1.4 Present Condition of Agriculture

1.4.1 Land Holding and Farm Size

The land holding of farm household can be distinguished as fully-owned, partially owned & tenant, and full-tenant. There are two kinds of tenant. One is those who pay the land rent by cash and the other is by share cropping where the tenant share certain amount of product with land owner without renting land but offering free labor. The owners are registered with agricultural cooperatives. The full-tenants are not under the administration of the agricultural cooperatives, especially with the promulgation of the revised Agrarian Reform Act which provided for five (5) years buffer periods in 1992.

The number of farm households in the Priority Area is 24,790 and regionally 9,210 in Hamoul district, 12,090 in Biyala district, 2,510 and 980 in Talkha district. The average farm size for a farm household is calculated at 2.1 feddan. The number of farm household with more than 2.0 feddan of farm land is 15,380 which occupies 62 % of total farm households and 29 % of the total farming land in the Priority Area. The owners who hold over 10 feddan farm land are only 366 (1.5 % of the total owners) in the Priority Area and occupy 6,112 feddan (12 % of the total farm land) in the Priority Area. The small-scale farmers are renting lands, working on non-farm jobs or sometimes leasing their small land and fully attending non-farm jobs. (Refer to Appendix L3, Table L.3.1)

1.4.2 Population and labor force of farm household

The population of farm households is estimated at 128,500 and the labor force population (from 15 to 60 years old) is estimated at 73,800. The number of labor force per farm household is calculated at 3.2 persons. According to the result of the farm economy survey, 2.7 persons (84% of labor force in a family) are actually working on agriculture and two-third of them is supplied by men. Priority of work for women is firstly looking after children and housekeeping and secondly livestock breeding and farming labor. (Refer to Appendix L2, Table L.2.1 and Table L.2.6)

1.4.3 Land Use and Cropping Pattern

(1) Land Use

The Priority Area is divided into the following three areas, namely upstream midstream and downstream areas according to the locations of canals (refer to Table 2.4.1.2);

- Upstream area (southern part of the Biyala-Hamoul national road)

Because this are is located in the upstream on the Bahr Tera irrigation system, there is no severe water shortage in this area. Orchard area occupy only about one percent of the total cultivated area. while the remaining 99 % of the area are cropped with annual crops. Rice is grown with the cropping intensity of 60 %. As there are rather larger area which have less heavy textured soils to compare with the lower areas, vegetable cultivation is most popular in Priority Area.

- Midstream area (between the Biyala-Hamoul national roads and the district boundary)

This area have the favorable irrigation condition next to the above area in the upstream areas of canals, where rice area cover 58 % of the total cultivated area.. The area coverage of orchard is less than one percent. In the head portion of the delivery canals or just adjacent area of canals a considerable number of farmers grow vegetables. More than 15 farmers of the vegetable farmers are engaged in green house cultivation. The green house farming to grow cucumber as a main crop is rapidly expanded recently in the midstream..

- Downstream area (northern part of the district boundary)

Most of the land have been reclaimed from swampy land recently, where a large area have saline soils with heavy texture and relatively high water table. There is little area of fruit trees and vegetables. Rice has the cropping intensity of 45 %, which is the smallest in Priority Area. by the distribution of saline and alkaline soils with very heavy clayey soil texture.

It is observed that the "Estakoza(Procambarus clarkii and P. zonangulus)" is invading widely in Priority Area, causing the water leakage from the field to canals. One of the most effective measures to control the habitation is the lining of canals or installment of pipeline based on the experience in Japan. Such measure is the lining of canals or installment of pipeline according to the experience in Japan.

(2) Crops and Cropping Pattern

The annual cropping intensity is estimated at 200 %, each 100 % for winter and summer/ Nile season respectively. The major crops are wheat, long and short term berseems, and broad bean during the winter ,and cotton, maize and rice during the summer/Nile throughout. Rice is formally grown once in every three yeas under the three- year crop rotation, while cotton or maize is grown in the other years in summer season with cropping of wheat and berseem. However the cropping intensity of rice is respectively as large as 60 %, 58 % and

45 % in the upstream, the midstream and the downstream. This means rice is grown for two year in every three years. These high intensity of rice is one of the reason for the severe water shortage in the downstream during summer season. (refer to Figure 1.4.1, appendix E Tables E. 1.2.12)

Rice area in Kafr El Sheikh Governorate exceeded the permitted area by seven percent in 1996/97. The cropping area of most agricultural cooperatives have been increased further in Priority Area. 93 % of sample farmers grow rice for home consumption as the first reason. The second and third reasons are the profitability(about 50 % of sample farmers) and the effect on leaching out the salts from the soils (about 39 % of sample farmers). (refer to Appendix E Figure E.1.1)

There are other crops like sugar beet and flax. The area of sugar beet increase as it goes from the upstream to the downstream. The seed water melon is widely grown with the cropping intensity of 10 %, 21 and 14 %, respectively in the upstream, the midstream and the downstream, which is the highest in the midstream. The cropping intensities are almost double of maize areas in the three areas. This is a short duration cash crop, adopting to the heavy clayey soil. There are other crop including potato, onion, carrot, tomato and cabbages. However the cropping area of vegetables are less than three percent in the midstream and the downstream. The most probable reasons why vegetables are grown in the limited area may be because of the prevalent saline soils in these areas. Onion is grown in a limited area in Priority Area, although many farmers grow it in similar soil area in the master plan study area.

1.4.4 Farm Input and Crop Production

(1) Farm Input

According to the estimated farm input including fertilizer, chemicals, labor, draft animal and farm machinery use, the nitrogen fertilizer input per feddan for wheat and rice is respectively 75 kg (179 kg/ha) and 65 kg (155 kg/ha). These amounts are in the same level to the standard of fertilizer input for Nile delta area, prepared by MALR.(refer to Appendix E Table E.2.15)

(2) Crop Yield and Production

The crop unit yield are lower in the down stream area, as compared to those in the upstream and midstream areas. The statistical data based on the crop cutting in Biyala and El Hamoul districts show significantly smaller yield in El Hamoul district by five to 25 % for rice, maize, wheat, sugar beet. The crop unit yield in the upstream, the midstream and the downstream are estimated based on the said statistical data and the result of the Farm Economy Survey. The average unit yield per feddan for the major crops of wheat, sugarbeet, berseem, cotton and rice are respectively estimated at 15.60 ardab(5.57 ton/ha),16.95ton(40.36 ton/ha), 16.63ton(39.63ton/ha), 5.40 kantar(2.02ton/ha) and 3.14ton(7.48 ton/ha). The total crop production in Priority Area is estimated respectively at 48,300ton of wheat, 88,300 ton of sugarbeet, 414,500ton of berseem, 9,600 of cotton and 93,800 ton of rice (paddy). The crop yields in the upstream and the midstream are almost same level of the national average (refer to Table 1.4.1 and Appendix E Tables E.3.4)

(3) Land and Water Conditions at On-farm Level

10 % to 60 % of sample farmers in different delivery canal areas Farm Economy Survey have intention to grow potato and other vegetables with IIP. However the sample farmers in Foda and Shorafa delivery canal areas have no intention to grow vegetables, where they have the problems on the function of subsurface canals. There is a need of development or rehabilitation of subsurface drainage systems in the problem areas and in the area without the subsurface drainage system in Priority Area to introduce vegetables. (Refer to Appendix E Figure E.5.1)

62 % of the sample farmers require the operation of land leveling by laser beam ,while 37 % and 27 % of sample farmers need gypsum application and subsoiling. Moreover 42 % of the sample farmers want to have development or rehabilitation of subsurface drainage system.

1.4.5 Animal Husbandry

Average farmer raise two or three heads of water buffaloes and cows, which are mostly female. These buffaloes and cows afford to bear baby buffalo and calf almost yearly. Farmers sell fattened buffaloes and cattle. Most farmers also raise a donkey, several number of chickens and ducks .The main sources of their feed are berseem and maize fodder. Berseem covers more than 40 % of cropping intensity in Priority Area. Aside of these fodder, the byproducts of wheat and rice straw are other sources of feed. A buffalo or cow need 6 kirot (0.25 feddan, 0.1 ha) of fodder. (refer to Appendix E Table E.4.3)

1.4.6 Agricultural Supporting Services

(1) Farmers Organization on Water Management

With little data on water management like irrigation area by crop, irrigation water is distributed to the farmers by MAWWR. There are many farmers who have the problems of untimely and inadequate irrigation water in the tail portions. Under these condition there is a need to collect and renew these data to improve water management.

(2) Support by Ministry of Agriculture and Land Reclamation on Irrigation and Drainage

Ministry of Agriculture and Land Reclamation (MALR) has created the organization of " Land and Water Directorate " to have intermediary services between farmers and MAWWR for the quick solution on the problems regarding to the maintenance and operation of irrigation and drainage systems. The directorate in Gharbia MALR has held regular meeting every week between MALR and the MPWWR at district level for past four (4) years and also among the undersecretaries of the two agencies for the past two (2) years. As a general farmers pay the cost to repair the irrigation and drainage facilities at Meska level. The cost sharing among the farmers and MPWWR is decided by the directorate of Land and Water. The amount of the loan will be released by the village banks with the decided cost by the directorate.

(3) Agricultural Extension

MALR is going to establish an agricultural extension center for strengthening the activities in both districts of Biyala and El Hamoul. However, there is only one agricultural extension office with about 15 staff in each district. An agricultural cooperative is generally serving farmers with about 15 staff for various activities including preparation of crop rotation plan, arrangement of farm input supply. Both staff of agricultural extension office and agricultural cooperatives have little chance to have training on water management at farmers level.

1.4.7 Marketing and Agro-processing

(1) Marketing

According to the result of farm economy survey, about 40 % of grains such as rice, wheat and maize are consumed by farmers while the 30 to 40 % are sold to middlemen. The remaining percentage are directly sold by farmers to the village market or milling factories. Cotton and sugar beet are purchased by village banks and sugar factory, respectively. 80 % of berseem are consumed by farmers while the remaining 20% are traded between farmers. Vegetables and fruits are sold in the village markets. The farmers who grow large amount of vegetables sell to middlemen or large-scale farmers who bring the products mainly to Tanta wholesale market. In Tanta wholesale market, the total of supply of vegetables in 1997/98 is 72,000 ton (197 ton per day) about half of which are tomatoes and 30 % are potatoes. Sweet potatoes, eggplants, peppers, marrow, carrots, cucumbers, garlic, and watermelons, etc. are traded in the market. Onions are collected at the sites along the main roads and preserved from three (3) to five (5) months covering with rice straw and sold to middlemen who in turn sell the product to the local, central and foreign markets. (Refer to appendix E, Table E.6.3)

(2) Agro-processing

Large-scale agro-processing facilities in the Priority Area are mainly located in Kafr El Sheikh. There are two (2) large-scale rice mills with the capacities of 50 and 150 tons per day. The mills have color sorting system to grade rice for export. There are three (3) cotton ginning factories. One of the factories have been privatized in 1996 and has a capacity of 200,000 kantar per year, with 75 permanent employees and 75 temporary employees. There is a large-scale sugar factory with the capacity of 250,000 tons per year (1.8 million tons as sugar beet) and with 1,500 employees. At present, 1.2 million tons of the materials are obtained on contract basis by sugar beet growers.

Other factories available in the Priority area are private small-scale vegetable oil extraction factories, factories for oil extraction of aromatic plants, daily foods processing factories, flour mills for mixture of wheat and maize, fodder factories and rice mills (about two (2) tons/day).

1.4.8 Agricultural Credit

The village bank was established in 1976 as the branch of PBDAC. There are seven (7) village banks whose jurisdictions cover the Priority Area. Regionally, there are five (5) in Kafr El Sheikh (Biyala, Abshan, Abu Badawe, Hamoul, and Kafr El Shariki) and one (1) each in Gharbia and Dakhalia (Bashbeesh and Dreen).

The number of loans in 1997/98 are 31,000 for agricultural investment loan, 36,000 for short term investment loan, and 10,000 for medium term investment loan. The amount of loan obtained are 46,857 thousand LE (1,509 LE per capita), 65,700 thousand LE (1,846 LE per capita), and 26,230 thousand LE (2,549 LE per capita), respectively. The amount of loans for short and medium term investment loan has been increasing in recent three (3) years in contrast to the fluctuating agricultural investment loan. In terms of purpose, the loan for livestock (animal wealth) investment has the biggest share about 80 % for short term and 54 % for medium term investment loan. The number of long term investment loan is only nine (9) in the last three (3) years since the average amount of the loan per capita is as high as 18,000 LE. (Refer to Appendix E.6, Table E.6.2)

According to the results of the detailed farm economy survey in the Priority Area, 19 farm households out of 26 surveyed have been borrowing from the village banks. Their loans amount varies from 400 LE to 10,000 LE. The purposes for the loan are mainly for fertilizers, seeds and livestock. There are three (3) households who borrow more than two (2) items. The village bank is considerably involved in farm management in the Priority Area.

1.4.9 Farm Economy

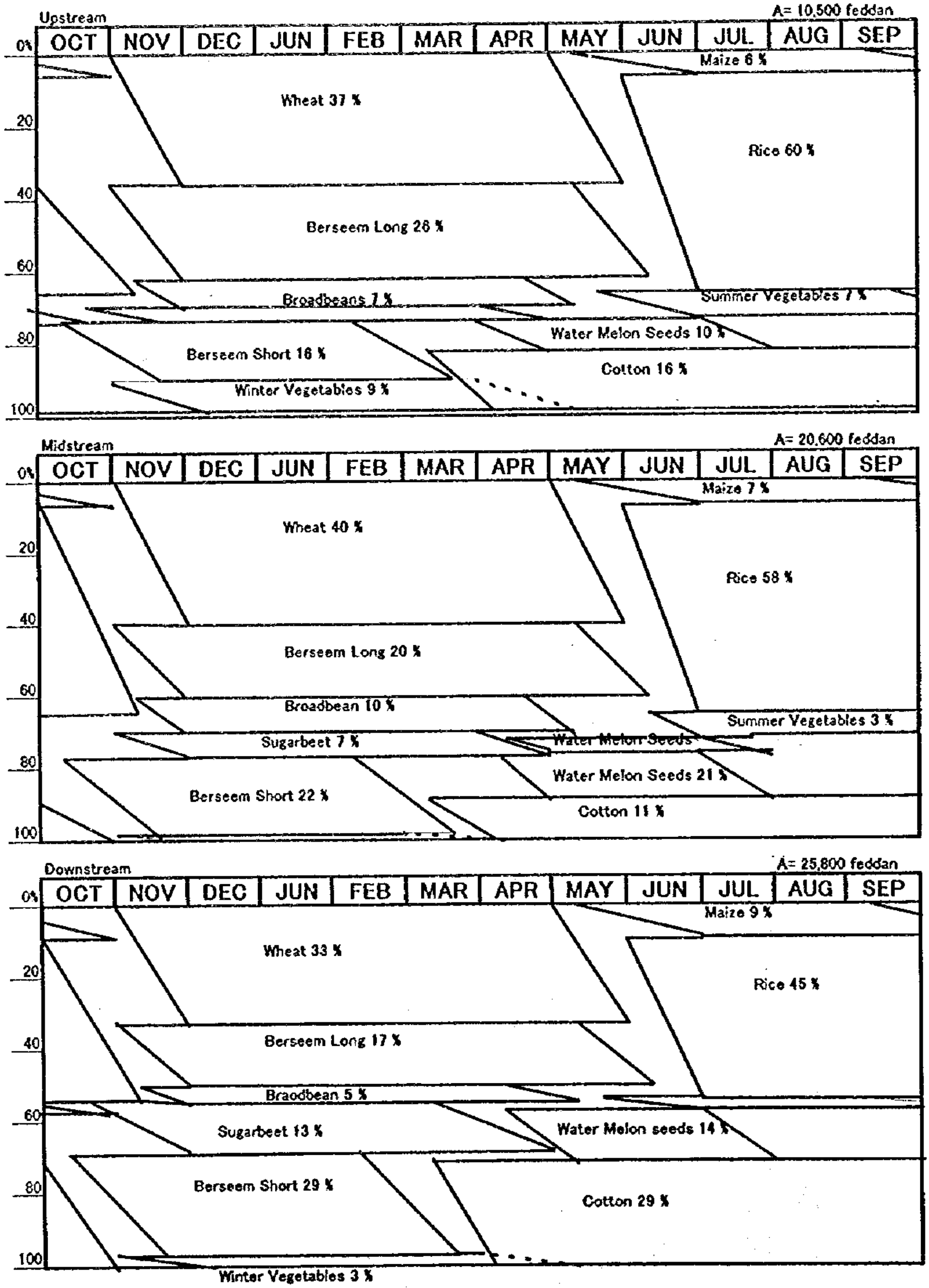
According to the farm economy survey which was executed to 130 sample farm households, gross return and farm income for the average farm size (2.1 feddan) in the Priority Area is estimated at 7,260 LE and 3,890 LE, respectively. Farm income per feddan is calculated at 1,850 LE/feddan. Since it is difficult for average farm size household to earn a living with this farm budget, farmers are required to work on other farm or non-farm jobs. Among the sample farmers, 15 farm households (19 % of the sample) have family members who are working on other farm. On average 0.5 person per household with 63 days working on other farm would earn about 500 LE per year. Also 67 farm households (58 % of the sample) have non-farm income. It ranges from 400 to 16,600 LE and the average non-farm income per household is about 2,000 LE. (Refer to Appendix L2, Table L.2.4)

