to fulfill the objectives of the Project, namely equitable water supply, effective water use and improved irrigation application the following:

(1) Rehabilitation and improvement of the existing facilities is planned to provide facilities by less initial investment and link it to the on-going modern management system of the Main System Management (MSM) Project after it's completion.

(2) Major superannuated structures such as Dairout barrage, and four regulators will be reconstructed nearby the existing site. Improvement of these structures will be the major works of the Project and in this regard, modern facilities with remote operation system will be provided.

(3) Works on excavation and trimming of the cross section and shortcut of the canal course is planned at minimum extent. These works will be executed in parallel with maintenance works during the operation period.

(4) Aged pump equipment of drainage and irrigation pump stations are to be replaced and spareparts/accessories of equipment and operation panel are procured for improvement of the operation. Pump buildings and civil works are to be improved by renovation and minor rehabilitation.

(5) Design procedures and criteria for rehabilitation and improvement of the branch canals are to be provided through the study of Harika canal which is a representative of the branch canals. The results of the study will be applied for the planning and design of the whole branch canals along Bahr Yusef canal.

(6) There exist a potential hydropower generation only at the site of Lahoun regulator which has a generating capacity of 640 kilowatts. It is confirmed that the hydropower generation along Bahr Yusef canal is not economically viable and socially unacceptable at present in Egypt.

(7) The improvement plan of the Project is composed of rehabilitation and improvement of the major facilities on the main irrigation system operated and managed by MPWWR. For the on-farm facilities operated by farmers, a standard plan for improvement is presented based on the study of the pilot area, however, the improvement cost is not included in the project cost but is included in the project evaluation. It shall be noted that the Water User's Association (WUA) plays a major role in the improvement of the on-farm water management.

Table E-3-9 Calculation of Proposed Intake Water (at Dairout Barrage)

(unit:m3/sec)

	NWR based on FAO ①	G. Water Contrbtn. ② 1*0.1	Differ-ence ③ 1-2	GWR ④ 3/0.8	Farmer's Gain W. ⑤	Difference ⑥ 4-5	DWR ⑦ 6/0.8	Drink-ing etc. ⑧
Jan	60.81	6.08	54.73	68.41	0.00	68.41	85.51	16.21
Feb	79.36	7.94	71.43	89.28	0.00	89.28	111.60	16.21
Mar	86.74	8.67	78.06	97.58	0.00	97.58	121.97	16.21
Apr	57.48	5.75	51.73	64.67	0.00	64.67	80.83	16.21
May	70.27	7.03	63.25	79.06	0.00	79.06	98.82	16.21
Jun	100.77	10.08	90.69	113.36	0.00	113.36	141.71	16.21
Jul	160.23	16.02	144.21	180.26	0.00	180.26	225.33	16.21
Aug	140.62	14.06	126.55	158.19	0.00	158.19	197.74	16.21
Sep	92.52	9.25	83.27	104.09	0.00	104.09	130.11	16.21
Oct	31.04	3.10	27.94	34.92	0.00	34.92	43.65	16.21
Nov	40.85	4.08	36.76	45.96	0.00	45.96	57.44	16.21
Dec	48.14	4.81	43.33	54.16	0.00	54.16	67.70	16.21

	NRA ⑨	NRA in Future ⑩	Gain W. by DPS ⑪	Gain W. by Grvty ⑫	Gain W. from NRA ⑬	Addtnl. Q by DPS ⑭	Balance (m3/sec) ⑮	Intake W. (MCM/day) ⑯	
Jan	6.00	7.43	14.81	0.74	3.47	0.00	96.13	8.31	
Feb	7.67	9.47	21.61	0.74	3.47	0.00	119.13	10.29	
Mar	8.37	11.16	24.70	0.74	3.47	0.00	128.80	11.13	
Apr	2.64	5.28	24.49	0.74	3.47	0.00	76.26	6.59	
May	4.10	8.93	21.32	0.74	3.47	0.00	102.53	8.86	
Jun	9.39	11.72	20.89	0.74	3.47	9.07	144.86	12.52	
Jul	13.75	13.68	23.84	0.74	3.47	14.42	226.50	19.57	Max
Aug	9.76	10.36	23.66	0.74	3.47	12.66	193.55	16.72	
Sep	3.84	4.86	28.15	0.74	3.47	0.00	122.66	10.60	
Oct	2.21	3.82	28.57	0.74	3.47	0.00	33.11	2.86	Min
Nov	3.08	4.14	33.19	0.74	3.47	0.00	43.47	3.76	
Dec	4.62	6.08	33.86	0.74	3.47	0.00	56.54	4.89	

Note: NWR based on FAO = net water requirement by modefied Penman equation based on FAO Irrigation and Drainage Paper #24

G. Water Contrbtn. = ground water contribution, 10% of net water requirement

GWR = gross water requirement, on-farm irrigation efficiency 80%

Farmer's Gain W. = Farmer's gain water from drain = 0% of GWR during Jun to Aug.

DWR = diversion water requirement, conveyance efficiency of 20%

Dirnking etc. = *drinking and industrial water etc., two (2) times of present estimated amount*

NRA = based on the proposed cropping pattern by the JICA study team

NRA in Future = based on the proposed cropping pattern on the expansion planned by the JICA study team

Gain W. by DPS = gain water by 9 *Drainage Pump Stations (DPS)* related to Bahr Yusef canal and 2 DPS in Faiyum

Gain W. by grvty = gain of drain water by gravity in Faiyum

Gain W. from NRA = reuse of water from expansion area of 56000 feddan
= 1.5 mm/day * 56000 feddan * 0.85 * 4200 m2/feddan / 86400
= 3.47 m3/sec

Addtnl. Q by DPS = additional reuse water by proposed drainage pump stations

⑭=⑦+⑧+⑨+⑩-⑪-⑫-⑬-⑪

(Irrigation Water Requirement)

32. The proposed water requirement for about 670 thousand feddan of the old lands, about 44 thousand feddan of the reclaimed lands and about 56 thousand feddan of the expansion area, is calculated by the Modified Penman method along with the proposed cropping pattern and cropped area by crop. At present, the MPWWR and MALR have no development plan for the expansion area, therefore, the water requirement including leaching water in the expansion area is estimated taking into account the data of the neighbouring area reclaimed. Considering reuse water of 38.3 m^3/sec of the nine drainage pump stations, reuse water in Faiyum and the groundwater contribution, the intake of 19.5 MCM/day for Bahr Yusef canal are considered sufficient amount for the Project. According to the results of analysis, the overall irrigation efficiency rate account to 69.8% by counting the annual net water requirement of 3,355 MCM and annual total water supply of 4,804 MCM. It is proposed that the reuse water lifted by small pumps of farmers from the drainage will be changed to the reused water to be lifted by drainage pump stations. The existing drainage pump stations have sufficient capacity for such changes.

(Irrigation Rotation System)

33. Irrigation rotation system as a principal factor of the irrigation system operation was studied taking into consideration the adequate combination between the continuous flow at the principal canal and the rotational irrigation at on-farm level. As a result of the alternative study, it is proposed the continuous flow up to the branch canals and three-turn rotation at sub-branch canals.

(Distribution Control System)

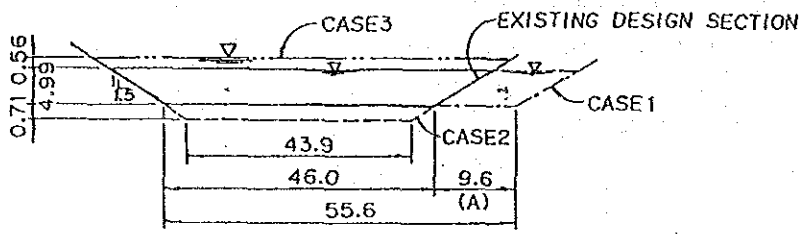
34. For the water distribution control system improvement, control and communication function for water level adjustment and monitoring, evaluation and feedback shall be established. An operation center shall also be established to undertake the distribution operation of the integrated Bahr Yusef canal irrigation system. On-farm water distribution control, on the other hand, shall be improved by establishing of Water User's Associations (WUAs) which shall manage pump operations at Meska intakes. The Irrigation Advisory Services (IAS) shall provide strong support, guidance, training and monitoring to the farmers.

Table F-2-1 Hydraulic Calculation on Alternative Cross Section of Bahr Yusef Canal

a) Between Dairout and Manshat El Dahab regulator

Dimension; Q = 234.06 cu.m/s, I = 7.15 cm/km (1/14,000)

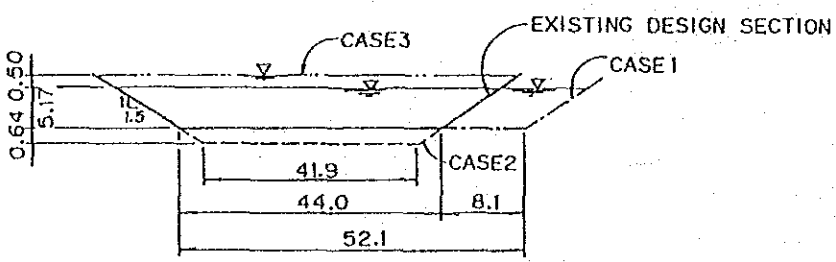
	"n" value	Width of Canal Bed	Width of Water	Water Depth (m)
Existing Section	0.025	46.0	61.0	4.99
Case 1	0.030	55.6	70.6	4.99
Case 2	0.030	43.9	61.0	5.70
Case 3	0.030	46.0	62.7	5.55



b) Between Mazoura and Lahoun Regulator

Dimension; Q = 194.86 cu.m/s, I = 5.00 cm/km (1/20,000)

	"n" value	Width of Canal Bed	Width of Water	Water Depth (m)
Existing Section	0.025	44.0	59.5	5.17
Case 1	0.030	52.1	67.6	5.17
Case 2	0.030	42.1	59.5	5.81
Case 3	0.030	44.0	61.0	5.67



(Alternative Improvement Plan of Principal Canal)

35. The maximum and minimum water requirement are occurred in July and October, respectively. Based on the results of the water balance study in the principal canal, the flow capacity of the canal section for the design discharge is comparatively studied for the improvement. On the improvement plan of the canal section, the alternative-2 is proposed based on the following alternative studies:

Alternative-1 : Widening water surface width by about 10 m, keeping the present water level and water depth of about five meters requiring Right-of-Way acquisition.