Table 1.4.1 Present Crop Unit Yield (F/S Area)

Crop	Unit	kg per unit	Upstream		Midstream		Downstream	
			Per feddan	Ton per ha	Per feddan	Ton per ha	Per feddan	Ton per ha
Winter Crops								
- Wheat	Ardab	150.0	16.53	5.90	16.53	5.90	14.33	5.12
- Broadbean	Ardab	155.0	8.48	3.13	8.48	3.13	7.81	2.88
- Sugarbeet	ton	1,000.0	18.83	44.83	18.83	44.83	15.91	43.74
- Vegetables(Onion)	ton	1,000.0	8.78	20.90	8.78	20.90	5.22	12.43
- Berseem(Long Term)	ton	1,000.0	22.06	52.52	22.06	52.52	18.38	43.76
- Berseem(Short Term)	ton	1,000.0	14.69	34.98	14.69	34.98	12.24	29.14
Summer crops								
-Cotton	Kantar	157.5	5.39	2.02	5.39	2.02	5.51	2.07
- Maize	Ardab	140.0	17.85	5.95	17.85	5.95	16.05	5.35
- Rice	ton	1,000.0	3.20	7.62	3.20	7.62	3.05	7.26
- Water Melon Seeds	ton	1,000.0	0.35	0.83	0.35	0.83	0.30	0.71
- Vegetables(Tomato)	ton	1,000.0	10.54	25.10	10.54	25.10	9.86	23.48
Fruit trees(Orange)	ton	1,000.0	8.93	21.26	-	-	-	-

Source: MALR,DOS

Figure 1.4.1 Present Cropping Pattern(F/S Area)



1.5 Irrigation and Drainage Condition

1.5.1 Water Availability for the Priority Area

The water balance study, between water supply and crop consumption including losses, will be carried out over whole Bahr Tera command area since the outflow from the Priority area into the downstream of Bahr Tera is not known, making it difficult to estimate the water available only for the Priority Area.

The available water for the Bahr Tera command area will remain the same as the previously delivered. The discharge at Bahr Tera intake and the mixing volume by Hamoul MPS are known, and the last five years' average will be undertaken as the available water source. The annual average discharge at Bahr Tera intake is 830MCM and the Hamoul MPS's one is 321 MCM. Municipality usage is 17 MCM and this has to be subtracted for estimating the available for irrigation. Therefore the annual average is to be 1,133 MCM.

1.5.2 Canal Features and Area Served

The Priority Area is composed of whole Biyala and a part of Hamoul Water Districts, both of which fall in Biyala Irrigation Inspection under Kafr El Sheikh Irrigation Directorate. The main canal is Bahr Tera. The canal's total length is 63.7 km, of which 35.5 km is in the Priority Area. The service area in the Priority Area is 56,930 feddan (The total Bahr Tera command area is 163,665 feddan).

There are 29 delivery canals being operated under rotational irrigation. Of the 29 delivery canals, 8 canals are categorized in 2nd delivery branching from such 1st deliveries as Bahr Biyala, Abshan and El Banawan El Asfal. Also, 10 deliveries are Ganabias which run in parallel to the main canal of Bahr Tera. The area served by delivery ranges between 300 and 5,470 feddan (130 ha and 2,300 ha) with the average of 1,700 feddan (720 ha). The length of delivery varies from 0.5 to 17.4 km with the average of 4.85 km. (Refer to Figure 1.5.1 and Table 1.5.1)

1.5.3 Irrigation Practice

Rotational irrigation for delivery canal level is practiced in such way of; 4 days-on and 8 days-off during winter and 5 days-on and 5 days-off during summer with one month period of 7 days-on and 7 days-off for cotton. For the winter rotation, the delivery canals for Bahr Tera are divided into three groups in such areas as Biyala, Hamoul& Baltcem and Monsour districts. Summer rotation system divides the all delivery canals into two groups such as Biyala & Monsour districts and Hamoul & Balteem districts. Abshan regulator located at 17.6 km at Bahr Tera plays the role to divide the deliveries within the Priority Area for the rotation.

Farmers take irrigation water from Meska or from delivery canal, and the means to lift up the water onto Marwa (field ditch) or their field is Sakia and pump both operated by diesel engine. Common capacity of diesel engine pump is about 20 lit/sec (4 inch pump), while Sakia's capacity depends on the diameter ranging 3m to as big as 5m with the capacity of 40 to 90 lit/sec. The on-farm irrigation practiced is either basin or furrow, both of which fall in the category of surface irrigation with a few exceptions. There are about 20 farmers in El Agamy and Bahr El Nour irrigation areas, who practice drip irrigation.

1.5.4 Present Condition of Meska

Meska information is partly available in relevant irrigation offices and agricultural cooperatives. However it is very difficult to have the accurate information since Meska is not undertaken by the Government. A survey had been carried out during the Phase II study in collaboration with IAS field agents, inquiring length, area served, water shortage, night irrigation, tail conditions and spillage, and so on for all Meskas in the Priority Area.

There are total of 194 Meska (tentative as of preparation of this Report), and the total area served is 27,060 feddan which occupies 48 % of the whole irrigation area of 56,930 feddan. The remaining area, about half the whole area, is served by direct irrigation practiced either legally or illegally. The area served by Meska varies widely between as small as 15 feddan and as large as 1,000 feddan. The average area per Meska is worked out at 139 feddan (58 ha). Summing up the length of the 194 Meska, a total of 246 km is worked out, giving an average length per Meska of 1.3 km.

Meska is supposed to be equipped with gate at the intake. However, since rotational irrigation is controlled at delivery canal level, no need is arisen to control the discharge into Meska. With this situation, only 34 Meska (18%) have operational gate at those intakes, while others have only pipes taking water from the delivery canal.

Meska maintenance is carried out by either manually or dredger or both. Of the total 194 Meska, farmers reported that 30 Meskas (15%) had been maintained manually. However the maintenance work has not been regularly carried out and has not engaged all farmers concerned. Thus, the maintenance level remains somewhat poor. On the other hand, 152 Meska (78%) were reported to have been regularly maintained by dredger (small excavator). The dredger is owned by agricultural cooperative to which farmers belong. Farmers request the cooperative of maintaining the Meska at their cost, mostly rehabilitating some parts and taking out weeds. The maintenance by dredger is usually carried out once a year.

1.5.5 Tail Condition and Waste Spillage for Delivery Canals

Waste spillage may occur from tails of either delivery canal, Meska or both. The tail condition has been observed in field and information for waste spillage has been gathered from relevant water district engineers, irrigation inspectors as well as farmers farming at around the tail. The tails of the 29 deliveries are categorized as below;

Condition of Tail End;	No. of Canal	Ratio (%)
Feeder (connected to downstream canal);	15	52
Aqueduct (connected with another canal);	2	7
Stop;	4	14
Tail escape (flowing into drain if excess water);	4	14
Gate (connected to drain);	4	14

There are 15 deliveries, tails of which carry excessive water, if any, to another canal located downstream, thus play a role of feeder. There are 2 tails connecting with another canal by means of aqueduct. Those are Hazek and El Banawan El Asfal. The former is connected with Marzouk canal and the latter with El Eslah canal under West Dakahlia Irrigation Directorate. These 17 canals, about 60 % of total 29 deliveries, give no waste spillage.

Four (4) tails are just stopped and no over-spillage has been reported so far and observed during Phase 2 study between October and December in 1998. Four deliveries have tail escapes that are small emergency spillway. The relevant irrigation engineers have reported almost no spillage, and the farmers around the tail reported some spillage but very rare.

There are 4 deliveries, tails of which are equipped with gate and connected to an open drain. Of them, Ragheb Basha can take drainage water when water level in the canal is lower than that in the drain. This canal was reported no waste spillage into drain, rather taking drainage water when water shortage prevailed. For the remaining 3 tails, no noticeable waste spillage has been reported because of water shortages often prevailing, but some leakage coming through the gate has been observed during Phase II filed survey. The leakage at Zobaa was negligible, at El Shorafa was just 1 to 2 l/s, and at Banawan Branch was 10 to 15 l/s.

Taking into the above information and observation, it is concluded that there is no noticeable waste spillage but just minor leakage for delivery canals under the responsibility of the Government. The leakage from the tail of Banawan Branch may be a certain amount (about 1,300cum/day) because the gate is dilapidated and cannot be properly closed. Replacement of the gate is required.

1.5.6 Tail Condition and Waste Spillage for Meska

The tail condition for the total 194 Meskas (tentative number) is categorized as below (See Table 1.5.2, Figures 1.5.2 & 1.5.3);

Conditions		Number	Ratio(%)
Stop:		129	66
Open:		29	15
	Connected to another canal/Meska	25	13
	Connected to drain	4	2
Pipe/Aqueduct		36	19
	Connected to another canal/Meska	17	9
	Connected to drain	19	10

The tails of 129 Meskas, 66% of the total, are just dead end and no protection like stone pitching is done. According to the inquiry to the farmers around, no Meska and 3 Meskas have been reported to have had waste spillage due to overflowing during summer and winter respectively. The spillages are not so big but just 1 to 2 times per week mostly and in some cases 3 to 4 times per week. Farmers reported that if the water level was coming up and about to overflow they usually made small ridge in order to avoid the overflowing.

Twenty nine Meskas' tails (15%) are just opened and equipped with neither gate nor aqueduct. Of them, 25 tails (15%) are connected to another canal or Meska located downstream, thus no waste spillage occurs. This kind of Meska behaves as a feeder when excess water is flowing. There are 4 Meskas (2%), tails of which are just opened and connected to drain. These tails are mostly intentionally left opened in order to take water from the drain when the water level in the Meska is low and suffering from water shortage. There are occasions that water go to drain, leading to waste spillage, but this case does not consists of the majority. Of the 4 tails, only one tail was reported to have had waste spillage always.

There are 36 Meskas (19%), tails of which are equipped with pipe or aqueduct. Of them, 17 tails (9%) are connected to another canal or Meska. These play a role of feeder when excess water exists, and no waste spillage is expected. Nineteen pipes (10%) are connected to drain in order to discharge excess water or drain out the water when maintenance work is required. Since water level rarely reaches to high level enough to overflow, not many waste spillages have been reported. Farmers reported there were 7 Meskas and 10 Meskas which had waste spillage during summer and winter respectively.

Summarizing above situation, 42 Meskas (22% of total) are connected to another canal or Meska. These Meskas give water to the downstream Meska when excess water comes, or take water from the Meska downstream when there is water shortage. No waste spillage is expected for these Meskas. The Meskas, which were reported to have had waste spillage, are 9 and 14 in number during summer and winter respectively. Most waste spillage are not so often, just one or twice a week. Thus, it can be, as a whole, concluded that waste spillage from Meska tail are very less. This somewhat contrasts to what has been commonly believed.

1.5.7 Water Level Recorded at Representative Canal and Meska Tails

Total 12 number of water level recorders had been installed in canals and Meskas relevant to Bahr Biyala area during Phase II study. Of them, 3 recorders were at the tails of Bahr Biyala, El Shorafa and Bahr El Nour, and 2 recorders were also at the tails of Meskas as Abo Kora and El Bagara (Refer to Appendix F.19).

The recorders had been measuring the pressures in every 10 minutes for 2 months from around October 20 to around December 20, 1998. The records at the 5 tails identified if overflowing has occurred or not during the 2 months as summarized below;

Canal/Meska	Max WL, m	GL, m	Free, m	Remarks
Bahr Biyala	1.41	1.57	0.16	Delivery Canal
Bahr El Nour	2.12	2.69	0.57	-do-
El Shorafa	1.98	2.41	0.43	-do-
Abo Kora	1.64	2.26	0.62	Meska
El Bagara	2.15	2.65	0.50	Almost same as Bahr

Viewing the above results, the 5 canals/Meskas had not overflowed during the measured period with some free board ranging from 16 cm to 62 cm. Though overspillage usually occur during winter season rather than summer, this case had not occurred in the above Bahr Biyala related canals.

1.5.8 Water Shortage

Based on the information given by relevant irrigation engineers, Bahr Biyala and Abshan canals, both in Biyala Water District, suffer from the most severe water shortage. During summer season, water shortage for the canals always prevails because of the long reach, 13.7 km of Bahr Biyala and 17.4 km Abshan, and illegal rice cultivation occupying as much as 70% of the area.

Small drainage pumping station installed at the tail of Bahr Biyala lifts drainage water from Drain No.4 to mitigate the water shortage. The pump capacity is 1 cum/sec and supposed to work 10 hours/day in June and July, but sometimes operated 24 hours continuously. The farmers engaged to Abshan canal takes drainage water, to mitigate the water shortage, from Abshan drain or Garbia drain by their own pump.

Other canals suffering from water shortages, next to Bahr Biyala and Abshan, are Ragheb Basha and Ganabia No. 10 Right. The former's reach is 5.5 km, giving difficulty to carry enough water to the tail. Ganabia No. 10R is said not be able to take enough water because of high intake elevation. Also, such canals as Tahweelah Bahr Biyala, El Shorafa, El Banawan El Asfal, Banawan Branch, Ganabia No.7 Left and Zobaa were reported suffering from water shortages to the lesser extent. There is a canal, Ganabia No.2 Right, which suffers from water shortage during winter season only but not in summer because of low water level in Bahr Tera. The bed level of this Ganabia requires to be lowered.

Farmers tend to report more water shortages than those given by relevant irrigation engineers. An inquiry for water shortage was made to each farmer at upstream, midstream and downstream for all Meskas. The result clearly shows that the more one goes to downstream, the more water shortage the one encounters especially during summer season. Given an example for summer water shortage, number of Meskas which rarely suffer from water shortage is 54 (28%) for upstream and 17 (9%) for downstream, and in contrast the number which suffer always water shortage is 4 (2%) for upstream and 75 (39%) for downstream (See Table 1.5.3 &

Figures 1.5.4 and 1.5.5).

Farmers reported that the reasons of water shortage are; long off-period given by rotational irrigation in most cases for upstream, long-off period plus upstream's much pumping for midstream, and upstream and midstream's much pumping plus to the lesser extent long-off period for downstream. Other reasons besides those are high bed level of Meska, low water level in Meska, lack of continuous maintenance, Meska slope collapse, etc. (Refer to Appendix F, F.15)

1.5.9 Night Time Irrigation Practice

It is well known that farmers practice night time irrigation. An inquiry was made to each farmer at upstream, midstream, and downstream how much irrigation the farmers do in night. The answers clearly correspond to the result of water shortage. Especially during summer season, farmers at downstream area suffer from water shortage so that they have to depend on night irrigation rather than daytime irrigation (See Table 1.5.4 & Figures 1.5.6 and 1.5.7).

Forty eight farmers at downstream areas reported they practiced night time irrigation more than 60 % (6 times in every 10 times) during summer, while only 3 % farmers each at upstream and midstream practiced the same frequent night irrigation. Same trend can also be seen during winter season, but to the lesser extent. Night irrigation practice decreases during winter season. No farmers for all up, mid and down streams reported night irrigation more than 60 % during winter. However, 27% of the downstream farmers still practice night irrigation of 40 - 60% (say once in every tow times).

1.5.10 Excessive Irrigation and its Return Flow

Canals in Egypt are constructed below field level and groundwater table is generally high ranging -1.5 m to -0.5 m. This leads to an idea that canal conveyance and distribution efficiencies are relatively high than ones applied in other countries, thanks to the high groundwater table, despite the fact that the canals are unlined. However, irrigation undertaken by farmers is expected to remain some low level, leading to low field irrigation application efficiencies.

Excessive irrigation dosages have been sometimes reported, but not experimentally confirmed. Field observation during this Study confirmed that some excessive irrigation water ran into filed drain and/or returned into Meska or canal from which the irrigation water had been pumped up. Farmers usually make small field open drains to catch excessive irrigation water, then the excessive water goes to open drain downstream constructed by Drainage Directorate or in some cases returns into Meska.

A questionnaire was done to farmers if there was excessive water for rice cultivation and then where the excessive water goes to; namely, Meska or Canal, next field, or drain. The questionnaire was done at total six places per Meska such as; upstream, midstream, downstream just near Meska and the same three locations but away from the Meska.

The result shows that fields not only near Meska but also away from Meska have some excessive irrigation dosages that return to Meska and/or canal and the return has a possibility that had been reused. Although about 20 to 60 % farmers reported that they had not any excessive irrigation dosages, 13 - 23 % and 6 - 10 % farmers at "near Meska" and "away from Meska" respectively recognized some excessive dosages going back to canal and/or Meska. Also, 31 - 56 % farmers had reported that excessive dosages went to drain, giving possibility of on-farm irrigation improvement (Table 1.5.5 & Figures 1.5.8 and 1.5.9).

1.5.11 Drainage Condition

With respect to drainage network, the Priority Area falls in Biyala Drainage Center and a part of West Bilqas Drainage Center. Drain No.4 demarcates the study area's most eastern boundary, and Drain No.3 and its branch of El Banawan Drain demarcate the northern part of the eastern boundary. Drain No.3 and Drain No.4 merge into one and then into Gharbia Drain at the most downstream (north). The Priority Area's south-western boundary is demarcated by Drain No.5 which merges into Gharbia Drain. Gharbia Drain, the biggest in the Master Plan Study Area, demarcates western boundary of the priority area.

There are 4 drainage pumping stations such as No.3 DPS, No.4 DPS, No.5 DPS, and No.6 DPS. The first 3 drainage pumping stations are located in the corresponding drains. No.3 and No.4 drainage pumping stations lift the drainage so high that the drain water can go into Gharbia Drain. No.5 pumping station lifts the drainage water in Drain No.5 and discharges into Gharbia Drain. No.6 pumping station is located at the tail of Abshan Drain that runs in between Abshan canal and

Bahr Tera main canal.

Subsurface drain has been installed for the last ten years extensively over the priority area with an exception of the northern part. The area not installed with subsurface drain is encompassed by El Banawan El Asfal canal, Gharbia Drain and Drain No.3. The area is planned to have subsurface drainage within current Fourth Five-Year National Development Plan (1997/98-2001/02)

Open drains are maintained by Central Delta Drainage Directorate located in Tanta. Regular maintenance is done by dredger (excavator) or dragline usually once every year, removing domestic wastes and weeds. No maintenance of subsurface drainage is carried out. Subsurface drainage has been observed to well work to drain seepage water even during winter season. Farmers often complain too much seepage during rice cultivation since the subsurface drains in this area are not equipped with stoppage.

Figure 1.5.1 Irrigation Area by Delivery Canal

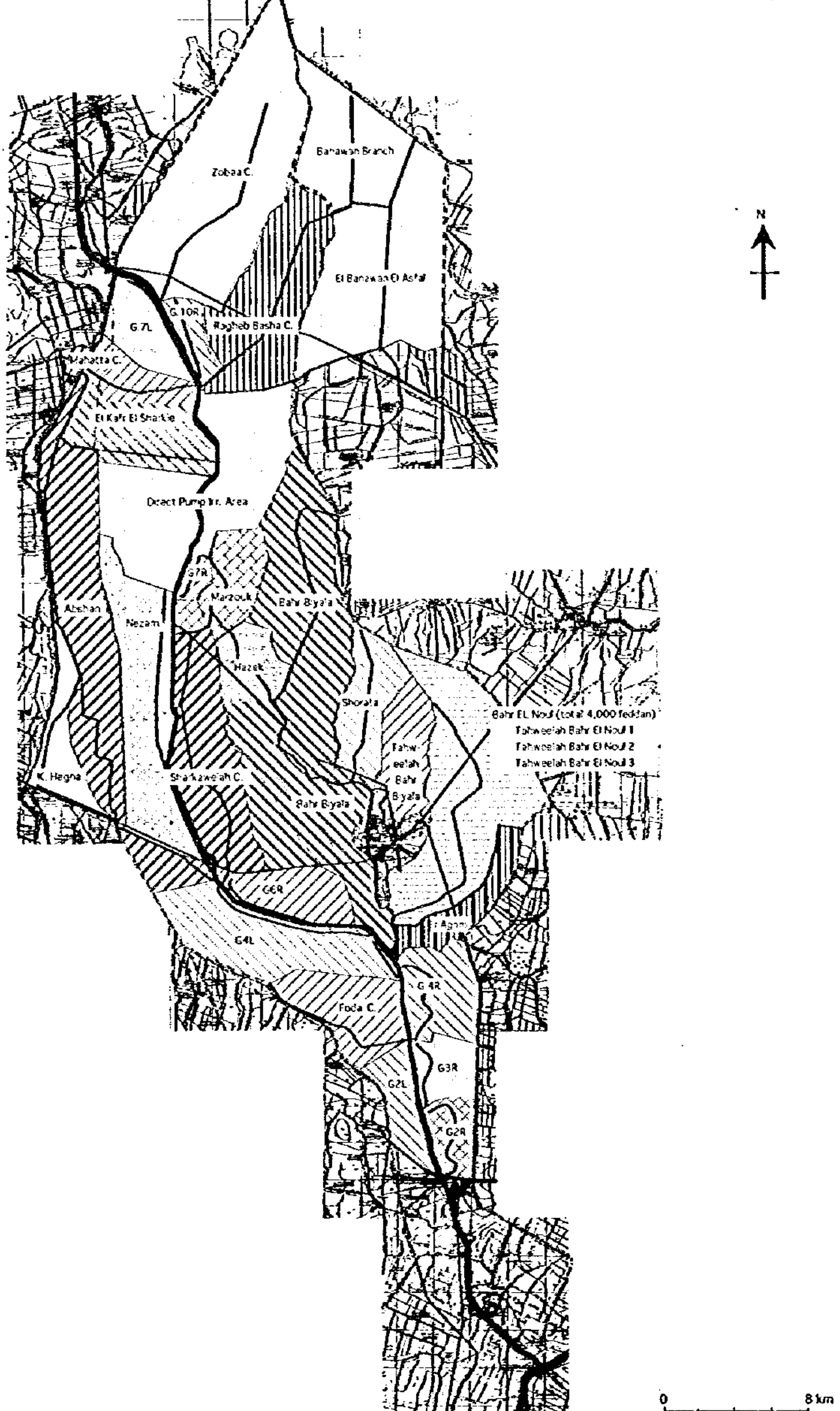


Table 1.5.1 Canal Inventory in the Feasibility Area of Biyala & Hamoul Water Districts under Kafr El Sheikh Directorate

Main Canal	Branch Canal (Delivery)	Location km	Location L/R	Area feddan	Length km	No. of Meska	Area by Meska	% for Meska	Water Shortage Sum.	Water Shortage Win.	Reason of Water Shortage	Tail Condition	Spillage Sum.	Spillage Win.	Intake Condition	Remarks
Biyala District																
Bahr Tera		47.2		38,505	27.50											Km from El Abasee
	Directly from Bahr Tera			4,253												Km from intake of Bahr Tera
	Ganabia No.2 Right	1.0	R	1,400	2.60	7	675	48	1	3	Low water level at Bahr Tera (high level intake)	Feeder fr Bahr Tera			1	
	Ganabia No.2 Left	6.2	L	840	3.02	3	438	52	1	1		Feeder to Fada			1	
	Ganabia No.3 Right	7.0	R	680	0.51	4	430	63	1	1		Feeder to G 4 R			1	
	Fada	10.8	L	1,650	3.90	12	1,462	89	1	1		Tail escape	Negligible	Negligible	1	
	Ganabia No.4 Right	10.8	R	1,440	2.07	8	1,025	71	1	1		Feeder fr Bahr Tera			1	
	Ganabia No.3 Left	11.6	L	300	0.76	1	300	100	1	1		Feeder fr Bahr Tera			1	
	Bahr Biyala	11.9	R	8,470	13.72	26	6,197	96	4	1	Illegal rice & long canal (11.9km)	Stop	Negligible	Negligible	1	Small MPS at the tail (Working in June&July, 10 hrs/day)
Bahr Biyala	Bahr Biyala & El Nour	0.0	R	1,150	1.66	4	307	27	1	1		Feeder to Bahr Biyala			1	
	El Agamy	0.9	R	850	4.60	2	120	14	1	1		Tail escape (need rehabilitation)	Negligible	Negligible	1	
	Bahr El Nour (Total 4,000feddans)	1.2	R	2,780	7.42	14	1,777	64	1	1		Stop (connected to Meskas)	Negligible	Negligible	1	Total Meska area=2175, T.O.A.=4000, Meska Ratio=54%
	Tahwealah Bahr El Nour 1	0.6	R	160	1.05	0	0	0	Old Bahr El Nour			Feeder to Bahr El Nour				Named "El Kadema", Km from intake of Bahr El Nour
	Tahwealah Bahr El Nour 2	2.4	L	720	1.49	1	13	6	Old Bahr El Nour			do				Named "El Sheahine", Km from intake of Bahr El Nour
	Tahwealah Bahr El Nour 3	4.4	R	840	1.67	5	395	46	Old Bahr El Nour			do				Named "El Saasa", Km from intake of Bahr El Nour
	Tahwealah Bahr Biyala	3.3	R	1,326	1.57	1	300	23	2	1	Long Meskas & weeds	Stop	Negligible	Negligible	1	Passing through residential area, much domestic wastage
	El Shorafa	3.8	R	840	4.32	3	260	31	2	1	Long Meskas & illegal rice	Pipe with gate to Drain No.4 (need rehabilitation)	Negligible	1~2 l/s	1	Unofficial drainage reuse from Drain No.4 during water shortage
	Nazak	7.2	L	750	2.39	1	100	13	1	1		Aqueduct with Marzouk			1	
Bahr Tera	Ganabia No.4 Left	13.6	L	1,960	3.94	8	690	35	1	1		Feeder to Abshan			1	
	Ganabia No.6 Right	13.6	R	1,150	3.66	4	820	71	1	1		Feeder to El Sharkaweiah			1	
	El Sharkaweiah	15.2	R	1,712	4.48	9	964	56	1	1		Feeder to Bahr Tera			1	
	Abshan	17.4	L	3,750	17.40	12	1,500	40	4	1	Long canal (17.4 km), Low WL in Gharbia Drain	Feeder to El Kafr El Gharbia			1	Unofficial drainage reuse from Gharbia Drain during water shortage
Abshan	Kom El Hegna	2.2	L	700	5.34	2	450	64	1	1		Feeder to Abshan			1	
Bahr Tera	El Nezam	17.4	L	2,850	8.39	15	1,605	56	1	1		Feeder to Bahr Tera			1	
	Marzouk	24.4	R	1,000	3.18	0	0	0	1	1		Tail escape	Negligible	Negligible	1	
	Ganabia No.7 Right	25.4	R	460	0.94	0	0	0	1	1		Feeder to Bahr Tera			1	
				38,505	96.83	140	19,909	49								
Hamoul District																
Bahr Tera				18,425	9.00											
	El Kafr El Gharbia	29.5	L	1,425	7.06	4	830	58	1	1		Tail escape	Negligible	Negligible	3	No gate (Pipe only for the intake), Unofficial drainage reuse
	El Banawan El Asfal	31.2	R	5,000	12.30	19	3,142	63	2	2	Located at Tail End of Banawan	Aqueduct with El Ealeh			1	
El Banawan El Asfal	Banawan Branch	8.8	L	2,000	3.90	5	890	45	2	1	do	Pipe with gate to Qumiayun drain (need rehabilitation)	Negligible	10~15 l/s	1	
Bahr Tera	Ragheb Basha	31.7	R	2,050	5.50	7	632	31	3	2	Long canal	Pipe with gate to Drain No.4, Drainage flows back into in canal	Negligible	Negligible	1	
	El Mahatta	31.7	L	2,500	2.57	3	500	20	1	1		Stop	Negligible	Negligible	3	Gate capacity is not enough
	Ganabia No.7 Left	31.8	L	1,150	3.26	3	423	37	2	1	Direct Irrigation & Congestion	Feeder to Bahr Tera			1	
	Ganabia No.10 Right	31.9	R	500	2.46	0	0	0	3	2	High bed level of the intake	Feeder to Zobaa			3	High bed level
	Zobaa	34.0	R	3,800	6.15	13	1,835	48	2	2	Long Canal	Pipe with gate to Qumiayun drain	Negligible	Negligible	1	
				18,425	43.21	54	8,262	45								
Total Area Served				56,930	176	194	27,060	48								
Area served by Delivery (excluding direct fr Tera)				52,677	140											
Average Area served per Delivery				1,616	4.63											

Official drainage reuse; Bahr Biyala has a small mixing pumping station at its tail, lifting drainage water from Drain No.4 and working 10 hours a day in June and July.
Unofficial drainage reuse; El Shorafa having about 2% drainage irrigation area from Drain No.4 at its tail,
Abshan having about 10% drainage irrigation area along Gharbia Drain.

Note: Water Shortage given by Relevant Irrigation Engineers (1=Rare, 2=Often, 3=Very often, 4=Always), Intake Condition (1=Good, 2=Repair, 3=Replacement)

Table 1.5.2 Meska's Tail Condition and Waste Spillage from the Tail

Tail Condition	Total No	%	Br'k D'wn	%	Summer 1-2/week	Summer 3-4/week	Summer 5-6/week	Summer Always	Winter 1-2/week	Winter 3-4/week	Winter 5-6/week	Winter Always	Remarks
Stop	129	66							1	2			
Open	29	15											
To Meska/Canal			25	13									Works as Feeder if excessive water
To Drain			4	2	1			1				1	
Pipe/Aqueduct	36	19											
To Meska/Canal			17	9									Works as Feeder if excessive water
To Drain			19	10	6			1	6	3	1		
Total	194				7	0	0	2	7	5	1	1	
Total No. of Feeder =	42												
% of Feeders	22												

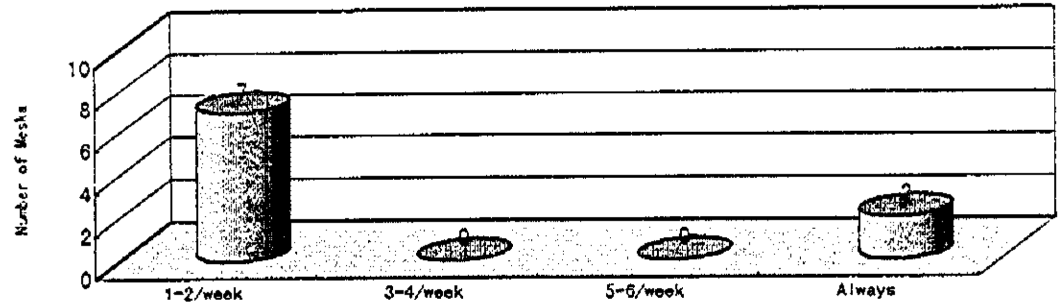


Figure 1.5.2 Waste Spillage From Meska Tail During Summer

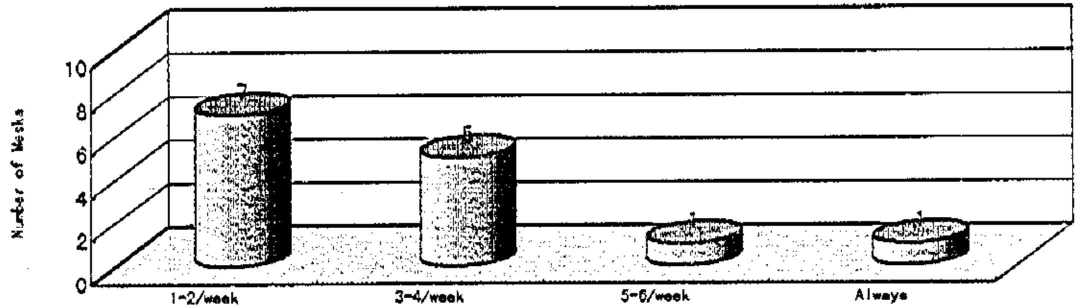


Figure 1.5.3 Waste Spillage From Meska Tail During Winter

Table 1.5.3 Farmers' View on Water Shortage by Location along Meska

Water Shortage	Upstream		Midstream		Downstream		Remarks
	Summer	Winter	Summer	Winter	Summer	Winter	
Number of Meska							
Rare	54	99	15	41	17	29	
1-2/week	55	69	29	68	12	32	
3-4/week	73	17	75	74	31	73	
5-6/week	8	7	71	9	59	53	
Always	4	2	4	2	75	7	
Percent to 194 Mesks							
Rare	28	51	8	21	9	15	
1-2/week	28	36	15	35	6	16	
3-4/week	38	9	39	38	16	38	
5-6/week	4	4	37	5	30	27	
Always	2	1	2	1	39	4	