Alternative-2 : Deepening water depth by about 0.70 m, keeping the present water surface width of about 61 m and the present water level, resulting no Righ-of-Way acquisition.

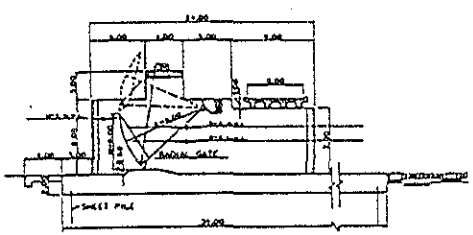
Alternative-3 : Raising water level by about 0.60 m, keeping the existing canal bed width of 46 m, resulting problems to be happened by too high water level at certain area.

According to the hydraulic analysis at the peak and low water demand periods, there is no problem on the intake of the branch canals, because most of the branch canal intakes are located at the upstream close to the regulator. However, irrigation pump stations of Kamadir and Terfa are required to improve due to low water level during both in the present and future.

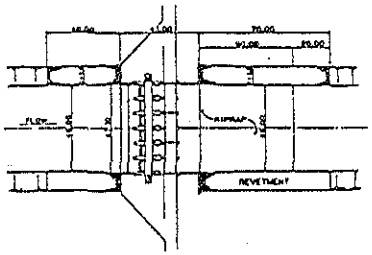
(Proposed Improvement Plan of Principal Canal)

36. Some reaches of Bahr Yusef canal have an insufficient flow capacity of the canal cross sections in changing the original trapezoidal section to nearly elliptical section by erosion and sediment of the flow. The improvement plan of the canal sections are recommended by deepening the canal bed and keeping the present total surface width to avoide an additional acquisition of Right-of-Way. For the improvement of the canal course to be straightened by the shortcut, it is proposed the improvement of four places out of 17 candidate sites according to the results of the detailed survey on the candidate sites in engineering and also environment of the villages concerned and livings.

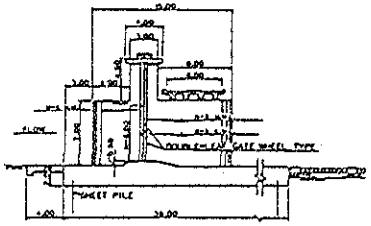
Figure F-2-7 Alternative Plan C of Improvement of Regulator



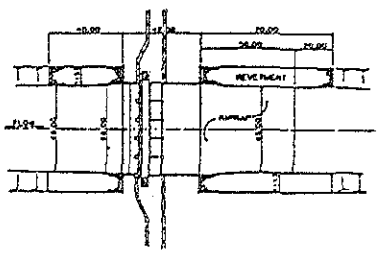
TYPICAL SECTION



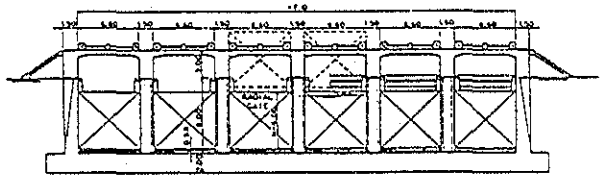
GENERAL PLAN



TYPICAL SECTION

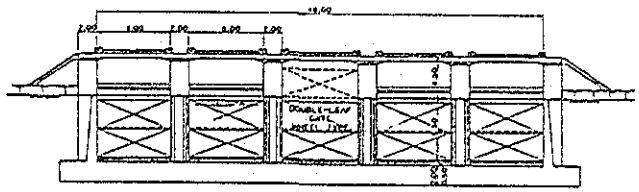


GENERAL PLAN



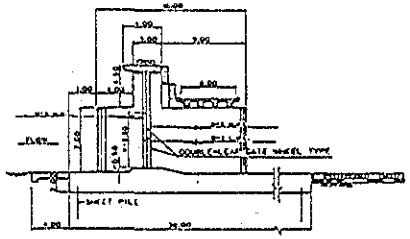
ELEVATION

ALTERNATIVE PLAN C-1

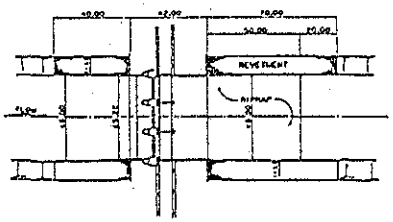


ELEVATION

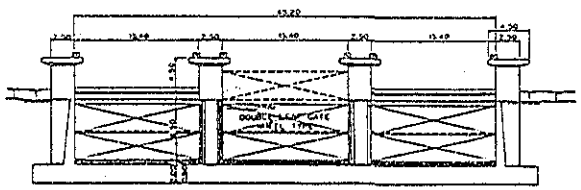
ALTERNATIVE PLAN C-2



TYPICAL SECTION



GENERAL PLAN



ELEVATION

ALTERNATIVE PLAN C-3

(Improvement of Barrage/Regulator)

37. Major facilities of Bahr Yusef canal like barrage/regulators are mostly over durable aged structures of more than 90 years after it's construction. It is proposed to reconstruct such superannuated barrage/regulators near the existing site through several alternatives study including a partial improvement plan.

(Improvement of Branch Canal Intakes)

38. Most of intake structures of the branch canals are over durable age and made mainly of bricks and equipped with Fahmy Henen Gate (FH). Giza and Hassan Wasef intakes are quite large scale structures covering a wide command area of 153 thousand feddan and 118 thousand feddan, respectively. These intakes play significant roles for the command area and are proposed to reconstruct with a new type structure. Likewise, 14 intakes of 3.0 to 2.0 meters vent with the FH gate are proposed to replace, while the small scale intake structures smaller than 1.5 meters vent with the FH gate are partially rehabilitated and strengthened the support of the gate frame with improvement of the partial civil works concerned.

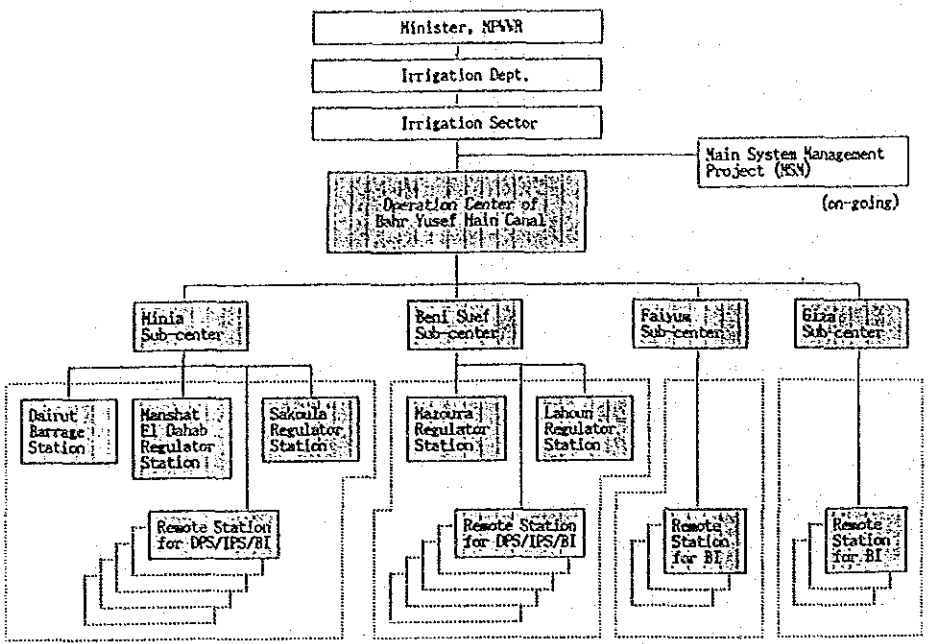
(Drainage Pump Station)

39. Since the existing pump stations aged more than ten or more years have low efficiency and it is rather difficult to secure the needed spareparts, pump equipment shall be replaced. The aged building are reconstructed and a by-pass canal in and around the drainage pump stations including El Badraman pump station out of nine stations, pump equipment and operation panels shall be replaced and needed spareparts for other four drainage pump stations shall be supplied. Furthermore, mechanical weed screen cleaning machine and a by-pass canal shall be provided.