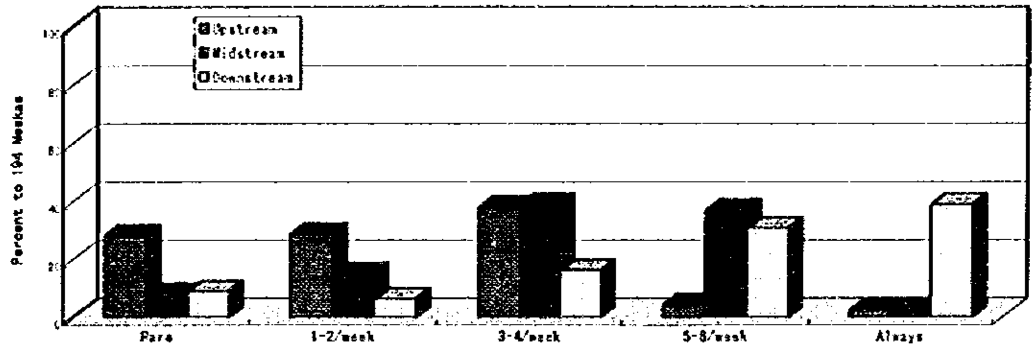


Figure 1.5.4 Farmers View on Water Shortage along Meska during Summer

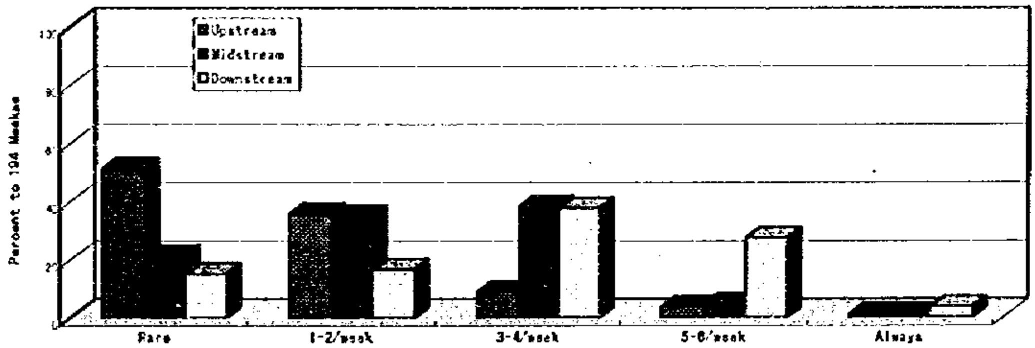


Figure 1.5.5 Farmers View on Water Shortage along Meska During Winter

Table 1.5.4 Night Irrigation Practices by Location along Meska

Night Irrigtion	Upstream		Midstream		Downstream		Remarks
	Summer	Winter	Summer	Winter	Summer	Winter	
Number of Meska							
Rare	42	134	10	54	13	45	
10-20%	91	53	25	79	8	35	
20-40%	52	3	78	56	24	62	
40-60%	3	4	75	5	56	52	
>60%	6	0	6	0	93	0	
Percent to 194 Mesks							
Rare	22	69	5	28	7	23	
10-20%	47	27	13	41	4	18	
20-40%	27	2	40	29	12	32	
40-60%	2	2	39	3	29	27	
>60%	3	0	3	0	48	0	

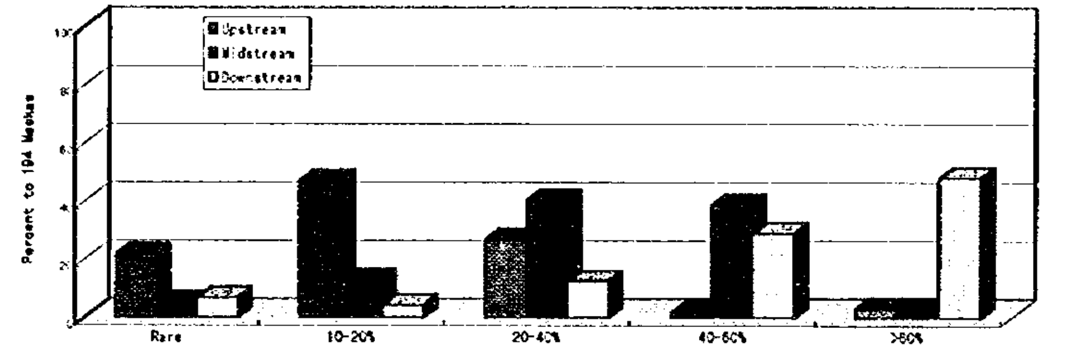


Figure 1.5.6 Night Irrigation Practices along Meska during Summer

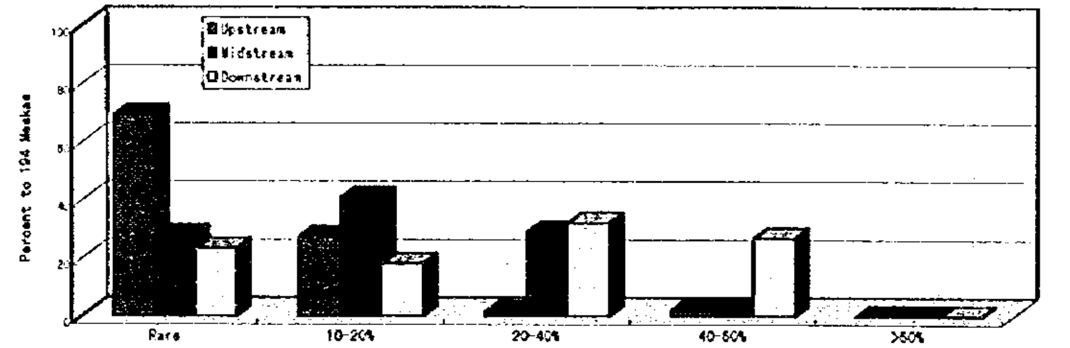


Figure 1.5.7 Night Irrigation Practices along Meska During Winter

Table 1.5.5 Excessive Rice Irrigation Water and Its Returning Place

Excwssive Water	Upstream		Midstream		Downstream		Remarks
	Near	Far	Near	Far	Near	Far	
Number of Meska							
No Excessive	40	68	91	109	106	117	
Canal/Meska	44	19	37	20	25	12	
Next Field	2	2	2	4	0	0	
Drain	108	105	64	61	63	65	
Percent to 194 Mesks							
No Excessive	21	35	47	56	55	60	
Canal/Meska	23	10	19	10	13	6	
Next Field	1	1	1	2	0	0	
Drain	56	54	33	31	32	34	

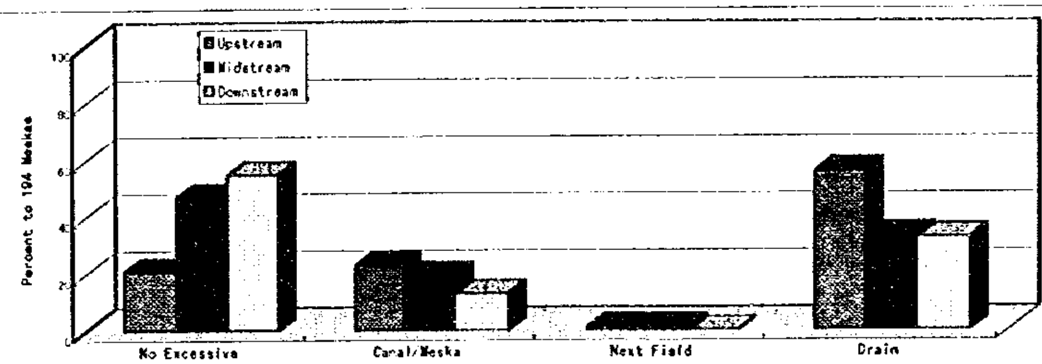


Figure 1.5.8 Excessive Rice Irrigation Water and Its Returning Place; Near Meska

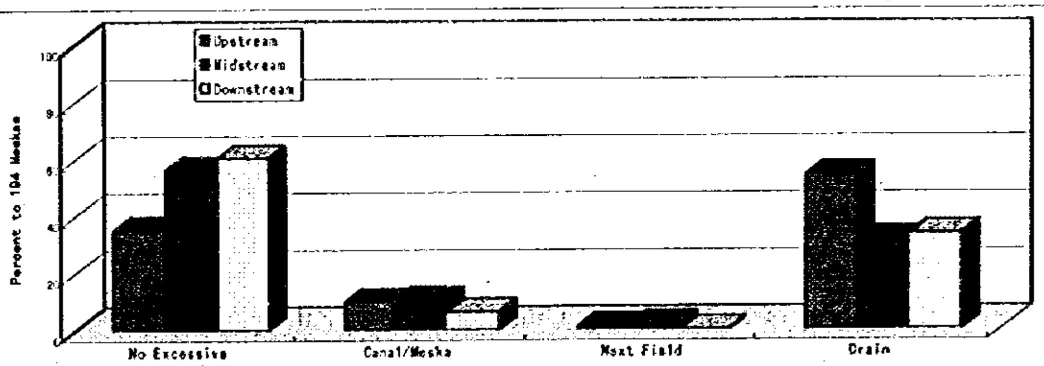


Figure 1.5.9 Excessive Rice Irrigation Water and Its Returning Place; Far from Meska

1.6 Water Management and O&M

1.6.1 Administration System of Water Management

(1) Headquarters of MPWWR

MPWWR is the organization responsible for water resources administration in Egypt with jurisdiction over water resources management and irrigation facilities management throughout plan formulation, final design, implementation and maintenance. The Irrigation Department plays pivotal role among MPWWR and comprises four Sectors and 24 Irrigation Directorates. (Refer to Part 1, Figure3.6.1)

The Irrigation Sector in the Irrigation Department is the responsible agency for water management operation and consists of four Central Departments. The Irrigation Sector collects all necessary data and information relevant to water management, estimates the total amount of water requirement in the Republic, decides the release plan from the Aswan High Dam and distributes water to the 38 principal canals. This indicates that the Irrigation Sector manages consistently the entire water resources in the Republic.

(2) Irrigation Directorate

The local administration of the Irrigation Department is performed under five jurisdictions, which contain four to six Irrigation Directorates or a total of 24. The duty of the Irrigation Directorate is to distribute water to the Main Canal following instructed distribution procedures. In a similar way, the water is distributed to the Branch Canal. The distribution amount conforms to the result of water requirement estimation which is based on the cropping plan. However, necessary arrangement is actually considered according to local circumstances in the irrigation area. (Refer to Part 1, Figures3.6.1 and 3.6.2)

The Priority Area is located in the jurisdiction of the Kafr El-Sheikh Irrigation Directorate in the Central Delta region. There are regional offices located in the Priority Area as follows: 1) Water Distribution Directorate of Lower Egypt which measures discharge in the principal canal to monitor the hydraulic conditions, 2) Irrigation Improvement Projects (IIP) that improves irrigation facilities, 3) General Egyptian Authority for Drainage Projects in charge of drainage works, the Ground Water Resources Department responsible for groundwater, 4) Water Channel Maintenance Department that maintains canals, 6) MED (the Mechanical and Electrical Department) that manages pumping station in Tanta or in Kafr El-Sheikh. These regional offices are closely related with the Irrigation Directorate but covering different matters.

(3) Inspection Office

The Inspection Office under the Irrigation Directorate instructs the Water District Offices. The Inspector is the responsible engineer of the Office. There are two Project Directors and two Assistant Project Directors under him to instruct and supervise the Water District Engineer. The Priority Area is situated in the territory of the Biyala Inspection Office, which covers the Bahr Tera irrigation canal system. There are four Water District Offices, as Biyala, Hamoul, Mansour and Balteem under the Biyala Inspection Office.

(4) Water District Office

The Water District Office is the job site of water management activities. The Water District Engineer is head of the Office instructing the Bahari. He receives all necessary reports in the District. The Water District Engineer is in position to intervene all water management activities such as preparation of cropping plan, estimation of irrigation water requirement, and instruction of water distribution. In this context, he is the person most familiar with the local situation. Farmers complain to him on water shortage and he himself manages directly this matter. However, matters beyond his control are entrusted to his supervisors. Thus, the Water District Engineer performs his duties in close contact with local farmers forging close and reliable relationship with farmers.

(5) Bahari

The Bahari means Navigator or gatekeeper. The Bahari perform gate operation work together with the water level observation under instruction of the Water District Engineer and reports site conditions to the Engineer in case of any trouble in his canal system.

One Water District Engineer covers 56,930 feddan as in the case of the Bilaya Water District Office with the assistance of 24 Bahari. In principle, one Bahari takes care of one Delivery Intake Gate and Meska Intakes therefrom.

1.6.2 System of Water Distribution

(1) Framework of Water Distribution

The socio-economy in Egypt is fully dependent upon the Nile water, which is consistently managed under the power and responsibility of MPWWR. The major task of water management in ordinary case is the water distribution operation, which is based on the water distribution plan. The water distribution plan in the Directorate level is generally established following the line of Under Secretary, General Director, Inspector and Water District Engineer with slight differences among Directorates. The line members meet periodically, once or twice a year to discuss the cropping plans for the estimation of irrigation water requirement.

The responsible person for the water distribution in the MPWWR Headquarters is the Head of the Irrigation Sector who controls the Irrigation Directorates. However, in ordinary case, the Under Secretary of the Water Distribution is entrusted to conduct water distribution operations. The procedures of water distribution operations are presented with reference to the Kafr El-Sheikh Irrigation Directorate where the Priority Area is located. (Refer to Figure 1.6.1)

(2) Estimation of Irrigation Water Requirement

The irrigation water requirement accounts for 85% of the entire Nile water and is acquired through the following procedures. The irrigation water is estimated multiplying cropping area prepared under MALR's initiative by unit water duty with ten-daily time interval and summed up in all Irrigation Directorates in terms of canal system and irrigation area. However, cultivation areas of strategy crops as rice, cotton, wheat and maize are determined by MPWWR's initiative and notified to MALR. The Under Secretaries act as the negotiation channel in both Agencies as shown in Figure 1.6.1. The information flow related to the irrigation water requirement is indicated as Circle 1 in Figure 1.6.1. The information flow of the notification is also presented in Figure 1.6.1 as Circle 3, which shows counter direction to the Circle 1.

(3) Decision of Water Distribution Plan

In addition to the above irrigation water, municipal and industrial water, drainage reuse amount, groundwater amount, augmentation factor, conveyance loss and navigation water amount are also taken into account in the request to MPWWR Headquarters. The computation methods differs from Directorate to Directorate according to the circumstances. The requested amounts are finally summed-up and confirmed employing computer program in the Central Department of Water Distribution. The information flow in the decision making process is identical to Circle 1 in Figure 1.6.1 in accordance with the water use objectives.

(4) Instruction of Water Distribution

Water distribution plan and operation in ordinary case is entrusted to the Central Department of Water Distribution. The estimated amount of water distribution plan is used only for reference because the canal diversion ratios are fixed according to the actual discharge of the previous year since 1992. Furthermore, the amount release from the Aswan High Dam is fixed at

55.5 billion cubic meter per annum under an Agreement with Sudan. Hence, there is no room to increase the total amount of supply itself and no reasonable basis to modify the diversion ratios. This refer only to the distribution plan and not to the distribution operation which is conducted with due considerations of the local conditions. The information flow of water distribution instruction is transmitted through the channel of Inspection, Water District and Bahari who materializes the instructed discharge amount through actual gate operation. (Refer to Figure1.6.1)

(5) Reporting of Water Distribution

To ensure compliance of the instructed water level and discharge, the local offices are under obligation to report the hydraulic data. The reporting process is indicated by Circle 4 in Figure 1.6.1 in case of the Irrigation Directorate.

The hydraulic quantities in the Principal Canal through major regulator and intake amount to major main canal are also directly managed by the Water Distribution Directorate of Lower Egypt and reported to the Central Department of Water Distribution. There are two reporting channels. One is Circle 4 in Figure 1.6.1 through administration and the other is Circle 5 in Figure 1.6.1 through the Telemetry Project. Both figures are crosschecked against each other.

(6) Verification of Water Distribution

The Discharge Measurement Teams in the Water Distribution Directorate exclusively conduct discharge measurements in the Principal Canal. There are 25 measuring sites in the jurisdiction of the Lower Egypt Water Distribution Directorate among which Zifla Intake, Santa Regulator and Meet Yazied Intake, Rahbeen Regulator and Sahel Intake are located within the Master Plan area. The Measurement Teams are also organized in the Irrigation Directorate for the Main Canal reaches. This information channel is shown by Circle 6 in Figure 1.6.1.

1.6.3 Irrigation System

The Priority Area with an irrigation area of 56,930 feddan is distributed in both the bank sides of the Bahr Tera Main Canal in the section between the Tera Intake and the Hamoul Pump Station. (See Figure 1.6.2) The Abshan Regulator is situated in the middle of the above section at station 17.6 km that corresponds to the boundary point of the rotational irrigation area in the Bahr Tera Canal system. The Continuous Flow is being practiced throughout the Bahr Tera Main Canal itself, while 21 lines of the Delivery Canals branching off from the Bahr Tera are under Rotational Flow through on-off gate operation at the diversion sites.

Meantime, the Bahr Biyala Branch Canal with seven Delivery Canals under Rotational Flow starts at 12.1-km point from the Bahr Tera Intake site. The name and irrigation area of the Delivery Canal in the study area are presented in Figure 1.6.2.

1.6.4 O&M of Facilities

The operation and maintenance (O&M) of the irrigation facilities are divided into the local and regular maintenance. The local maintenance refers to maintenance under the Water District Office level. When the Water District Engineer is informed of any minor damage in the canal system, he instructs the Bahari to repair immediately the damage. However, when the damage is serious to be tackled at the Water District Office level, he reports the scope and extent of damage to the Irrigation Directorate through the Inspector. Then, the General Director in the Irrigation Directorate requests the Water Channel Maintenance Governorate to restore the damage.

The Water Channel Maintenance Governorate undertakes preventive and regular maintenance of projects facilities which covers such structures as gate, aqueduct, bridge, Sawla, staff gauge and canal bank categorized by maintenance, reform and renewal.

In addition to the above maintenance works, canal cleaning by weed cutting and dredging are executed once or twice a year. Initially, the canal bottom weed is cut by cutter boat and then dredged out together with the root zone. Repetitive operation of such work enlarge the canal cross section into an irregular shape causing not only the lowering of the water level but also to threatening the neighboring roads and houses. The persons concerned are always anxious about the matters, as it is the most serious assignment for them to be overcomed. However, it is difficult to find proper resolution of the problem.

The O&M costs of the work mentioned above are born by the Government. However, the O&M costs of Meska down to Marwa are born by the local farmers themselves. In some exceptional cases, due to technical reasons, the farmers entrust O & M to the government. An average O&M cost in the area comes up to 70 LE/feddan in which cost for pumping up is as high as 80%.

Accidents or emergency are dealt with in the same manner as previously mentioned. When water shortage occurs in the area, the Water District Engineer copes with the matter in as far as he can manage through gate operations in the District. However, in case of serious water shortage, he reports the matter to the Inspector who follows the same procedures mentioned beforehand. Case by case resolutions had been practiced in many occasions since there are no standard formula to overcome emergency cases. In case of abnormal flooding such as in 1998, responsible officials are instructed to stand by at the specified places for emergency operations/instructions.

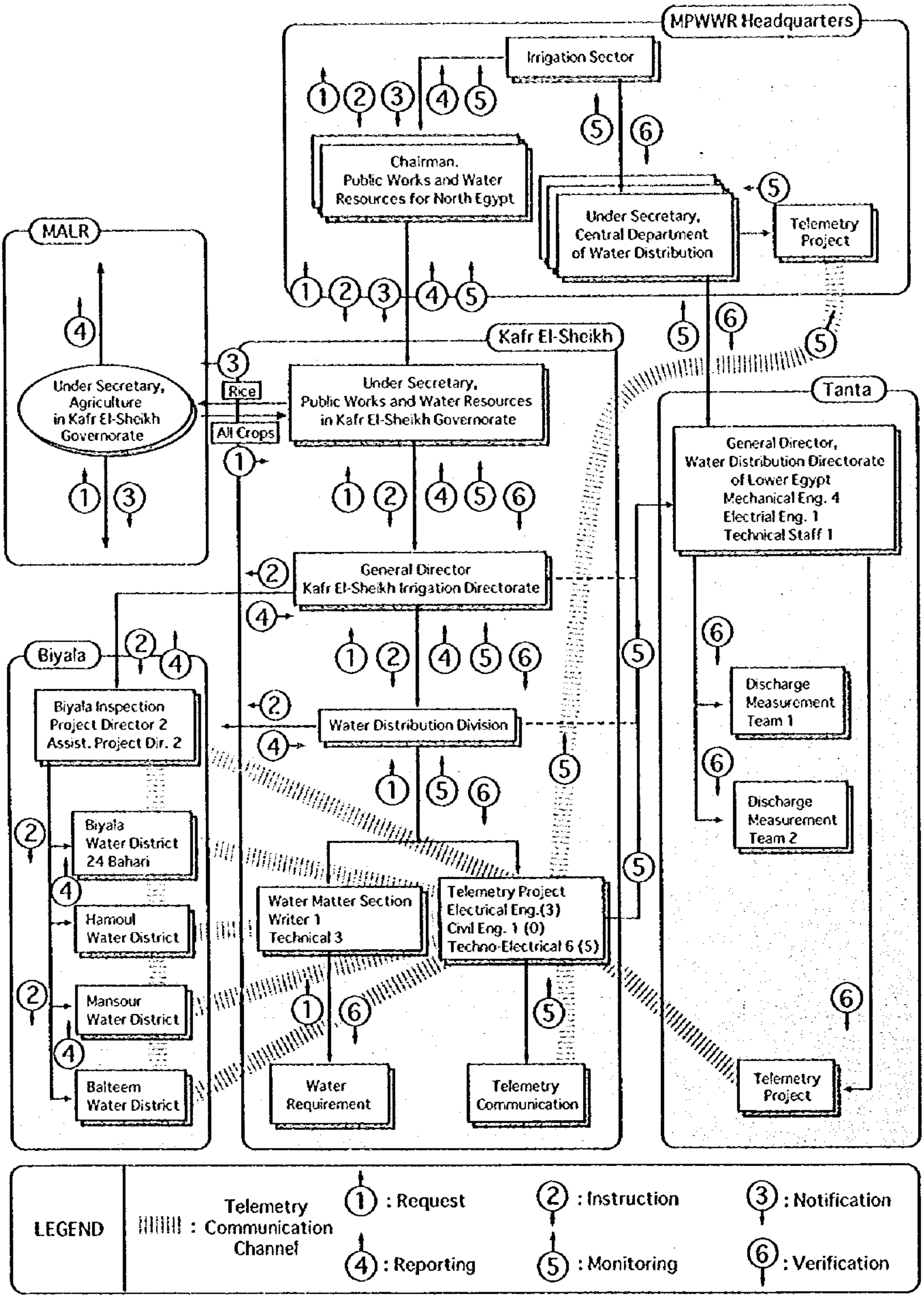


Figure 1.6.1 Information Flow in Water Distribution Operation

No.	Delivery Canal	Area(fd)
1	Ganabia No.2 Right	1,400
2	Ganabia No.2 Left	840
3	Ganabia No.3 Right	680
4	Foda	1,650
5	Ganabia No.4 Right	1,440
6	Ganabia No.3 Left	300
7	Bahr Biyala & El Nour	1,150
8	Bahr Biyala	5,470
9	El Agamy	850
10	Bahr El Nour	4,000
11	Tahweelah Bahr Biyala	1,320
12	El Shorafa	840
13	Hazek	750
14	Ganabia No.6 Right	1,150
15	Ganabia No.4 Left	1,950
16	Kom El Hegna	700
17	Abshan	3,750
18	El Sharkaweiah	1,712
19	El Nezam	2,850
20	Marzouk	1,000
21	Ganabia No.7 Right	450
22	El Kafr El Sharkie	1,425
23	El Banawan El Asfal	5,000
24	Banawan Branch	2,000
25	Ragheb Basha	2,050
26	El Mahatta	2,500
27	Ganabia No.7 Left	1,150
28	Ganabia No.10 Right	500
29	Zobaa	3,800
	Direct Irrigation	4,253
	F/S Area Total	56,930

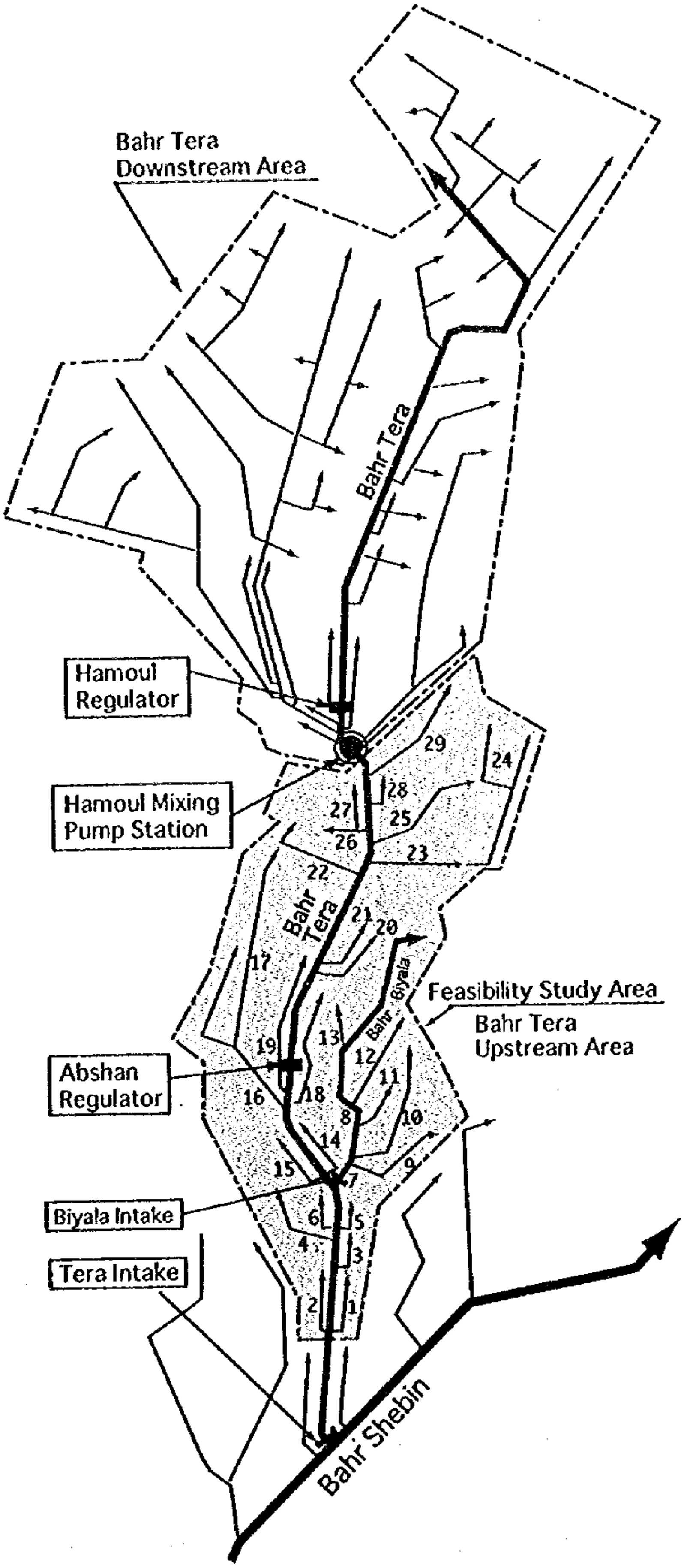


Figure 1.6.2 Bahr Tera Canal System

1.7 Present Conditions of Irrigation and Drainage Facilities

1.7.1 Irrigation Facilities

(1) Major Facilities

The major facilities in the Priority Area consist of Rahbeen regulator, Bahr Tera intake gate, Abshan regulator and Hamoul MPS.

a) Rahabee Regulator

▪ General features

The Rahbeen regulator can control a discharge of 150 cu.m/sec in the Bahr Shebin. This regulator plays a very important role to control the water supply to the downstream command area. The Regulator consists of two (2) structures such as main and subregulator. The former was constructed in 1930, while the latter in 1967 to increase water demand in the area. The main regulator, which is located at the right side, consists of six (6) Fahmy Henien gates with a width of 5.0 m and a lock with a width of 8.0 m which adjoins to the gates. The left regulator consists of three (3) Fahmy Henien gates with a width of 5.0 m.

▪ Superstructure and Base

The superstructure of the Regulator, which is commonly used as a road way in Egypt, is two- way, about of 7.6 m including side works of a 1.0 m for each. The superstructure is a T-shape concrete structure. The support of superstructures are concrete pier with a 1.5 m width. The regulator base was dammed by 1.95 m concrete. The front of base has a length of 4.5 m with slope of 3:1 while its front apron is 14.5 m extended with a concrete of 0.5m thickness. The more extending canal bottom is covered by stones with length of 10.0 m length. The sill of the gate with 1.0 m width has a concrete top crest. On the other hand, the down stream of base consists of a incline concrete slope (10 :1) of 20.0 m, to extend a concrete apron of 5 m with a 0.75 m thickness. The canal bottom protection is constructed by a concrete blocks with length of 10 m (for 5 m : 0.75 m x 0.5 m x 1.0 m and another 5 m : 0.2 m x 0.2 m x 0.5 m)and more extending 10 m riprup of the rime stones.

▪ Foundation and geological conditions

There is no any data on the foundation work at the implemented time. According to the geological boring data at about 20 km upstream in the Bahr Shebin canal, the foundation consists of a flood diluvial formation. Its upper layer of about 10 m are composed of clay soil, sand, gravel and boulder. Accordingly, a detailed geological survey should be carried out during the detailed design stage in compliance with the recommendation sites as indicated in the improvement plan of the regulator.

- Present Condition in the Canal Bed

According to the site survey data in October 1998, of the topographical canal beds, about 200 m for upper and lower canal, the canal bed is scoured at 1.8 m deep at the upper location of the regulator and 4.1 m deep in downstream due to the hydraulric flow energy. The canal formation is unstable under the progress of hydraulic phenomena. The water loss head about 70 cm is occurred for peak water releasing downstream.

b) Bahr Tera Intake Structure and Main Canal

The intake of Bahr Tera main canal is located about 11.25 km downstream from the Rahbeen regulator at left bank, The normal intake water of 50 cu.m/sec is the second largest intake water in the Bahr Shebin command area. The largest one is 90 cu.m/sec for the Meet Yazied canal. The length of Bahr Tera main canal within the Priority Area is 35.5 km and the Abshan Regulator is located at 17.6km, about mid location of the canal. At 17.9 km downstream from Abshan Regulator, Hamoul regulator exists, however, this structure is out of the Priority Area.

- Bahr Tera Intake

The Bahr Tera intake has two (2) structures of new and old. The new canal joins the old canal at about 200 m downstream of the main canal. The old intake with four (4) Fahmy Henien gates x 3.0 m width and 5.0 m height was constructed in 1933. The gate operation device is equipped with manual hoist at each site. A navigation lock with 8.0m width and 40.0 m length is set at the gate. However the lock has not been used considering the present condition of weeds grown thick and rusting iron gates. At the upper and lower sites of the intake structure, the water level meters were installed and the data are recorded daily. The another intake gate 62.5 m away form the other one has also four (4) gates with 3.0 m width and 5.0 m height but without lock and constructed in 1967. The delay of opening and closing operation due to manual operation is the disadvantage of these two (2) gates.

- Bahr Tera main canal

The Bahr Tera main canal is an earth canal with the flow capacity in the following table, which made by station of 35.5 km in the study on the Priority Area

Section (km)		Design Discharge (m3/sec)	Canal Bed Slope (cm/km)	Hydraulic Gradient (cm/km)	Canal Bed Width (m)	Slope Gradient (:1)
0.0	17.6	50.00	9.5	10.0	28.0	1.5
17.6	37.5	40.21	6.0	8.0	24.0	1.5
37.5	49.8	31.92	1.0	4.0	20.0	1.5
49.8	57.5	24.39	1.0	4.0	15.0	1.5
57.5	66.2	11.27	1.0	4.0	8.0	1.5

The right bank of Tera main canal about 17.9 km from Abshan regulator to Hamoul MPS is low (0.5 m to 1.0 m) as compared to the left bank elevation. The certain discharge on emergency, when Hamoul MPS is suspended, can not be conformed to the elevation and size of the right bank.