(Irrigation Pump Station)

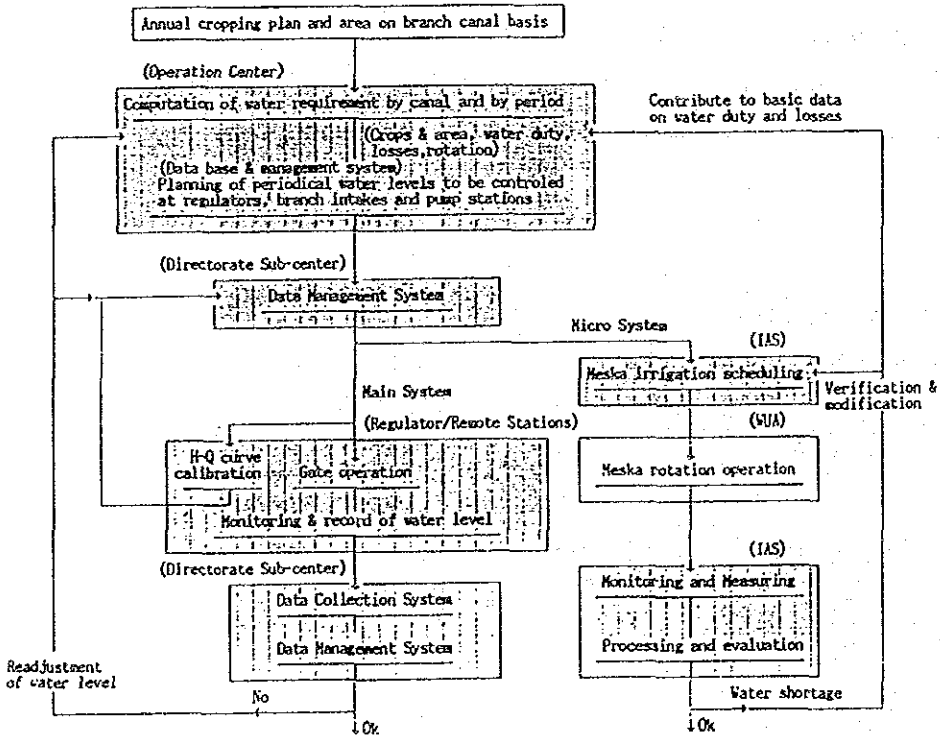
40. A new pump station combined with two irrigation pump stations of Arab Beni Khalid and Beni Khalid shall be advantageous for improvement of these stations. Pump equipment of Kamadir and Terfa No.1 irrigation pump stations shall be replaced and civil works of intake structures will be partially improved. On the improvement of Sakoula and Mazoura irrigation pump stations, only pump equipment shall be replaced. The above six pump stations shall be provided with weed screen cleaning machine. Terfa No.1 and Mazoura pump stations are comparatively new stations and no necessity for any improvement.

Figure G-2-1 Proposed Organizational Structure for Operation and Maintenance of the Main System



(IPS: Irrigation pump station, DPS: Drainage pump station, BI: Branch intake)

Figure G-2-2 Chart of Proposed Water Distribution Control System for Bahr Yusef Canal



(Improvement of Branch Canals)

41. Harika branch canal is selected and studied as a representative of a lot of branch canals to formulate the rehabilitation and improvement plan of the branch canals.The capacity of the existing canal is good for the discharge of the two-turn rotation system, therefore, the present capacity is not applicable for the three-turn rotation system recently practiced. However, the proposed irrigation system is a combined system of the continuous flow in the principal and branch canals and the three-turn rotation system in the on-farm level, resulting the capacity of the existing canal has enough capacity for the proposed system, and the canal sections will be improved partially at the minimum extent. For proper water management by control of water level, it is proposed to construct a regulator, improvement with replacement of gates of two existing regulators and construction of a tail wasteways. Planning and design criteria on these improvement on the Harika canal shall be applied for improvement of all branch canals in the Bahr Yusef canal command area and projected the improvement cost of the branch canals.

42. As the design velocity of the regulator was arranged 0.5 ~ 0.6 m/sec, the elevation of gate sill was set about 30 cm higher than the canal bed. The gate of regulator would be installed the proposed wheel type and the span of the gate should be less than 3.0 m. The specification of those facilities are shown as below.

		Regulator No.1	Regulator No.4	Tail Escape	New Regulator
Design Discharge	(m^3/s)	5.169	2.434	0.292	3.533
Gate Type		Wheel	Wheel	Slide	Wheel
Dimension of Gate	(m)	2.5×2.3×2	2.5×2.1×2	1.0×1.3×1	2.0×1.85×2
Design WL	(EL.m)	31.75	31.00	30.10	31.59
The Max. WL	(EL.m)	32.15	31.36	30.30	31.75
Gate sill EL	(EL.m)	29.85	29.30	28.80	29.90

(Improvement of On-farm Facilities)

43. Improvement of the on-farm facilities are studied in the three pilot areas and formulated a standard on the improvement of the whole Bahr Yusef canal command area. Major works are improvement/construction of Meska, construction of Meska intake and rehabilitation/construction of farm road. Such works shall be undertaken by WUAs under technical assistance and support to be extended by MPWWR.

Fig. H-2-1 Proposed Cropping Pattern in Command Area in Minia Governorate

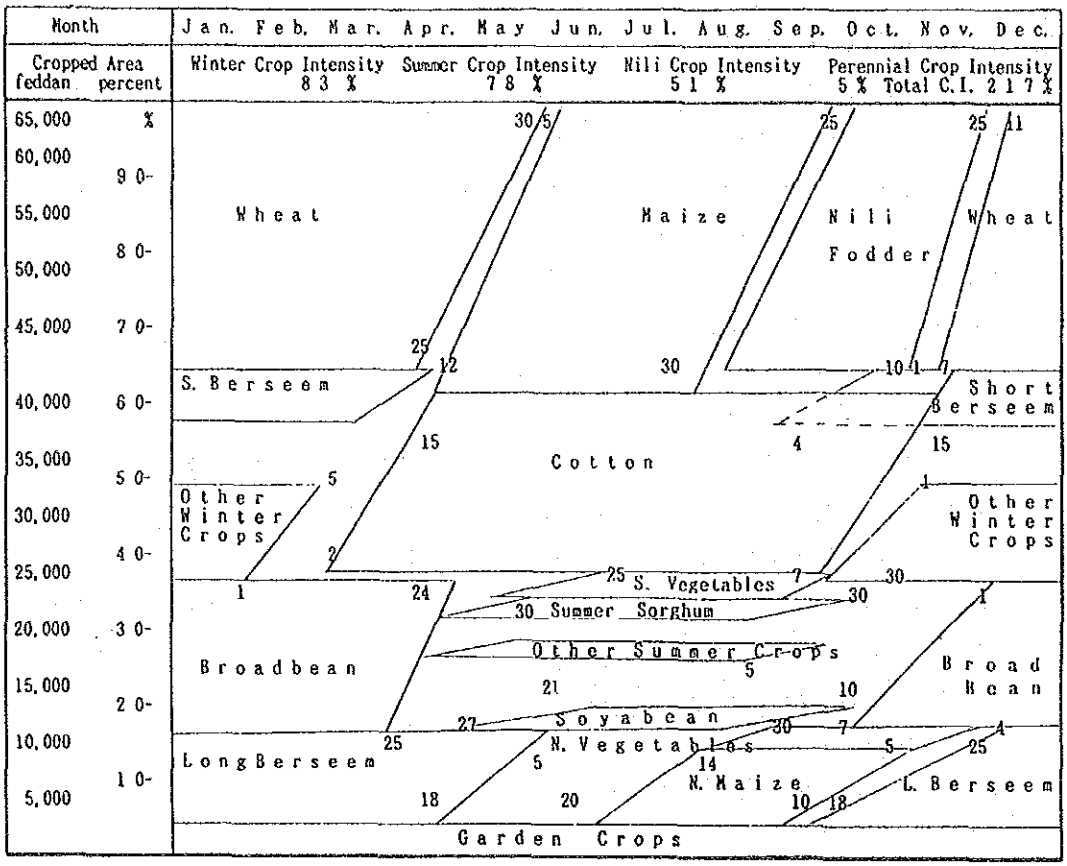
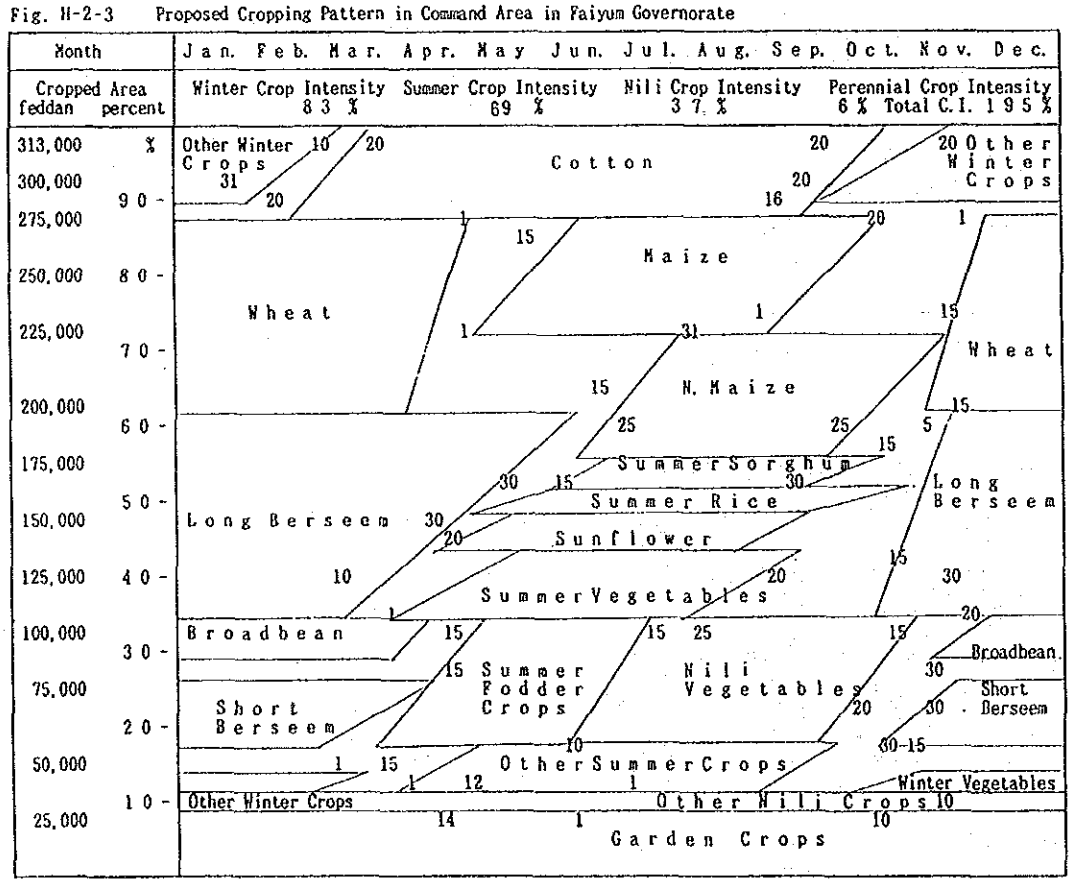


Fig. H-2-3 Proposed Cropping Pattern in Command Area in Faiyum Governorate



(Improvement Cropping Pattern)

44. Increase in crop yield and cropping intensity can be expected by efficient water use, equitable water distribution, and timely and appropriate irrigation in the command area of Bahr Yusef canal, particular in summer season, in which water shortage often occurs. Target yield is drived by using the average of the best five crop yield in each governorate, and data on yield before and after establishment of WUAs surveyed by IIP under assistance of USAID are also considered.