- Abshan Regulator

The Abshan regulator consists of two (2) structures which were constructed in 1963. The former regulator has five (5) Fahmy Henien gates with 2.2 to 3.0 m width to control water in the down stream. The latter has lock which was closed for the new road construction. The regulator is conducted to control the rotational irrigation water supply system. The superstructure is used for a road (11 m width) with side walks.

c) Hamoul Mixing Pumping Station (MPS)

The Hamoul MPS was erected in 1960 for purpose of supplemental irrigation water supply from the Garbia drainage water (reuse) into the Tera main canal to use in the downstream command area. The pump station equiped with three (3) pump units based on the one unit capacity of ten (10) cu.m / sec with inclined type pump is still being operated by MED for 36 years with degraded pump function. The access canal from Gharbia drain to the Bahr Tera canal through pumping station has a trapezoid shape with a dimension of 12.4 m canal bed and 4.9 m water depth with a total length of 400 m. The pipe length of the suction side is 4.6 m and the incline degree is 45 degree of the pump diameter of 1,800 mm. The suction inlet and delivery outlet pipes show a trumpet shape. The width and length of the suction pit are 3.8 m and 12 m, respectively. The width of the pump house is 14.15 m and length of the delivery basin is 8.0 m. The transition canals, 25 m each at the suction and delivery sides are used to conduct smooth flow.

The pump operation is recorded daily and processed by a computer at the Middle Delta Information Center at Kafr El Sheikh. The processed items are operation hours, consumed electricity and water levels at the suction and delivery sides. At the peak water demand period, two (2) sets of pump are usually operated for 24 hrs a day. The 24 hrs pump operation is sometimes suspended due to low water level in the Gharbia drain at the suction side. In 1997, during a period of five (5) months from May to September, the pump could not operate for the total 536.2 hrs. The downstream command area was placed in a serious water shortage condition. (Refer to Table 1.7.1)

Table 1.7.1 Monthly Average Pump Operation Record of Hamoul MPS

Year	Lifting Volume (MCM)	WL at Delivery Side (m)	WL at Suction Side (m)	Total Operation Hrs (hr)	Remarks
1994	23.27	0.94	0.34	861	refer to *1
1995	25.14	0.93	0.29	935	
1996	28.23	0.91	0.34	1,059	
1997	34.49	0.81	0.24	1,022	refer to *2

Notes : *1 The minimum WL of -0.17 m was recorded at April.

*2 The minimum WL of -0.01 at January and -019 m at November

In 1985, motors and their parts were replaced, however, the pump itself was not changed and is still used now. The pump efficiency is too low due to old age. (Refer to Figure 1.7.1 to 1.7.4)

- Pump performance test

Based on the pump efficiency test in 1998, all pumps show low efficiency of less than 32 % as described in the following table. (Refer to Table 1.7.2)

Table 1.7 2 Results of Pump Performance Test

Pump No.	Average Lifting Head (m)	Average Lifting Discharge (cu. m/sec)	Power Consumption (kW)	Efficiency (%)
1	0.39	9.247	185	19.2
2	0.75	8.458	195	31.5
3	0.70	8.431	200	28.9

Source: Information Center, Kafr El Sheikh, MED, MPWWR

(3) Delivery Canal

There are 29 delivery canals in the Priority Area. The river bed slope is very gentle as 1:10,000. The delivery canals are extending about 140.7 km in total and 4.85 km in average length of a delivery canal. The longitudinal bed slope of the canal is gentle as about 10 cm per 1.0 km. All canals are not paved except some small portions in the town area. The canal has a trapezoid shape with a side slope of 1:1 to 1.5:1 and a canal bed width of 1.5 to 5.0 m.

- Hydraulic features

A delivery canal is unlined and the design water level is as kept below the ground surface. The canal section is made by large width dimension of canal and shallow depth. However, at the downstream of the canal section is made near by a most suitable hydraulic section.

- Appurtenance structures (check structure, etc.)

In general, a check structure is provided to secure a certain water level to supply water to Meska. However, in the Priority Area, there is almost no such structure in the irrigation system. Especially, a regulating pond and a farm pond, etc. to minimize a conveyance loss are not provided yet.

- Intake structure and tail end structure

One (1) or two (2) manual Fahmy Henien gates are installed at the intake structure according to the acreage of the area served. At the end point of the canal, a spill-way structure with a manual slide gate is provided for canal maintenance such as cleaning and repairing the canal without water. The end of some canals is connected to the downstream area with a pipe, etc. A tail end of another canal is perfectly closed without any structure.

(4) Meska

Meska, which is unlined and having a dimension of a canal width of 1.0 to 2.0 m, a canal depth of 1.0 to 1.5 m, is a private property and the O & M is practices by farmers. Meska has an average length of about 1.3km. The end point of some Meska was connected to a drain during the past years. However, at present, it is closed at 20 to 30 m before its end. Most of Meska are in poor conditions with side slope sliding, irregular canal width, weed and tree growing to interrupt smooth flow of water. Generally individual irrigation is practiced without certain rules.

1.7.2 Drainage Facilities

The drainage system in the Priority Area consists of the main drainage canal, branch drainage canal and farm drain. The type of drainage canal is an open type canal system, however, the farm drainage type is implemented by the open and a pipe drainage structure.

(1) Main drainage canal

The water drain from a field is collected to a main drainage canal via a branch drainage canal to haul drain water to the outside of the Priority Area. These drainage canals are maintained by the Drainage Authority. The major drainage works for maintenance are dredging and weed control in and along a drainage canal. There is no problem on the drainage canal system in the Priority Area. The drainage pumping station is one of the important facilities in Egypt, however, there is no any problem as same as the drainage canal system. The operation and maintenance has been done by MED.

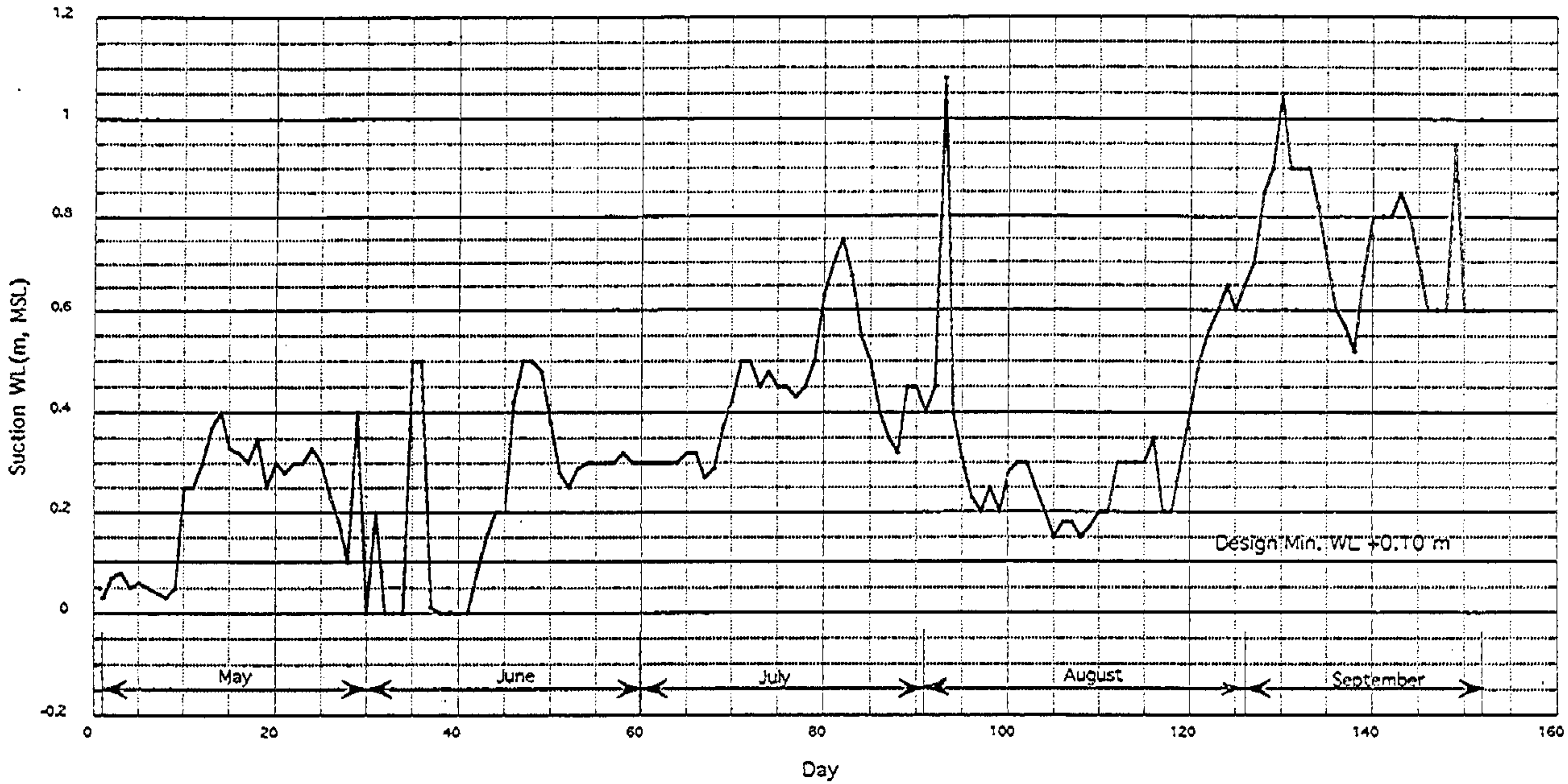
(2) Branch drainage canal

A branch drainage canal which unlined has a function to convey drain water from a field to the main drainage canal. The canals are also maintained by Drainage Authority as same as the main drainage. There is no any problem at present.

(3) Farm drainage canal

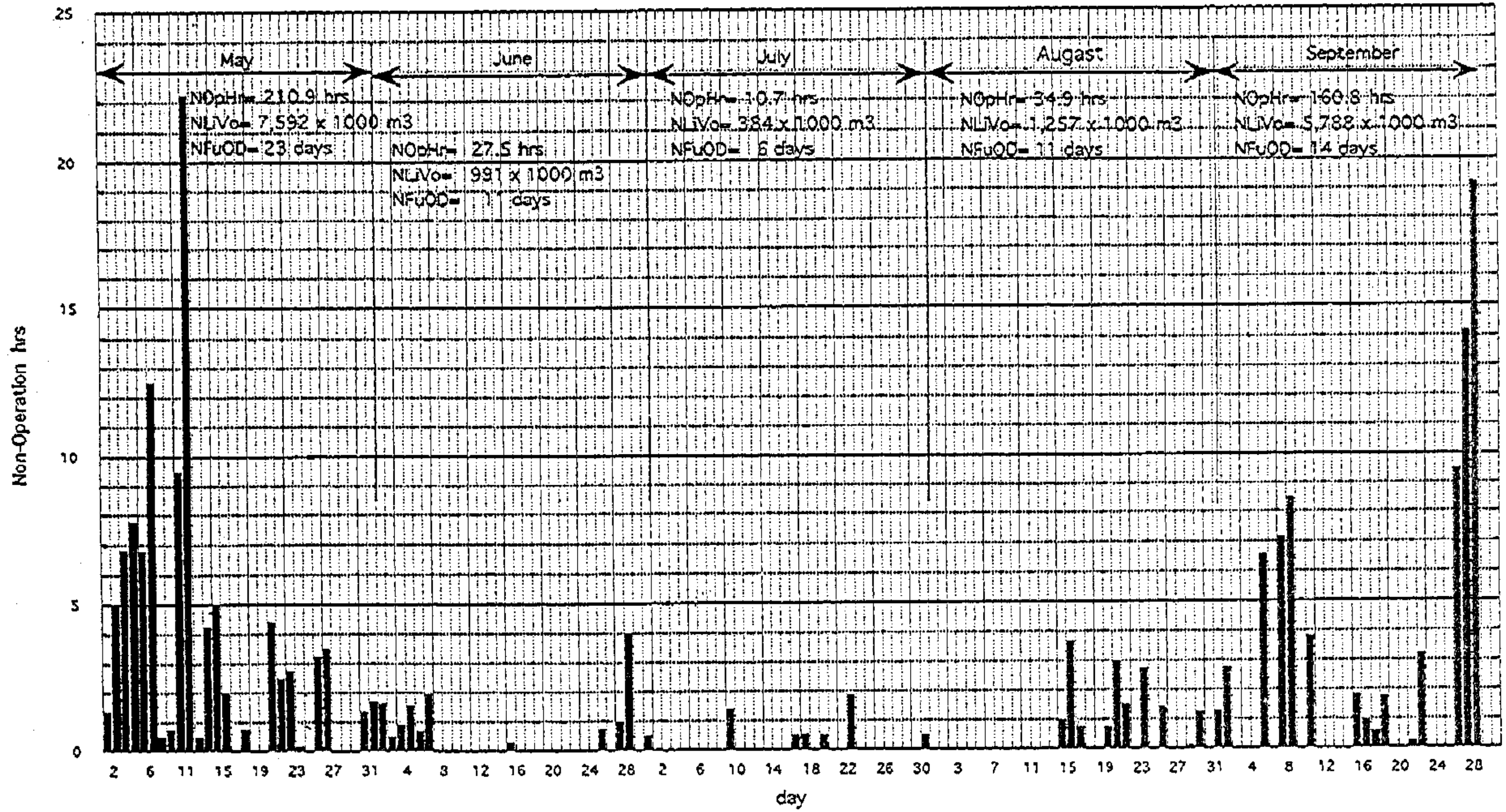
There are two (2) kinds of farm drain systems in the area as open farm drain and other tile drain (sub-surface drain). The open farm drain has a dimension of canal bed width of 1.0 to 2.0 m and a canal depth of 2.0 to 3.0 m without paved. While a tile drain is introduced to draw down groundwater table at a field . The collector pipe of concrete and PVC materials with a diameter of 100 to 300 mm is buried about 1.3 m on average underground and its spacing is between 40 to 60 m, while a corrugate PVC pipe to absorb water in soil with a diameter of 75 mm is placed with a space of about 20 to 30 m based on the soil condition of the project area. The pipe is covered by sand and gravel filter for easy drainage water. On the way of collector, manhole structures are provided to check and maintain the collector pipe, which is placed every 100 to 200 m interval depending on the soil conditions. Due to the lack of relief well, it is impossible to control the groundwater table. The distribution of tile drain is set according to the land form without regarding to the field lot boundary. There are some areas where farmers are reporting the lowering of efficiency of ever installed tile drains.