Crop composition in case of with-project is studied based on 1) ecological/physiological, 2) strategic/political, 3) economic, 4) demand-supply of view. Particularly, berseem, which is the main animal feed in winter, occupying the largest area in crops, is indispensable for maintain soil fertility of farm land. As the result of study on feed balance, a part of berseem area is planned to be converted to more strategic crops such as wheat, maize, broadbean in Minia and Faiyum.

45. Since cropping intensity in each governorate reaches more than 170%, remarkable increase might be limited, however, possible improvement of cropping intensity is studied along with improved water management excepting Giza governorate which has reached leveled off. Consequently, improved cropping intensity are 217% from the current 171% in Minia, 196% from 187 percent in Beni Suef, 195% from 179 percent in Faiyum and 225% in Giza. Moreover, the cropping intensity in the reclaimed area and the expansion area are planned at 145.2% and 136.9%, respectively.

Table 4-2 Project Cost

Unit : 1,000 L.E.

DESCRIPTION	TOTAL		PHASE-1		PHASE-II		PHASE-III	
	Q'ty	AMOUNT	Q'ty	AMOUNT	Q'ty	AMOUNT	Q'ty	AMOUNT
1. Improvement of Bahr Yusef Canal		357,700		125,600		130,900		101,200
1.1 Remodelling & Trimming of Canal		122,000		18,000		48,000		56,000
1.1.1 Improvement of Canal Section	311 Km	95,000	70 Km	18,000	140 Km	48,000	101 Km	29,000
1.1.2 Improvement of canal Course	4.8 Km	27,000	-	-	-	-	4.8 Km	27,000
1.2 Improvement of Barrage/Regulator		169,000		69,000		64,000		36,000
1.2.1 Preparatory Work for Const.		20,000		20,000		-		-
1.2.2 Dairout Barrage		36,000		-		-		36,000
1.2.3 Manshat El Dahab Regulator		35,000		-		35,000		-
1.2.4 Sakoula Regulator		31,000		31,000		-		-
1.2.5 Mazoura Regulator		29,000		-		29,000		-
1.2.6 Lahoun Regulator		18,000		18,000		-		-
1.3 Improvement of Canal Structure		66,700		38,600		18,900		9,200
1.3.1 Intake of Manshat El Dahab C		7,200		-		7,200		-
1.3.2 Intake of Harika C		3,200		3,200		-		-
1.3.3 Intake of Saab C		3,200		3,200		-		-
1.3.4 Intake of Hasan Wasef Branch		11,000		11,000		-		-
1.3.5 Intake of Giza Branch		14,000		14,000		-		-
1.3.6 Reconstruction of I.S. 3.0m	3 Places	6,000	2 places	4,000	1 place	2,000		-
1.3.7 Reconstruction of I.S. 2.5m	3 places	6,000		-	3 places	6,000		-
1.3.8 Reconstruction of I.S. 2.0m	5 places	4,500		-	1 place	900	4 place	3,600
1.3.9 Rehabilitation of I.S. 1.5m	8 places	3,200	1 place	400	1 place	400	6 places	2,400
1.3.10 Rehabilitation of IS. 1.2m	21 places	8,400	7 places	2,800	6 places	2,400	8 places	3,200
2. Improvement of Branch Canals		356,400		106,400		106,400		143,600
3. Improvement of Pump Station		94,000		26,000		37,500		30,500
3.1 Drainage Pump Station (PS)		19,000		14,000		2,500		2,500
El Badraman PS		14,000		14,000		-		-
Other 8 PSs		5,000		-		2,500		2,500
3.2 Irrigation Pump Station		75,000		12,000		35,000		28,000
Arab Beni Khalid & Beni Khalid		12,000		12,000		-		-
Kamadir & Terfa		35,000		-		35,000		-
Sakoula & Mazoura		28,000		-		-		28,000
4. Operation and Maintenance		42,000		16,500		16,500		9,000
O/M Facilities		18,000		5,000		8,000		5,000
Enhancement of O/M		2,000		2,000		-		-
Water Management		12,000		4,000		4,000		4,000
Training & Education		10,000		5,500		4,500		-
Grand Total of Project Cost		850,100		274,500		291,300		284,300

(Condition of Cost Estimate)

46. The project cost is estimated based on the following conditions:

(1) The project cost is estimated based on the current market prices on September 1991.

(2) The construction mode is considered by contract basis.

(3) The construction unit rate for civil works and the unit price of laborers and construction materials are based on the prevailing practice of the contract works. Those which are not available cost are calculated by adding up all the necessary materials, laborers and machine at the current market price.

(4) The miscellaneous works in the civil works is estimated at 10% of the baseline costs of the civil works, while the mobilization and the other temporary works is also added at 10% of the baseline cost.

(5) The cost of gates is estimated based on their weight according to it's size and manufacturing in locally and abroad.

(6) The cost of mechanical and electrical equipment for pump stations is estimated on the b(asis of recent tenders, which is added a customs duties and taxes to the CIF cost.

(7) A provision of 15% of the cost of the works is included in the project cost to cover the engineering and administration cost of planning, design and implementation of the project by MPWWR.

(8) The cost of the technical assistance is estimated at 13% of the cost of the works to cover staff charges as well as ancillary costs such as international travel, supplies and equipment and home office support costs, and a local component to cover subsistence and local expenses and support costs.

(9) Physical contingency equivalent to 10% of the baseline costs is estimated in the project cost.

(10) The exchange rate among Egyptian Pound, U.S. Dollar and Japanese Yen is adopted as follows:

1.00 US$ = 3.30 L.E = ¥140.00

1.00 L.E = ¥ 42.00

(Project Cost)

47. The project cost at current price is estimated at 850.1 million Egyptian Pound, of which 274.5 million, 291.3 million and 284.3 million Egyptian Pound are scheduled for the Phase-1 project, Phase-II project and Phase-III project, respectively.

(Operation and Maintenance Cost)

48. The annual operation and maintenance cost is composed of salary and wages for the O/M organization staff, administration and general expenditues, equipment depreciation and repair cost, fuel and oil cost maintenance cost of the facilities and office facilities and special expenditure for training/seminar/demonstration programme.

Figure 5-1 Organization of Implementation of Project

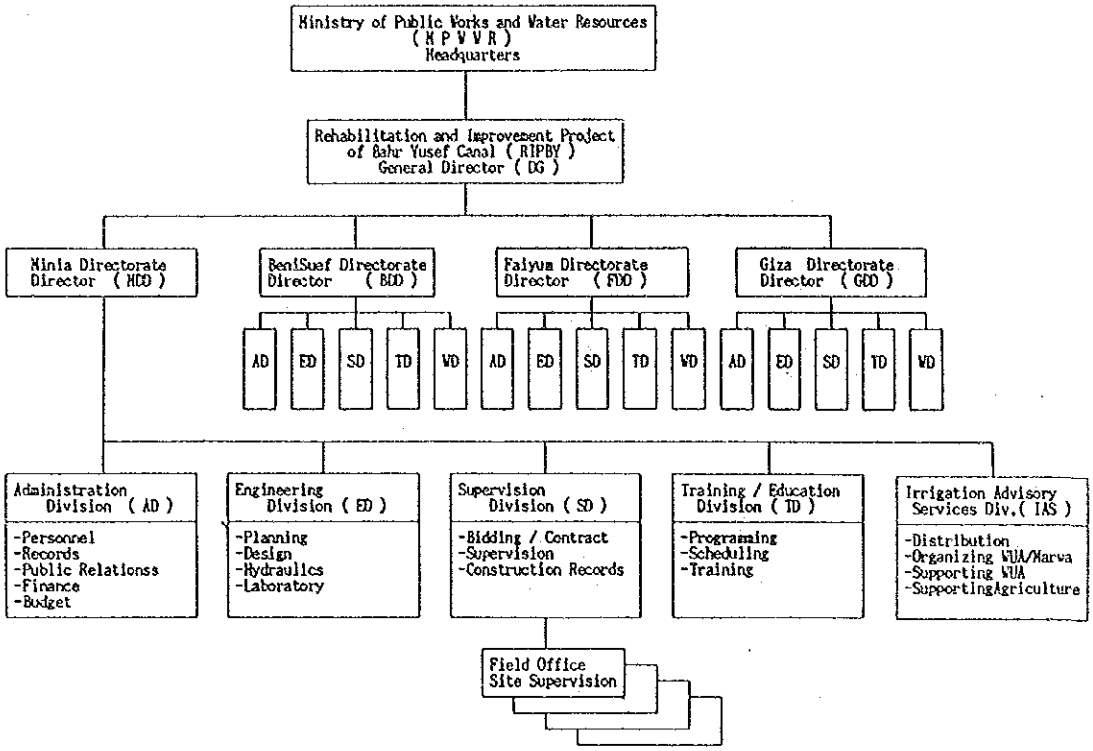


Figure 5-2 Implementation Schedule of Project

DESCRIPTION / PHASE / PROJECT YEAR	PHASE-I				PHASE-II				PHASE-III				REMARKS
	1	2	3	4	5	6	7	8	9	10	11	12	
1. Improvement of Bahr Yusef Canal													
1.1 Remodelling & Trimming of Canal													
1.1.1 Improvement of Canal Section	———	———	———	———	———	———	———	———	———	———	———	———	
1.1.2 Improvement of canal Course									———	———	———		
1.2 Improvement of Barrage/Regulator													
1.2.1 Preparatory Work for Const.	———												
1.2.2 Dairout Barrage									———	———	———		
1.2.3 Manshat El Dahab Regulator					———	———							
1.2.4 Sakoula Regulator			———	———									
1.2.5 Mazoura Regulator						———	———						
1.2.6 Lahoun Regulator	———	———	———										
1.3 Improvement of Canal Structure													
1.3.1 Intake of Manshat El Dahab C					———	———							
1.3.2 Intake of Harika C			———	———									
1.3.3 Intake of Saab C			———	———									
1.3.4 Intake of Hasan Wasef Branch	———	———	———										
1.3.5 Intake of Giza Branch	———	———	———										
1.3.6 Reconstruction of I.S. 3.0X3			———	———	———	———	———	———					
1.3.7 Reconstruction of I.S. 2.5X3					———	———	———	———					
1.3.8 Reconstruction of I.S. 2.0X5							———	———	———	———	———	———	
1.3.9 Rehabilitation of I.S. 1.5X8			———	———			———	———	———	———	———	———	
1.3.10 Rehabilitation of IS. 1.2X21			———	———	———	———	———	———	———	———	———	———	
2. Improvement of Branch Canals			———	———	———	———	———	———	———	———	———	———	
3. Improvement of Pump Station(PS)													
3.1 Drainage Pump Station													
El Badraman PS			———	———									
Other 8 PSs					———	———	———	———	———	———	———	———	
3.2 Irrigation Pump Station													
Arab Beni Khalid,Beni Khalid PSs			———	———									
Kamadir,Terfa PSs					———	———	———	———	———	———	———	———	
Sakoula,Mazoura PSs									———	———	———	———	
4. Operation and Maintenance													
O/M Facilities	———	———	———	———	———	———	———	———	———	———	———	———	
Enhancement of O/M		———	———	———		———	———	———		———	———	———	
Water Management		———	———	———	———	———	———	———	———	———	———	———	
Training & Education		———	———	———	———	———	———	———					
5. Improvement of On-farm Facilities													

CHAPTER 5. PROJECT IMPLEMENTATION AND OPERATION

(Executing Agency)

49. The executing agency of the Project shall be MPWWR in close coordination with the WUAs which will be organized among the farmers concerned and also other government agencies concerned led by the MALR. Under the MPWWR, Rehabilitation and Improvement Project of Bahr Yusef Canal (RIPBY) will be headed by the General Director (GD), who shall be also act as the Manager of the Project.

50. Construction of the project component will be expecuted on contract basis, particularly the construction of the major structures such as regulators, intake structures with large size, pump stations and so on through international competitive bidding.

(Implementation Schedule)

51. Implementation of the RIPBY will be done into three phases and each phase will be implemented in four years. The Project is expected to be completed within a period of 12 years. Phasing of the Project implementation is made taking into consideration the priority of the project component which provided based on a durability of the structure, situation of the command area concerned, budgetary availability, etc.

(Engineering Services)

52. Engineering services shall be provided during the final design of the Project as well as in supervision of the Project implementation in order to introduce modern engineering on design and construction management. The schedule of the engineering services will be made based on the implementing schedule of the Project.

(Operation and Maintenance)

53. After completion of the construction of the Project, all the facilities and equipment provided by the Project shall be turned over to the Irrigation Directorate concerned for the operation and maintenance of the system.

Table 6-1 Calculation of EIRR

(UNIT : '000 LE)

YEAR	PROJECT COST			BENEFITS	RETURN	PRESENT WORTH VALUE BY DISCOUNT RATE					
						12 %		14 %		20 %	
	CAPITAL	O & M	TOTAL			(COST)	(BENEFITS)	(COST)	(BENEFITS)	(COST)	(BENEFITS)
1	65590.00	0.00	65590.00	0.00	-65590.00	65590.00	0.00	65590.00	0.00	65590.00	0.00
2	65590.00	0.00	65590.00	0.00	-65590.00	52287.98	0.00	50469.43	0.00	45548.62	0.00
3	73098.00	0.00	73098.00	0.00	-73098.00	52029.74	0.00	49339.18	0.00	42302.14	0.00
4	73098.00	0.00	73098.00	0.00	-73098.00	46455.15	0.00	43280.03	0.00	35251.80	0.00
5	80293.00	7963.00	88256.00	-5990.00	-94246.00	50078.91	-3398.89	45837.62	-3111.03	35468.18	-2407.25
6	80293.00	7963.00	88256.00	-2273.00	-90529.00	44713.35	-1151.58	40208.48	-1035.55	29556.83	-761.23
7	80293.00	7963.00	88256.00	6476.00	-81780.00	39922.63	2929.42	35270.62	2588.07	24630.70	1807.34
8	92553.00	7963.00	100516.00	29262.00	-71254.00	40596.86	11818.47	35237.07	10258.14	23376.90	6805.43
9	90614.00	17137.00	107751.00	72017.00	-35734.00	38856.22	25970.14	33134.58	22146.00	20882.95	13957.43
10	90614.00	17137.00	107751.00	107844.00	93.00	34693.08	34723.02	29065.46	29090.55	17402.47	17417.49
11	90614.00	17137.00	107751.00	151883.00	44132.00	30975.97	43662.93	25496.05	35938.56	14502.07	20441.73
12	90613.00	17137.00	107750.00	179588.00	71838.00	27656.88	46095.99	22364.77	37275.58	12084.95	20142.11
13	23278.00	25146.00	48424.00	216711.00	168287.00	11097.59	49664.82	8816.64	39456.95	4525.92	20254.77
14	23278.00	25146.00	48424.00	224789.00	176365.00	9908.57	45996.55	7733.91	35901.56	3771.61	17508.16
15	23278.00	25146.00	48424.00	230914.00	182490.00	8846.94	42187.40	6784.14	32350.74	3143.01	14987.69
16	23278.00	25146.00	48424.00	233907.00	185483.00	7899.06	38155.55	5951.00	28745.69	2619.17	12851.64
17	0.00	25146.00	25146.00	239262.00	214116.00	3662.40	34847.39	2710.78	25792.81	1133.42	10784.41
18	0.00	25146.00	25146.00	239953.00	214807.00	3270.00	31203.61	2377.88	22690.64	944.52	9012.97
19	0.00	25146.00	25146.00	241253.00	216107.00	2919.64	28011.33	2085.86	20011.93	787.10	7551.50
20	41970.00	25146.00	67116.00	242821.00	175705.00	6957.76	25172.68	4883.58	17668.44	1750.68	6333.82
21	0.00	25146.00	25146.00	242821.00	217675.00	2327.52	22475.61	1605.00	15498.64	546.60	5278.19
22	0.00	25146.00	25146.00	242821.00	217675.00	2078.15	20067.52	1407.90	13595.31	455.50	4398.49
23	0.00	25146.00	25146.00	242821.00	217675.00	1855.49	17917.44	1235.00	11925.73	379.58	3665.41
24	0.00	25146.00	25146.00	242821.00	217675.00	1656.69	15997.72	1083.34	10461.18	316.32	3054.51
25	0.00	25146.00	25146.00	242821.00	217675.00	1479.19	14283.68	950.30	9176.48	263.60	2545.43
26	0.00	25146.00	25146.00	242821.00	217675.00	1320.70	12753.29	833.59	8049.55	219.67	2121.19
27	0.00	25146.00	25146.00	242821.00	217675.00	1179.20	11386.87	731.22	7061.02	183.05	1767.66
28	0.00	25146.00	25146.00	242821.00	217675.00	1052.86	10166.85	641.42	6193.88	152.55	1473.05
29	0.00	25146.00	25146.00	242821.00	217675.00	940.05	9077.55	562.65	5433.23	127.12	1227.54
30	0.00	25146.00	25146.00	242821.00	217675.00	839.33	8104.96	493.56	4766.00	105.93	1022.95
31	0.00	25146.00	25146.00	242821.00	217675.00	749.40	7236.58	432.94	4180.71	88.28	852.46
32	0.00	25146.00	25146.00	242821.00	217675.00	669.11	6461.23	379.78	3667.29	73.57	710.39
33	0.00	25146.00	25146.00	242821.00	217675.00	597.42	5768.96	333.14	3216.92	61.30	591.99
34	0.00	25146.00	25146.00	242821.00	217675.00	533.41	5150.86	292.23	2821.87	51.09	493.32
35	0.00	25146.00	25146.00	242821.00	217675.00	476.26	4598.98	256.34	2475.32	42.57	411.10
36	0.00	25146.00	25146.00	242821.00	217675.00	425.23	4106.24	224.86	2171.34	35.48	342.59
37	0.00	25146.00	25146.00	242821.00	217675.00	379.67	3666.28	197.24	1904.69	29.56	285.49
38	0.00	25146.00	25146.00	242821.00	217675.00	338.99	3273.47	173.02	1670.78	24.64	237.91
39	0.00	25146.00	25146.00	242821.00	217675.00	302.67	2922.74	151.77	1465.60	20.53	198.26
40	41970.00	25146.00	67116.00	242821.00	175705.00	721.29	2609.59	355.34	1285.61	45.67	165.21
41	0.00	25146.00	25146.00	242821.00	217675.00	241.29	2329.99	116.79	1127.73	14.26	137.68
42	0.00	25146.00	25146.00	242821.00	217675.00	215.44	2080.35	102.44	989.24	11.88	114.73
43	0.00	25146.00	25146.00	242821.00	217675.00	192.35	1857.46	89.86	867.75	9.90	95.61
44	0.00	25146.00	25146.00	242821.00	217675.00	171.74	1658.45	78.83	761.19	8.25	79.67
45	0.00	25146.00	25146.00	242821.00	217675.00	153.34	1480.76	69.15	667.71	6.88	66.40
46	0.00	25146.00	25146.00	242821.00	217675.00	136.91	1322.10	60.65	585.71	5.73	55.33
47	0.00	25146.00	25146.00	242821.00	217675.00	122.24	1180.45	53.21	513.78	4.77	46.11
48	0.00	25146.00	25146.00	242821.00	217675.00	109.15	1053.97	46.67	450.69	3.98	38.42
49	0.00	25146.00	25146.00	242821.00	217675.00	97.45	941.05	40.94	395.34	3.32	32.02
50	0.00	25146.00	25146.00	242821.00	217675.00	87.01	840.22	35.91	346.79	2.76	26.68
TOTAL	1150315.00	1055948.00	2206263.00	9693047.00	7486784.00	599868.29	658660.06	529672.18	479496.16	388567.38	208023.83