Figure 1.7.1 WL Record at Suction Side of Hamoul PS in 1996



Source: MED, MPWWR

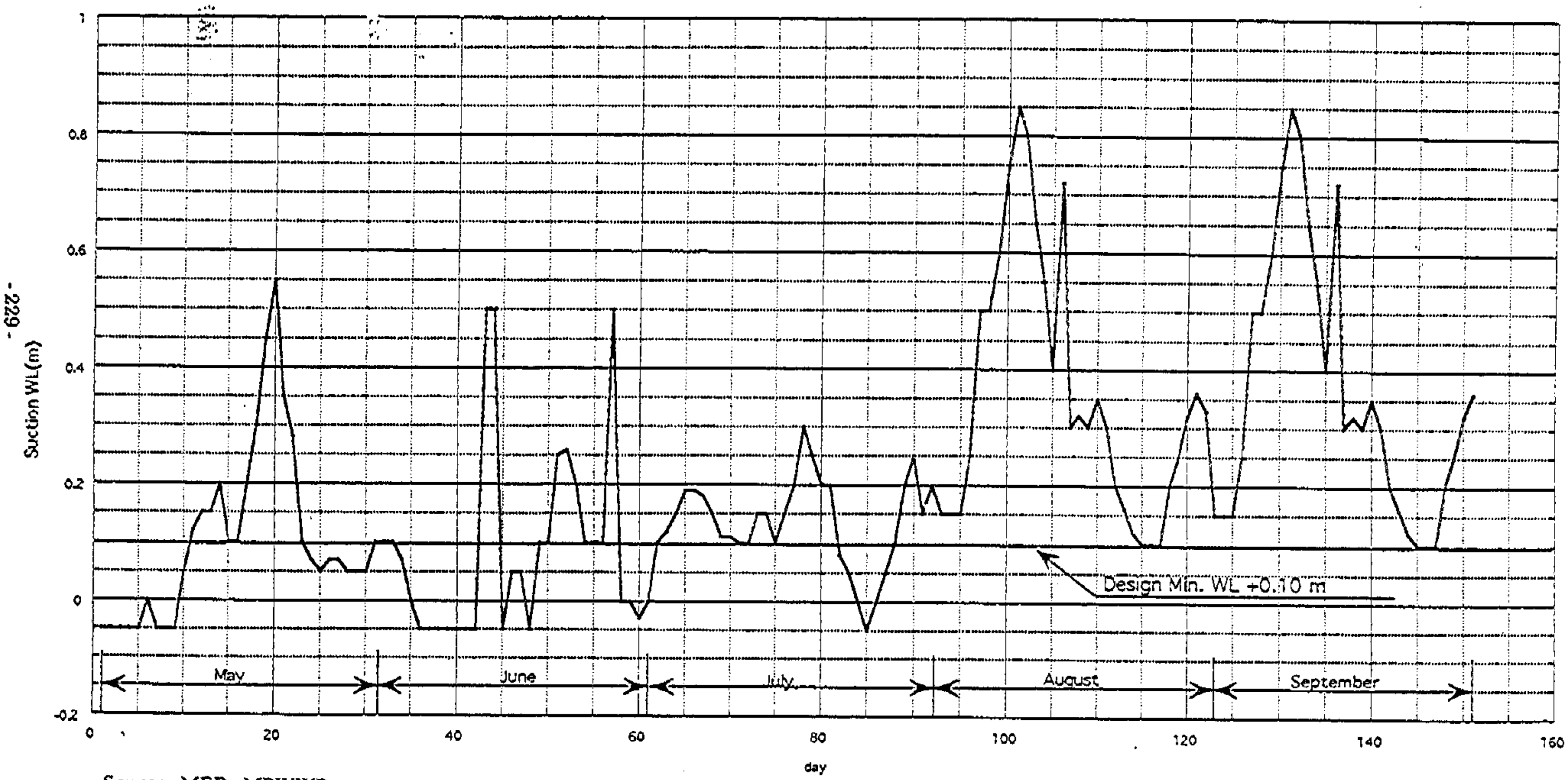
Figure 1.7.2 Estimated Non-Operation Hours at Hamoul PS in 1996



Note: NOpHr = Non Operation Hrs (hrs)
NLiVo = Non Liftable Water Volume ('000 cum)
NFuOD= Non Full Pump Operation Day (days)

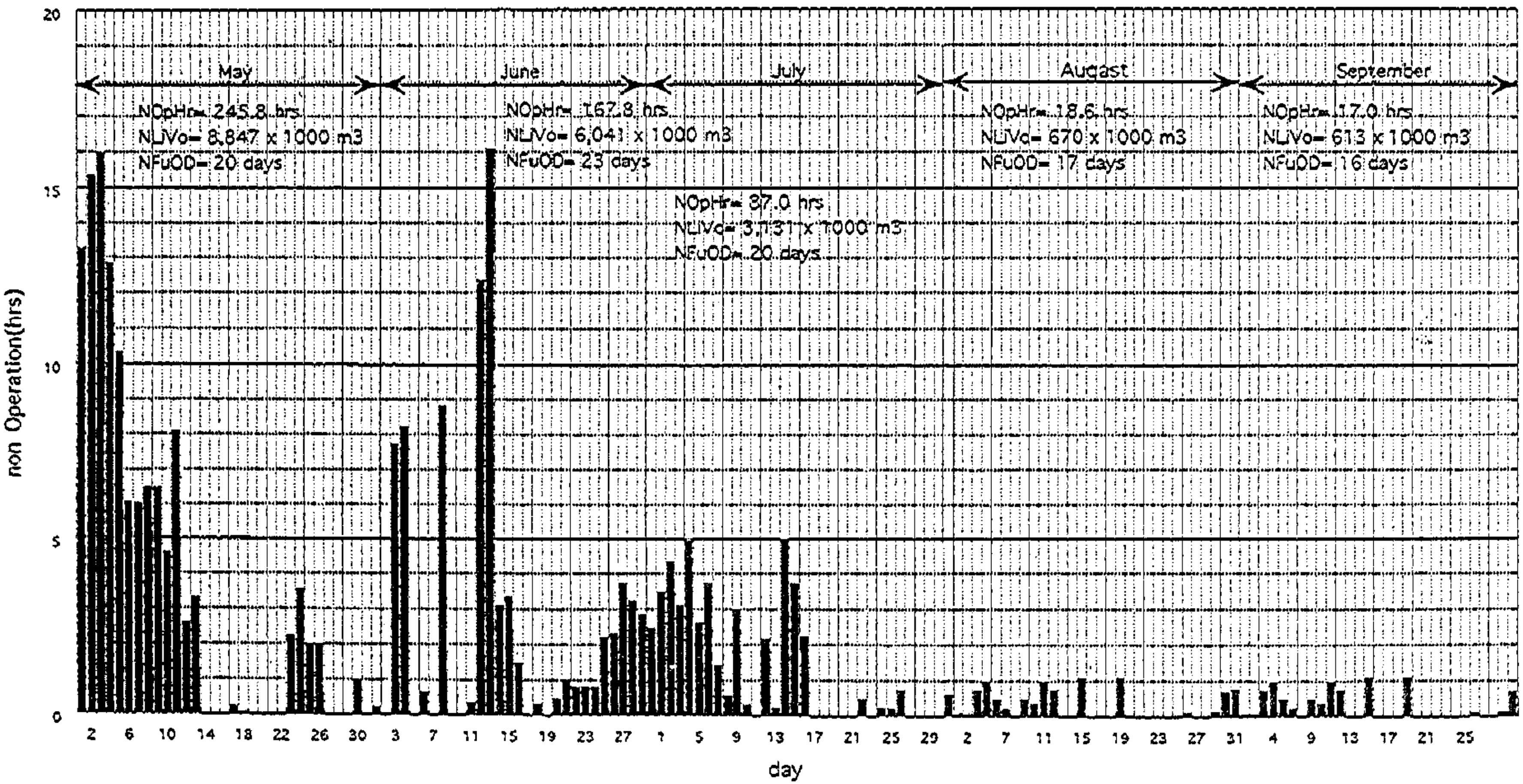
Source: JICA Study Team
Original Data from MED

Figure 1.7.3 WL Record at Suction Side of Hamoul PS in 1997



Source: MED, MPWWR

Figure 1.7.4 Estimated Non-Operation Hours at Hamoul PS in 1997



Note: NOpHr = Non Operation Hrs (hrs)
NLiVo = Non Liftable Water Volume ('000 cum)
NFuOD= Non Full Pump Operation Day (days)

Source: JICA Study Team
Original Data from MED

1.8 Water Quality Environment

1.8.1 Water Quality Environment

(1) Location of Water Quality Survey and Method

Water quality survey was carried out at 113 points in the Study Area. Thirty eighteen (38) irrigation canals and Meska, eleven(11) drainage canals, and two(2) subsurface drainage water from crop fields were used as observation points(refer to Figure 2.8.1). Measurement items used were water temperature, pH, turbidity, electric conductivity, dissolved oxygen, sodium, calcium, and magnesium. Water quality measurement was done by the Study Team using Water Quality Checker (U10 type), Ion Meter, and colorimetric method.

(2) Water Quality of Irrigation and Drainage Canals

Water quality of irrigation canal are classified mainly into two (2) category areas, good quality and worst. One area, west side of Bahr Tera canal, south of Biyala town, and east side from Bahr Tera canal up to about eight (8) Km has good water quality. On the other hand, area polluted is east side far from Bahr Tera canal after about eight (8) Km. This area is moderately polluted with 450 to 2,000 mg/l TDS level and three (3) to nine (9) SAR level. Problem canals are the El Shorafa, Bahr Biyala downstream, and Bahr Banawan downstream(refer to Appendix K).

TDS of drainage water ranged from 450 to 2,000 mg/l. These are considered as moderately polluted. Partial drainage water are polluted in serious situation more of than 2,000 mg/l (refer to Appendix K).

1.8.2 Soil Environment

The soil cracks at certain periods in dry condition that are one (1) to two (2) cm wide and at depth of 30 cm after harvest in the rice field. Therefore, growth of crop roots is dominated by physical condition of the surface layer. After harvest of summer crops, farmers change cultivation procedure of soil surface and water management to avoid this phenomenon, from rice to berseem or beans, and from cotton to potato.

By increasing the sodium concentration and its proportion to calcium plus magnesium content in the irrigation water, the soils become salt-affected and/or alkalifying. At the present, salt-affected soils are improved by the application of one (1) to five(5) of gypsum in the Study Area(refer to Appendix K).

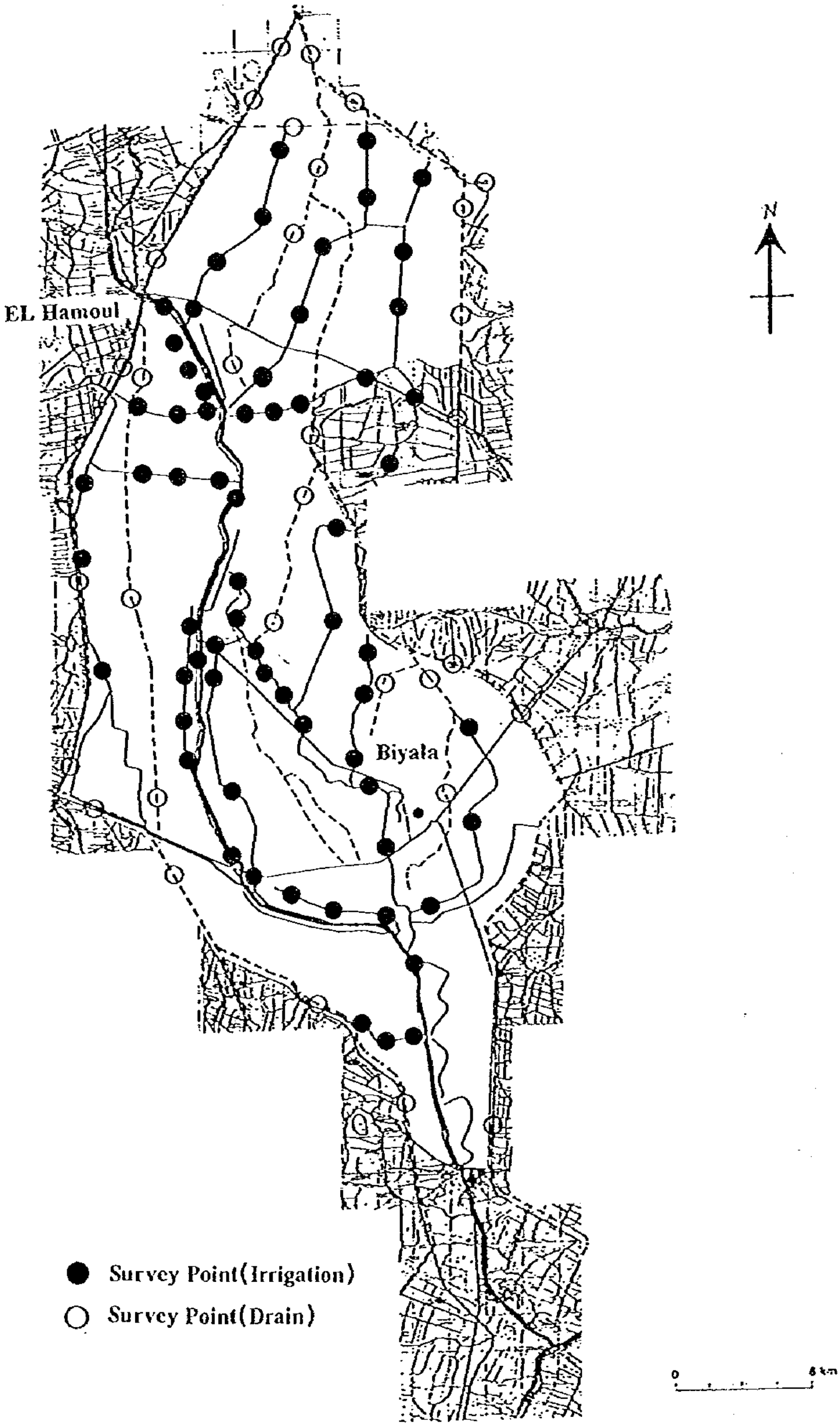
1.8.3 Current Situation for Life Water in Canal

Canal waters are also utilized as washing, tableware wash, and bathe of cattles. Toilet water are discharged directly in the partial areas. Farmers are anxious for diseases caused by water pollution and in conformity to life water, and demand strategies for water quality improvement(refer to Appendix K).

1.8.4 Water Quality Environment Analysis by Flow Diagram

Water quality environment was analysed to determine factors affecting water quality. Area was divided into three areas from Bahr Tera canal intake. Results shows an increase of TDS and salinity loads from the upstream area to the downstream area both of summer and winter crop season. This difference is due to the life drainage and fertilization amount caused mainly by population and upland crop area. TDS and salinity loads will be decreased with the improvement of irrigation efficiency and conversion of cropping pattern. However, irrigation water can be increased with the provision to the areas of the north from Hamoul pumping station. These need further examination for a detailed analysis (refer to Appendix K).

Figure 1.8.1 Location Map of Water Quality Test in the Feasibility Study Area



1.9 Problems and Constraints

1.9.1 Rural sociology and farmers' organization

(1) Problems on farmers' willingness and establishment of WUAs

IIP inauguration and its implementation are to be based on farmers' request in principle, however these decisions have actually been derived from scheduled IIP implementation by the governmental under the sign of the minister of MPWWR. This "top-down" decision is conveyed to the farmers of each delivery canal through directorate offices. According to the four criteria stipulated between MPWWR and USAID to issue budget for construction works, necessary maturity should be satisfied among concerning farmers.

However, after the preliminary survey and explanation done by IAS, a WUA is established if agreement is gained from farmers whose farmland occupies more than 30% of canal command, regardless of maturity among farmers. For these procedures, it takes usually 3-6 months only. This rough-and-ready procedure will inevitably cause a poor performance in IIP because farmers hardly have chances to exchange views about the necessity of IIP and about its desirable contents such as custom fit design etc. From now on, therefore, IIP inauguration and its implementation should actually be based on the farmers' request. In other word, any IIP will not be implemented if farmers' willingness and mutual consent among them are still not enough. (Refer to Appendix J.4.1)

(2) Problems on technical supports to WUAs

At present, a series of training course is executed by IAS staffs for councilors of WUAs after its establishment, and this job has so far occupied majority of IAS staffs' working time. Another problem on technical support to WUAs is a lack of permanent service measures for the pump equipment after the completion of the IIP. Regarding this matter, many farmers responded to the questionnaire survey. In this connection, for example, a function of MED(Mechanical & Electricity Department) should be strengthened from medium to long term view point specifically in the field site because the government is aiming at dissemination of successful IIP to whole of the nation (i.e. to 3,480,000F by 2017 year) and it means more than 50,000 of one-point lifting pumps would be installed at last. (Refer to Appendix J.4.2)

(3) Problems on financial supports to WUAs

Since the existing IIP has been implemented under the foreign grant aids and/or not reaching to the repayment period in the case of World Bank project, cost recovery problem has not become intensified so far. From now on, however, beneficiary farmers must bear IIP expenses, thus the capacity of repayment as well as O/M costs in farmers will become one of the most serious problems. Therefore, this problem should be taken into consideration mainly from the following three issues.

a)Lightening of the repayment period etc. for IIP
b)Advantageous supporting systems for a limited period
c)Re-allocation of O/M execution in delivery canal basis

a) Regarding lightening of the repayment period etc. for IIP, as shown in the collected data, pump procurement as well as collection of O/M fee encompass several problems even now. Besides, the future implementation of IIP in each delivery canal basis means that financial systems of the Federation of WUAs would be much complicated, when compared with meska basis WUAs, where a problem of cost sharing among farmers is included. Under such circumstances, it would necessitate some years in stabilizing new systems. Bearing this in mind, current regulations regarding the repayment period etc. for IIP should be lightened(In more detail, refer to 2.11). (Refer to Appendix J.4.3)

b) Regarding advantageous supporting systems applicable within a limited period only, some attractive and acceptable systems of financial supports for farmers should be introduced for new IIP implementation in each delivery canal basis.

c) Another problem is preparation of budget necessary for the period just after the turnover of canal O/M from the government to a Federation of WUAs. According to the collected examples from the Upper Nile areas (Herz Nomaniya etc.), around LE 70/F /year of budget is required for the sound O/M of meskas and around 2,000 LE/meska should be stocked anytime for emergent uses such as for pump troubles etc. Despite it, the Federation cannot stock enough budget for these purposes at its early stage. Therefore, some proposal of government subsidy is required. (Refer to Appendix J.4.3)

Regarding re-allocation of O/M execution in delivery canal basis, a premise that "a total cost necessary for O/M of a meskas cum delivery canal is to be decreased" should be satisfied until otherwise such re-allocation will have no meaning. It is estimated that a total cost necessary for O/M of meskas cum delivery canal could be decreased if joint O/M system of meska cum delivery is realized by a Federation of WUAs. Thus, it is quite reasonable for the government to pay a sum of LE3-5/F within the current budget when it decides a turnover of O/M jobs to a Federation in each delivery canal basis. Incidentally, such consignment allowance should be discriminated from LE5/F to zero to encourage farmers in accordance with the quality of O/M performance. (Refer to Appendix J.4.3)

(4) Problems on the Gov't commitment and legal framework

This subject is classified into the following four items.

a) Expansion of farmers' authority/ responsibility centering on Federation of WUAs
b) Cheap and quick implementation of IIP
c) Interaction among related organizations
d) High level commitment by the Government

a) The expansion of farmers' authority/ responsibility is reasonable direction since crop diversification will be enhanced year by year in accordance with the privatization policy and ways of irrigated agriculture will become much complicated in the future. Under such circumstances, management of terminal irrigation/drainage should unavoidably be turned over to the farmers with legal endorsement. Such example can be seen in the activities of LWB(Local Water Board) in Fayoum endorsed by Decree No.263 of 1997, and this enlightening example should be reinforced and applied in the whole country centering into clarification of authority/ responsibility to the Federation of WUAs.