BENEFIT COST RATIO BY DISCOUNT RATE (B/C) = 1.10 (12%),
INTERNAL RATE OF RETURN (IRR) = 13.1 %

CHAPTER 6. PROJECT EVALUATION

(Evaluation Method)

54. Project evaluation conducted from the viewpoint of national economy as the economic analysis and private economy as the financial analysis. Economic internal rate of return (EIRR) is used for judging economic feasibility of the Project. Result of the project evaluation shows 13.1 percent of EIRR, which is over 12 percent of the opportunity cost of capital applied by the Ministry of Planning. Therefore, the Project can be considered economically viable.

55. The existing barrage/regulators were maintained by strengthening the structures by grouting and repairing the gates to keep the function. Considering the durable age of the structures, more than 90 years after construction, it can be judged that the existing facilities have no any economic value.

(Economic Project Cost)

56. Economic project cost is composed of foreign currency portion and local currency portion which is converted by multiplied by the standard conversion factor (SCF) of 0.877. SCF is accounted based on the data of trade statistics in the past six years.

(Project Benefit)

57. Agricultural benefit from the Project are derived from the increase in crop yield, cropping intensity and agricultural production in the command area of the Project.

(Economic Sensitivity Analysis)

58. Taking into consideration the influence on the project evaluation, which may occur by unexpected factors in the future, sensitivity analysis is conducted as follows:

Conditions of Analysis	EIRR (%)
1) 10% increased of project cost	12.2
2) 20% increased of project cost	11.5
3) 10% reduction of benefit	12.0
4) 20% reduction of benefit	10.8
5) combination of 1) and 3)	11.2
6) combination of 2) and 4)	9.4

Table M-19 (1) Financial Analysis

Farm Model (without Project) Minia(1.38 fed/farm household)
Cropping intensity:171.4%

1. Crop Production

	Area (fed)	Yield Main Prod. (ton/fed)	Yield by-product (load/fed)	Production Main Product (ton)	Production by-product (load)	Unit Price Main Product (LE/ton)	Unit Price by-product (LE/load)	Value of Production(LE) Main Product	Value of Production(LE) by-product	Value of Production(LE) Total	Production Cost (LE)	Net Income (LE)
Winter												
Long Berseem	0.62	28.72	0.00	17.81	0.00	35.00	0.00	623	0	623	399	224
Wheat	0.25	1.13	6.30	0.54	1.58	467.00	25.00	253	39	293	157	136
Broadbeen	0.40	1.12	5.50	0.45	2.20	677.00	15.00	303	33	336	204	132
Sub-total	1.27							1180	72	1252	770	482
Summer												
Cotton	0.30	0.76	7.00	0.23	2.10	1373.00	5.00	313	11	324	183	140
Maize	0.35	2.35	4.50	0.82	1.58	393.00	5.00	323	8	331	132	199
Sub-total	0.65							636	18	655	315	339
Nili												
Maize	0.25	1.76	4.50	0.44	1.13	393.00	5.00	173	6	179	101	78
Potato	0.10	8.03	0.00	0.81	0.00	577.00	0.00	466	0	466	267	179
Sub-total	0.35							639	6	645	383	257
Sugarcane	0.10	41.61	0.00	4.16	0.00	50.00	0.00	208	0	208	108	100
Total	2.37							2663	96	2760	1581	1179

2. Income from Livestock(LE) 25% of Net Income from Crop 295
3. Total Net Income(LE) 1474

Farm Model (with Project) Minia(1.38 fed/farm household)
Cropping intensity:217.4%

1. Crop Production

	Area (fed)	Yield Main Prod. (ton/fed)	Yield by-product (load/fed)	Production Main Product (ton)	Production by-product (load)	Unit Price Main Product (LE/ton)	Unit Price by-product (LE/load)	Value of Production(LE) Main Product	Value of Production(LE) by-product	Value of Production(LE) Total	Production Cost (LE)	Net Income (LE)
Winter												
Long Berseem	0.35	29.15	0.00	10.20	0.00	35.00	0.00	357	0	357	234	124
Short Berseem	0.30	7.83	0.00	2.35	0.00	35.00	0.00	82	0	82	49	33
Wheat	0.75	2.38	7.00	1.79	5.25	467.00	25.00	834	131	965	551	414
Broadbeen	0.10	1.23	6.00	0.12	0.60	677.00	15.00	83	9	92	56	36
Sub-total	1.50							1356	140	1496	890	607
Summer												
Cotton	0.30	0.85	8.50	0.26	2.55	1373.00	5.00	350	13	363	206	157
Maize	0.35	2.96	5.50	1.04	1.93	393.00	5.00	407	10	417	166	251
Sub-total	0.65							757	22	780	372	408
Nili												
Maize	0.30	2.11	5.50	0.63	1.65	393.00	5.00	249	8	257	145	112
Fodder	0.35	25.00	0.00	8.75	0.00	30.00	0.00	263	0	263	124	139
Potato	0.10	8.97	0.00	0.90	0.00	577.00	0.00	518	0	518	319	199
Sub-total	0.75							1029	8	1037	587	450
Sugarcane	0.10	46.19	0.00	4.62	0.00	50.00	0.00	231	0	231	119	112
Total	3.00							3373	171	3544	1968	1575

2. Income from Livestock(LE) 25% of Net Income from Crop 394
3. Total Net Income(LE) 1970

Table M-19 (3) Financial Analysis

Farm Model (without Project) Faiyum(2.45 fed/farm household)
Cropping intensity:178.9%

1. Crop Production

	Area (fed)	Yield Main Prod. (ton/fed)	Yield by-product (load/fed)	Production Main Product (ton)	Production by-product (load)	Unit Price Main Product (LE/ton)	Unit Price by-product (LE/load)	Value of Production(LE) Main Product	Value of Production(LE) by-product	Value of Production(LE) Total	Production Cost (LE)	Net Income (LE)
Winter												
Long Berseem	0.83	19.20	0.00	15.94	0.00	35.00	5.00	22	0	22	12	10
Short Berseem	0.40	5.00	0.00	2.00	0.00	35.00	5.00	22	0	22	15	7
Wheat	0.65	2.49	6.30	1.61	4.10	441.00	25.00	723	102	826	356	470
Broadbeen	0.30	1.31	5.50	0.39	1.65	645.00	15.00	253	25	278	141	137
Sub-total	2.18							1021	127	1148	525	623
Summer												
Cotton	0.50	0.77	7.00	0.39	3.50	1338.00	5.00	515	18	533	330	202
Maize	0.50	2.12	4.50	1.06	2.25	393.00	5.00	417	11	428	202	225
Sorghum	0.30	1.67	0.00	0.50	0.00	427.00	0.00	214	0	214	102	112
Watermelon	0.30	10.65	9.00	3.19	0.00	654.00	0.00	2086	0	2085	951	1135
Sub-total	1.60							3231	29	3260	1585	1675
Nili												
Maize	0.20	1.05	4.50	0.21	0.90	393.00	5.00	83	5	87	60	27
Tomato	0.20	15.15	0.00	3.03	0.00	256.00	0.00	776	0	776	538	237
Sub-total	0.40							858	5	863	599	264
Sugarcane	0.20	32.23	0.00	6.45	0.00	50.00	0.00	322	0	322	188	134
Total	4.38							5433	160	5593	2897	2696

2. Income from Livestock(LE) 20% of Net Income from Crop 539
3. Total Net Income(LE) 3236

Farm Model (with Project) Faiyum(2.45 fed/farm household)
Cropping intensity:194.8%

1. Crop Production

	Area (fed)	Yield Main Prod. (ton/fed)	Yield by-product (load/fed)	Production Main Product (ton)	Production by-product (load)	Unit Price Main Product (LE/ton)	Unit Price by-product (LE/load)	Value of Production(LE) Main Product	Value of Production(LE) by-product	Value of Production(LE) Total	Production Cost (LE)	Net Income (LE)
Winter												
Long Berseem	0.83	24.00	0.00	19.92	0.00	35.00	0.00	697	0	697	404	293
Short Berseem	0.20	6.25	0.00	1.25	0.00	35.00	0.00	44	0	44	31	13
Wheat	0.65	2.62	7.00	1.70	4.55	441.00	25.00	751	114	875	377	498
Broadbeen	0.59	1.50	6.00	0.89	3.54	645.00	15.00	571	53	624	317	307
Sub-total	2.27							2073	167	2240	1129	1111
Summer												
Cotton	0.50	1.01	8.50	0.51	4.25	1338.00	5.00	676	21	697	432	265
Maize	0.45	2.56	5.50	1.15	2.48	393.00	5.00	453	12	465	267	199
Sorghum	0.30	1.93	0.00	0.58	0.00	427.00	0.00	247	0	247	142	105
Fodder	0.20	25.00	0.00	5.00	0.00	30.00	0.00	150	0	150	86	64
Watermelon	0.30	11.22	0.00	3.37	0.00	654.00	0.00	2201	0	2201	1224	977
Sub-total	1.75							3727	34	3761	2151	1609
Nili												
Maize	0.20	1.17	1.00	0.23	0.20	393.00	5.00	92	1	93	63	29
Tomato	0.35	17.42	0.00	6.10	0.00	256.00	0.00	1561	0	1561	852	709
Sub-total	0.55							1653	1	1654	916	738
Sugarcane	0.20	35.00	0.00	7.00	0.00	50.00	0.00	350	0	350	239	111
Total	4.77							7803	201	8004	4435	3569

2. Income from Livestock(LE) 20% of Net Income from Crop 714
3. Total Net Income(LE) 4283

(Farm Income Analysis)

59. Farm income of with-project and without-project are analyzed as a financial analysis. As the result, farm income of the average farm household in governorate will be improved as follows:

Discription	Minia	Beni Suef	Faiyum	Giza
Averaged farm size (fed/farmhousehold)	1.38	1.58	2.45	1.43
Farm income (LE/farmhousehold/year)				
without project	1,470	1,760	3,240	4,740
with project	1,970	2,090	4,280	5,130

(Socio-economic Impact)

60. Not only tangible benefit, but also intangible benefit from the Project can be expected. They are improvement of living conditions, and correction of economic disparity in the region. Further, the Project will be a model for improvement of the water management through the rehabilitation and improvement of the major structures and on-farm facilities.

Moreover, water level of the Lake Qarun, where located at western part of the Project Area in Faiyum governorate, is extremely influenced by the water management of Bahr Yusef canal due to keeping the water level of the Lake by a balance of runoff into the Lake and evaporation from the Lake surface. Once the water level of the Lake rises by an unbalance of the above two factors, a wide area of lands and a lot of houses along the coast of the Lake will be inundated.

The following is the proposed indicators in the ranking of project components :

I. Indicators of the Existing Facilities

I. 1	Durability	- Level of deterioration - Appearance of damages by abrasion / crack
I. 2	Function	- Original function - Applicability to the recent requirement
I. 3	Operation	- Easiness of operation - Accuracy of operation
I. 4	Risk of failure	- Probability of risk - Influential range in socio-economy and agriculture

II. Indicators of the Beneficiary

II. 1	Command area	- Command area to be controlled - Command area to be influenced
II. 2	Water resources	- Increase/decrease of availability in summer / winter season
II. 3	Efficiency of water utilization	- Increase / decrease - Potentiality

III. Indicators of the Implementation

III. 1	Conveniency of the construction	- Scale of the construction - Easiness of the preparatory works - Availability of construction site
III. 2	Accessibility	- Construction site - Grade of the access road
III. 3	Right-of-way	- Easiness on acquisition - Consensus of villagers
III. 4	Impact	- Agriculture - Socio-economy - Environment

CHAPTER 7. DEVELOPMENT OF PRIORITY PROJECT

(Identification of Priority Components)

61. Rehabilitation and Improvement of Bahr Yusef Canal Project (RIPBY) comprises various project components with a large volume of works. Implementation of the Project is scheduled based on the identification of the project components in engineering and socio-economic priority. In developing the framework in the ranking of the project components for rehabilitation and improvement project prioritization, the following basic assumptions are made :

- Avoiding risks of failure on the existing facilities among the various project components is a primary concern durint he planning stage. Hence, priority in the implementation of the project components should be given to the existing facilities with high risk of failure.
- Planning is considered a magnitude of the command area controlled and influenced by the facilities concerned as a beneficiary from the project components due to the irrigation facilities.
- Conveniency in the construction site, access to the site, availability of acquisition of the Right-of-Way for construction and also impact to the agriculture, socio-economy and environmental aspects.

(Indicators of Project Components Ranking)

62. The following is the proposed indicators in the ranking of project components:

Indicators of the Existing Facilities :	- Durability - Function - Operation - Risk of failure
Indicators of the Beneficiary :	- Command area - Water resources - Efficiency of water
Indicators of the Implementation	- Conveniency of construction - Accessibility - Right-of-Way - Impact

The proposed methodology in ranking the project components would arrange the observed values of indicators from highest to lowest. Values given to each indicator are 5 points for highest rank, 3 points for middle rank, 1 point for lowest rank and 0 point for not concerned.

Table N-1-1 Priority Ranking of Project Components

CRITERIA / INDICATOR	(1) Improvement Canal Sect.	(2) Canal Impr. by Shortcut	(3) Dairout Barrage	(4) Manshat Regulator	(5) Da Sakoula Regulator	(6) Mazoura Regulator	(7) Lahoun Regulator	(8) Intake Hasan	(9) Intake Was. Giza	(10) Intake Large	(11) Intake Small	(12) Branch Canals	(13) Drain. PumpS.	(14) Irrig. PumpS.
A.Existing Facilities Suntotal	10	2	29	29	29	29	29	21	21	17	13	12	28	24
50%	5.00	1.00	14.50	14.50	14.50	14.50	14.50	10.50	10.50	8.50	6.50	6.00	14.00	12.00
1. Durability														
Level of deterioration	0	0	5	5	5	5	5	5	5	3	3	0	5	5
Damages by abraision	0	0	5	5	5	5	5	5	5	3	3	0	3	3
2. Function														
Original function	1	1	5	5	5	5	5	3	3	3	3	3	3	3
Modern function	1	1	0	0	0	0	0	0	0	0	0	1	1	1
3. Operation														
Easiness of operation	3	0	3	3	3	3	3	1	1	1	1	3	3	3
Accuracy of operation	3	0	1	1	1	1	1	1	1	1	1	3	3	3
4. Risk on failure														
Probability of risk	1	0	5	5	5	5	5	3	3	3	1	1	5	5
Influential range	1	0	5	5	5	5	5	3	3	3	1	1	5	5
B. Beneficiary Sub-total	2	2	6	4	6	4	10	6	6	2	2	2	1	1
25%	0.50	0.50	1.50	1.00	1.50	1.00	2.50	1.50	1.50	0.50	0.50	0.50	0.25	0.25
1. Command Area														
Controlled	1	1	1	1	3	1	5	3	3	1	1	1	3	3
Influenced	1	1	5	3	3	3	5	3	3	1	1	1	3	3
2. Water Resources														
Availability in Summer														
Availability in Winter														
3. Efficiency														
Increase / Decrease														
Potentiality														
C. Implementation Sub-total	21	21	29	41	41	41	41	35	35	27	27	23	41	41
25%	5.25	5.25	7.25	10.25	10.25	10.25	10.25	8.75	8.75	6.75	6.75	5.75	10.25	10.25
1. Conveniency of Constr.														
Easiness Preparatory W.	3	3	1	5	5	5	3	3	3	3	3	3	5	5
Availability Const.Site	3	3	1	5	5	5	3	3	3	3	3	3	5	5
2. Access														
Construction Site	3	3	5	3	3	3	5	5	5	3	3	3	5	5
Grade Access Road	1	1	5	3	3	3	5	5	5	3	3	3	5	5
3. Right-of-way														
Easiness on acquisition	3	3	1	5	5	5	5	5	5	5	5	3	5	5
Consensus of villager	3	3	1	5	5	5	5	5	5	5	5	3	5	5
4. Impact														
Agriculture	3	3	5	5	5	5	5	3	3	3	3	3	5	5
Socio-economy	1	1	5	5	5	5	5	3	3	1	1	1	3	3
Environment	1	1	5	5	5	5	5	3	3	1	1	1	3	3
TOTAL OF WEIGHTED VALUES	10.75	6.75	23.25	25.75	28.25	25.75	27.25	20.75	20.75	15.75	13.75	12.25	25.75	23.75
GROUPED CLASSIFICATION	D	D	A	A	A	A	A	B	B	B	C	C	A	A

(Ranking of Project Components)

63. The observed values for the project formulation are finally grouped into four class intervals ; namely A, B, C and D. The priority of the project components is determined taking into consideration such other conditions as administrative and regional matters and financial availability. According to the results of the ranking the project components in respect of formulation of the implementation programme for the project, five barrage/regulators are placed in the high rank of Class-A, followed by drainage and irrigation pump stations. All major facilities of the project components are ranked as Class-A. Both large and small scale intake structures are placed in Class-B, while improvement and trimming of the canal sections and straightening the canal course are placed in rather low rank of Classes C and D, respectively;

Class-ranked	Project Components	Ranking Rate
A-ranked Group	Lahoun Regulator	27.25
	Sakoula Regulator	26.25
	Manshat El Dahab Regulator	25.75
	Mazoura Regulator	25.75
	Drainage Pump Station	25.75
	Irrigation Pump Station	23.75
	Dairout Barrage	23.25
B-ranked Group	Hasan Wasef Intake	20.75
	Giza Intake	20.75
	Larg Scale Intakes	15.75
C-ranked Group	Small Scale Intakes (Width > 1.5 m)	13.75
	Branch Canal	12.25
D-ranked Group	Improvement of Canal Sections	10.75
	Improvement of Canal by Shortcut	6.75

(Implementation Programme of Priority Components)

64. The implementation programme of the Project are scheduled based on the ranking rate of the project components. Lahoun regulator together with intake structures of Hassan Wasef and Giza are to be implemented in the first half of the Phase-I Project. The Sakoula regulator and the related structures ranked as second priority in Class-A is to be implemented in the second half of the Phase-I Project.

Table N-2 Priority Project Components

Components of Preparatory Works for Construction	Unit	Q'ty
1. Preparatory Works for Construction		
1.1 Procurement of Construction Equipment		
Bulldozer, 23 ton class	unit	2
Backhoe Excavator, Crawler 1.2 m³	unit	2
Dragline, w/ Bucket 1.5m³ , 55 ton class	unit	2
Crawler Crane , 45 ton class	unit	2
Truck Crane , 18 ton class	unit	2
Vibrohummer, 80 KW	unit	2
Water Jet Cutter, 45 KW	unit	2
Diesel Generator, 200 KVA	unit	2
Welder	unit	2
Gas Cutter	unit	2
Spare Parts & Others		LS
1.2 Procurement of Construction Materials		
Steel Sheet pile III-Type 12 m	pcs	500
Steel Sheet Pile IV-Type 12 m	pcs	200
H-Shape Steel H-300 X 300 X 10 X 15, 12 m	pcs	80
H-Shape Steel H-350 X 350 X 12 X 19, 12 m	pcs	150
H-Shape Steel H-400 X 400 X 12 X 21, 12 m	pcs	30
Channel Steel C-200 X 90 X 8 X 13.5, 12 m	pcs	20
L Steel L-100 X 100 X 10, 12 m	pcs	50
Steel Foot Plate 2.00 m X 1.00 m	pcs	100
Steel Foot Plate 3.00 m X 1.00 m	pcs	100
Steel Sheet Pile Driving Cap	pcs	20
Steel Stagings	m³	500
Tie-rod ϕ 55 X 10 m	pcs	200
Others		

Components of Civil Works	Unit	2. Lahoun Reg. Q'ty	3.Hassan II Int Q'ty	4. Giza Int Q'ty
(1) Civil Works				
Excavation	m³	48,000	10,000	10,000
Excavation for struct	m³	3,200	500	500
Filling canal	m³	2,000	-	-
Apron & pier concrete	m³	2,800	1,500	2,000
Concrete block riprap	m²	2,000	300	350
Revetment of stone	m²	3,000	800	900
Demolition of structur	m³	800	1,300	1,400
Access roads	Km	2	1	1
Miscellaneous Works		LS	LS	LS
Other works & Mobili.		LS	LS	LS
(2) Gates				
Gate leaves		Rack Wheel Type 5.5m X 3.15m 2 leaves 2 sets	Rack Wheel Type 4.0m X 2.65m 2 leaves 3 sets	Rack Wheel Type 4.0m X 2.4m 2 leaves 4 sets
Appurtenant works		LS	LS	LS
(3) Others				
Engineering & Administ		LS	LS	LS
Technical assistance		LS	LS	LS
Physical contingency		LS	LS	LS

(Project Components of Priority Project)

65. The project components to be implemented in the first half of the Phase-I project as a top priority are as follows:

I. Preparatory Works for Construction of Major Facilities

I.1	Construction Equipment	:	Bulldozer, Shovel, Crawler Crane, Vibro Hummer, Diesel Generator, others
I.2	Construction Materials	:	Steel Sheet Pile, H-Shape Steel, Channel Steel, Sheet Pile Cap, Tie-Rod, Steel Foot Plate, Steel Stage, others

II. Construction of Canal Structures

II.1	Lahoun Regulator	:	Intake	:	Vent 5.50 m × 2
			Gate	:	Double Wheel Gate 5.50 m × 3.15 m × 2, 2 sets
			Accessory	:	Screen, Handrail, others
			Detour	:	Bridge 30 m length 8 m width Access road 150 m
II.2	Giza Intake	:	Intake	:	Vent 4.00 m × 4
			Gate	:	Double Wheel Gate 4.00 m × 2.40 m × 2, 4 sets
			Accessory	:	Screen, others
II.3	Hassan Wasef Intake	:	Intake	:	Vent 4.00 m × 3
			Gate	:	Double Wheel Gate 4.00 m × 2.65 m × 2, 4 sets
			Accessory	:	Screen, others

CONCLUSION

1. Achievement of optimum crop production by improvement of the overall irrigation efficiency is a primary objectives under the Agricultural Program of the Egypt's Five-Year Plan. Agricultural sector is the major sector under the Plan, supplying foods, providing employment opportunity of 36 percent of the labour force, and contributing foreign exchange earnings through exports of agricultural production. Agriculture in Egypt depends upon irrigation through the limited water resources of Lake Nasser, which is now seriously affected by the prolonged Sahalian drought. Therefore, improvement of this situation should be given priority.

   MPWWR desires to accelerate the execution of the rehabilitation and improvement project of the country by seeking engineering and financial cooperation from international agencies and developed countries on a bilateral basis.

   Toward this end, Bahr Yusef canal is important source of irrigation. It covers about 13 percent of the whole agricultural lands in Egypt. Based on the Study, this rehabilitation and improvement project of Bahr Yusef canal is to be technically sound, economically viable and socially acceptable.

2. Bahr Yusef canal is a meandering, flat and unlined earth canal forming like a natural river. The major facilities along the canal are already deteriorated and outdated, with age 90 years since its construction. Low irrigation efficiency exist in the canal due to superannuated structures of the said facilities. Therefore, such major facilities as barrage/regulators and intakes of the branch canals should be reconstructed and pump equipment of the drainage and irrigation pump should be replaced stations in order to conduct a modernized water distribution and management and thus increase the irrigation efficiency in the irrigation system.

3. An executing agency of the Project will be MPWWR. The implementation of the Project shall be conducted into three phases for a period of four years each. In the first half of the Phase-I project, a large-scale construction equipment and materials shall be procured and utilized for the construction of all major structures on rotational basis. During the construction of the major structures, the irrigation system shall not be allowed to stop the operation, therefore it is needed to provide particular construction equipment and materials.

4. In conclusion, the proposed major components of the Project are as follows :

MAJOR PROJECT COMPONENTS

Description	Unit	Total	Phase-I	Phase-II	Phase-III
1. Improvement of Bahr Yusef Canal					
1.1 Remodelling & Trimming of Canal					
Improvement of Canal Sections	km	311.0	70.0	140.0	101.0
Improvement of Canal Course	km	4.8	-	-	4.8
1.2 Improvement of Barrage/Regulators					
Preparatory Works for Construction		LS	LS	-	-
Dairout Barrage	place	1	-	-	1
Manshat El Dahab Regulator	place	1	-	1	-
Sakoula Regulator	place	1	1	-	-
Mazoura Regulator	place	1	-	1	-
Lahoun Regulator	place	1	1	-	-
1.3 Improvement of Canal Structures					
Intake of Manshat El Dahab B.C.	place	1	-	1	-
Intake of Harika Branch Canal (B.C.)	place	1	1	-	-
Intake of Saab B.C.	place	1	1	-	-
Intake of Hassan Wasef B.C.	place	1	1	-	-
Intake of Giza B.C.	place	1	1	-	-
Large Scale Intake (3.m vent)	place	3	2	1	-
Median Scale Intake (2.5 m vent)	place	3	-	3	-
Median Scale Intake (2.0 m vent)	place	5	-	1	4
Small Scale Intake (1.5 m vent)	place	8	1	1	6
Small Scale Intake (1.2 m below)	place	21	7	6	8
2. Improvement of Branch Canals					
Branch Canals Command Area	1,000fed	670	200	200	270
3. Improvement of Pump Station					
3.1 Drainage Pump Station (D.P.S.)					
El Badraman D.P.S.	place	1	1	-	-
Other 8 D.P.S.	place	8	-	4	4
3.2 Irrigation Pump Station (I.P.S.)					
Arab Beni Khalid I.P.S.	place	1	1	-	-
Beni Khalid I.P.S.	place	1	1	-	-
Kamadir I.P.S.	place	1	-	1	-
Terfa I.P.S.	place	1	-	1	-
Sakoula I.P.S.	place	1	-	-	1
Mazoura I.P.S.	place	1	-	-	1

Description	Unit	Total	Phase-I	Phase-II	Phase-III
4. Operation and Maintenance of Bahr Yusef Canal					
4.1 Operation and Maintenance Facilities					
Hydraulic Observation Facilities	place	68	21	27	20
Communication Data Processing	place	61	18	25	18
4.2 Enhancement of Operation and Maintenance		LS	LS	-	-
4.3 Water Management		LS	LS	LS	LS
4.4 Training & Education		LS	LS	LS	LS
5. Project Cost					
Phase-I Project	274,500,000 LE				
Phase-II Project	291,500,000 LE				
Phase-III Project	284,300,000 LE				
Total Cost	850,100,000 LE				

RECOMMENDATION

1. Establishment of the Rehabilitation and Improvement Project of Bahr Yusef canal (RIPBY) headed by General Director (GD) under the administration of MPWWR Headquarters is a significant strategy for the successful implementation of the Project in taking into consideration the large volume of the construction works and wide command area spread over the four governorates of Minia, Beni Suef, Faiyum and Giza.

2. It is recommended to provide a training and education to the farmers in the Bahr Yusef canal command area during the early stage of the Project implementation. It shall be noted that proper water management at the on-farm level in cooperation with the field staff of MPWWR is a key to utilize the limited water resources effectively for the realization of the desired crop production, and in this case, the water management shall be conducted by the Water User's Association (WUA) to be organized among the farmers concerned on the basis of the rotational irrigation system. Whilist the IIP, which is under the MPWWR covers the activities of the on-farm water management including establishment and operation of the WUA in the IIP area. These activities shall also be applied for the RIPBY.

3. In carrying out the final design of the major structures such as barrage/regulator, large scale intake structure, etc., geological investigation on its foundation shall be conducted by boring and laboratory soil test to ensure a strong structural foundation.

4. During the implementation of the Project, training and education on the operation and maintenance of the modernized facilities shall be provided to the staff of MPWWR.

ANNEX

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