Another problem to be considered in this item is more active participation of women to farmers' organization. In other countries such as India and Laos, women involvement in WUAs is ruled by relevant regulations when a WUA is established. However, such examples are not necessarily applicable to Egypt mainly due to the traditional customs. Bearing this in mind, it might be recommended to establish a women's conference as an annex to a WUA. This conference is expected to contribute to a WUA not by direct participation in water policy decision, but by acting indirectly as a catalyst to convey necessary information for the better rural life like environmental issues, rural welfare and daily learns among women etc. For this purpose, the conference is to be composed by at least two members and they will report matters concerned directly to the chairman of the WUA. In the same way, a women conference will be attached to a Federation of WUAs, too.

b) Regarding cheap and quick implementation of IIP, the Egyptian government is aiming at the direction of future IIP in which expenses for construction and rehabilitation works (i.e. hardware works) are the less the better and IIP performance be gained as much as possible through the turnover of terminal O/M works to farmers' organization (i.e. software works). Also it is targeted to implement IIP in about 780,000 feddan (330,000 ha) by year 2002, 1,680,000 feddan (710,000 ha) by 2007, 2,580,000 feddan (1,080,000 ha) by 2012, 3,480,000 feddan (1,460,000 ha) by 2017. Understanding this direction, still a minimum hardware works should be undertaken since several unsuccessful examples can be seen in other countries where O/M works had been turned over to farmers' organizations without good physical condition of irrigation structures and as a result farmers had neither got stable water nor been willing to effort toward better O/M due to such physical shortcomings. Minimum hardware works necessary prior to the turn-over should be reinforcement of a gate at the head of delivery canal and lock structures at the tail-end points of each Meska and delivery canal.

c) Interaction among related organizations should be strengthened through the two ways. The first is arrangement of correlative sections of irrigation, drainage, mechanics and agronomy etc. in a Federation of WUAs, and the second is an active participation of officers/engineers to a Joint Committee which is organized between the government and farmers. Expected officers/engineers may be a District engineer, Area drainage engineer, Mechanical engineer and Agricultural manager etc. from each district-level office.

d) Regarding high level commitment by the government, so-called "the carrot and stick policy" should be introduced. As examples of "carrot", several advantages aforementioned should be precisely presented to concerning farmers. By contrast, although "stick" has probably never been presented so far to the farmers, this should be also shown to them in justifiable ways explaining that the government cannot avoid re-allocation of water resources and relevant budget from the existing farmland to the newly reclaimed area and/or to the more potential area being supported by highly willing farmers. In other word, it means farmers are indispensably required to guarantee necessary water through their self reliant manner from now on, no matter how they accept IIP. (Refer to Appendix I.4.4)

(5) Problems on Monitoring and Evaluation(M/E)

So far, M/E for the existing IIP has hardly been carried out in full-scale and systemized ways. Towards the final target of IIP implementation for 6,734,000F by 2017 year, however, compilation of systemized and highly reliable data is absolutely necessitated. In this context, following two categories of M/E should be executed. They are

* Stage-wise M/E throughout IIP procedures
* Overall M/E to compare "before" and "after" IIP

Taking into consideration current situation of insufficient number of IAS staffs, the first category is recommended to be carried out by farmers under a contract between IAS and a Federation of WUAs with reasonable payment. In this case, submitted data/information of

M/E will be checked by IAS and be input to computerized data-base system. For this purpose, an existing M/E format should be rearranged into simpler ways, and a computer system itself should be set up in IAS headquarters. Such system is expected to be transmitted to Federations of WUAs from the long term viewpoint.

On the other hand, regarding the above mentioned second category, there are some useful methodologies developed by international organizations like World Bank and IIMI. In such methodologies, as shown below, quantitative indices are used. By this, they are favorable to compare the performance of Egyptian IIP with that in the other countries.

*1: Agricultural output per cropped area = Crop production / Irrigated cropped area ($/ha)
*2: Agricultural output per unit command = Crop prod. / Command area($/ha)
*3: Agricultural output per unit irrigation supply = Crop prod. / Diverted irrigation supply($/m^3)
*4: Agricultural output per unit water consumed = Crop prod. / Vol. of water consumed by ET($/m^3)
*5: Relative water supply = Total water supply / Crop demand (in ratio)
*6: Relative irrigation supply = Irrigation supply / Irrigation demand (in ratio)

1.9.2 Agriculture

(1) Low Crop Yield in Downstream Area of Canals

Lower crop unit yields are found in the downstream area of canals, where there are problems of inadequate and untimely irrigation. The crop yields tend to be lower in the Meska downstream for most delivery canals.

(2) Crop Diversification and Location of Canals

The location of vegetable cultivation are limited to the head portions of the delivery canal or at the vicinity of the delivery canals. Since, vegetables need adequate and frequent irrigation, the introduction of vegetables are hampered by untimely and inadequate irrigation except the head portions and adjacent areas of the canals.

(3) Decrease of Orchard Area and workability of Subsurface Drainage System

Year round irrigation water is available since the Aswan High Dam supply water in the Nile delta area including the Priority Area. Statistically, there is a trend of decrease in the orchard area, which may be caused by the rising-up of water table. The large coverage area of rice and over irrigation at the head portions of the irrigation systems aggregate this situation.

(4) Excess of Rice Cultivation and Low Vegetable Production

The rice area have increased considerably in the Priority Area. However, the cropping intensities of vegetables area are very low, less than three percent in both summer and winter seasons. Moreover, the unit yield of vegetables area low especially in the downstream area. This is related to the saline soils in the area, where development of vegetable cultivation are disturbed by the saline soils.

(5) Infestation of "Estacoza" and Leakage of Irrigation Water

It is observed that the " Esatcoza" is widely invading the Priority Area, causing irrigation water leakage from the field to the canals. One of the most effective measures to control the inhabited " Estacoza" is the lining of canals or installation of pipeline with drying - up in the field.

(6) Marketing

The small-scale farmers who do not have the means to get market information bring their products to the middlemen and large-scale farmers. Due to high marketing risks for vegetables and fruits whose prices drastically fluctuate, the contracts between the small-scale farmers and the dealers are of two (2) types. One is through advance payment (the higher the prices, more profits will be received by the dealers) and deferred payment (the dealers try to keep their profit with this mean). With this means, the dealers take advantage of small-scale farmers since they have more market information. To expand vegetable production in the Priority Area, improvement of the dealing condition of products for the small-scale farmers who are the majority in the Priority Area will be required.

1.9.3 Irrigation and Drainage

- Hamoul mixing pump station (MPS) sometimes stops operation when the water level in the Gharbia drain is low because Gharbia Drain is already almost fully developed for the reuse. This requires 1.0 MCM/day as compensation from Bahr Tera in order to irrigate the downstream districts of Mansour and Balteem. This arrangement causes water dispute among Gharbia, West Dakahlia and Kafr El Sheikh Irrigation Directorates.

- The canal cross section between Abshan Lock and Hamoul is not sufficient to convey the additional 1.0 MCM/day. These is a need to raise the bank of the sections that is not high enough to convey the additional 1.0 MCM/day. Widening the Bahr Tera's sections cannot be undertaken due to the existing roads running along the canal and residential areas nearby.

- Submerged weed problem arises specially during winter in Bahr Tera and its branches. This weed creates losses and decreases the volume of the flow under the designed level. (No submerged weed exists after the Hamoul MPS because of the saline water.) At present, excavator or dragline is used to remove the submerged weeds. However, this is not efficient enough to take out all the roots.

- Illegal rice cultivation prevails specially in the Biyala District. The present permitted area for rice cultivation in the upstream of Bahr Tera is 50 % but the actual rice cultivation area reaches by as much as 70 %, leading to excessive water usage and decreasing the water that has to be conveyed to the downstream.

- Environmental problems such as sewerage emission and domestic wastes arise for the canals passing through the residential areas. The canal suffering mostly from the waste is the Tahweelah Bahr Biyala, and to the lesser extent, Bahr Biyala, Hazek, Abshan, El Mahatta, and Ganabia No.7 Left.

- There is no means of communication (telephone) between Biyala District and the gate keepers of Abshan Regulator and Bahr Tera intake. Also, gate keepers and field workers face transportation problem. Not even bicycles are provided.

- The intakes and bed levels of Ganabia No.2 Right and Ganabia No.10 Right are high, hence, they cannot intake enough water from Bahr Tera specially during winter season, thus requiring rehabilitation work. Intake gate is not installed at El Kafr El Sharkie canal. Also, the intake of El Mahatta canal is very small (400 mm pipe with slide gate) and very old. These two intakes require replacement.

- Waste spillage at the tails of the delivery canals are mostly negligible. However, the tail structures of Banawan Branch and El Shorafa canals are old and cannot not be properly operated. These tail structures need replacement.

- Though most Meska do not discharge any considerable waste spillage to drains downstream, there are 4 Meska, tails of which are opened and connected to drain. One of them was reported to discharge irrigation water to the drain downstream most often, leading to waste spillage.

- Water shortages prevail in the Priority Area, specially for such canals as Bahr Biyala and Abshan, because of illegal rice cultivation, long reach of some canals, weeds and domestic wastes decreasing designed capacity, congestion of daytime irrigation forcing night irrigation, and so on. Referring to the farmers' view, they gave the most common reason of water shortage to being off-period under the rotational irrigation system. Farmers tend to think that off-period under rotational irrigation is too long period during which they feel unable to irrigate.

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

- Despite the fact that water shortage prevails, as much as 50 % of farmers recognized that there were excessive irrigation dosages that went to drain, leading to waste spillage, or returned to canal/Meska. This leads to low on-farm irrigation efficiency.

1.9.4 Water Management

Water management issues in the Priority Area can be divided into a macroscopic viewpoint and a microscopic viewpoint. The macroscopic viewpoint refers to an overall or complex overlook on management problems in terms of institution, facilities, water distribution and information. It is able to conclude that there are no specific macroscopic problems to be identified at present but they will emerge within several years when the water situations become tight and severe.

Meantime, the microscopic viewpoint means individual identification of constraints relevant to institution, facilities, water distribution and information flow over the area. The microscopic issues are extensive and numerous if they are identified item by item. However, unless the macroscopic issues are substantially resolved, the microscopic issues will be repeatedly generated according to their natures.

It is therefore required to first overcome the macroscopic issues focusing the target upon specified subjects, setting the target deadlines and mobilizing the entire resources in relevant organizations.

1.9.5 Irrigation and Drainage Facilities

Since, there are many old facilities in the Priority Area, low efficiency and poor facilities condition cause the increase in the O&M cost and the loss and/or waste of water and time. The problems and constraints of these facilities are summarized as follows:

(1) Irrigation Facilities

Rahbeen regulator is deteriorated. Some of the gates and manpower hoist system as well as the canal bottom are scoured at the upper and lower locations. On the other hand, during the peak operation (150 cu.m/sec), it was observed through the regulator a surplus water level of about 0.7 m. It takes much time to operate due to the old gate. Land around the regulator is private owned land, hence the land acquisition is difficult.

To control the water supply at the downstresm, there are two (2) structures of Bahr Tera intake and Abshan regulator on the Bahr Tera main canal in the Priority Area. The gate operation is not smooth in the officers in Tanta and Kafr El Sheik. The operation sites the lack the necessary operation equipment and facilities.

Hamoul MPS is lifts drainage water from the Garbia drainage canal for irrigating purpose to the downstream area in Bahr Tera command area. However, these pump facilities have been used for 36 years and the pump efficiency is degraded. It is reported that cavitiation occurs when water level of drain drops. To avoid cavitation, MED stop pump operation. As a result, farmers, at the downstream of the Bahr Tera canal, suffer from water shortage.

On the Tera main canal section, from 3.5 km to about 35 km, the right bank elevation is low (0.5 m to 1.0 m). The low elevation is about about 20 km. Also, 4 m to 6 m of the bank width are not the same. At present the canal water conveyance capacity can not be enhanced.

There are few check structures in the delivery canal in the Priority Area. Therefore, it is rather difficult to divert design discharge to the second delivery canal and Meska. Also, there are many portions with canal side sliding. Delivery canal passing through the village areas are filled with garbage. The garbage obstruct flow of water and cause water pollution.

Earth Meska is in poor condition without periodic maintenance. In the long Meska, irrigation water do not reach the end of Meska resulting in water shortage. There is no governing rule to take water from Meska when water flows into Meska. There is no communication between farmers who cultivate farm lands at the upstream and downstream.

(2) Drainage Facilities

The main and branch drainage canals including drainage pump stations are not in so serious condition in the Priority Area. However, in the north-west part of the area, there is still no sub-surface drainage facility to improve soil and to introduce other crops instead of rice. Some areas with sub surface drainage facility has problem of ineffective and worn out facilities due to over use.

1.9.6 Water Quality Environment

The problems on water quality environmental preservation are as follows.

(1) Pollution Factors of Irrigation Water

The most positive significant relationships are pH-dissolved oxygen, turbidity-sodium and SAR, TDS-SAR, TDS-sodium, calcium, and magnesium, SAR-sodium and calcium. Increasing of TDS is caused by sodium, calcium, and magnesium, and SAR by sodium occupied among three ions (refer to Table 1.9.)

According to the Drainage Research Institute, the correlation between ECiw and crop yield of cotton, maize, rice, wheat, berseem, and bean, respectively, indicates moderate negative relationship which says that as EC of the irrigation water increase, the drop yield decrease(DWIP on Final Report, 1997). It should be noted that increase of TDS and SAR cause salinization of soil.

(2) Water quality of drainage and reuse for irrigation water

The most positive significant relationships are turbidity-sodium and SAR, TDS-sodium, calcium, and magnesium, SAR-sodium and calcium. As industry discharge and drainage from rural district areas flow into the canal, the drainage canal in most areas receives high degree of pollution. Therefore, careful monitoring of water quality is needed for reuse of drainage water (refer to Table 1.9.)

Table 1.9. Correlation Matrix across Parameters of Irrigation Water Quality

	Temp.								
pH	0.153	pH							
DO	0.167	0.541**	DO						
Turb.	0.109	0.169	0.172	Turb.					
EC	0.094	0.235*	0.171	0.543**	EC				
TDS	0.088	0.234*	0.174*	0.536**	-	TDS			
Na	0.096	0.233*	0.221*	0.697**	0.886**	0.884**	Na		
Ca	-0.140	0.257*	0.265**	0.520**	0.841**	0.845**	0.823**	Ca	
Mg	-0.367**	0.095	0.062	0.290**	0.597**	0.601**	0.559**	0.674**	Mg
SAR	0.156	0.242*	0.207*	0.703**	0.852**	0.849**	0.982**	0.757**	0.472**

Note: The measurement was done by JICA Study Team during with October to November in 1998, and numbers of result are one hundred(100) points.
** 1 % level of significance * 5 % level of significance

Table 1.9. Correlation Matrix across Parameters of Drainage Water Quality

	Temp.								
pH	0.467**	pH							
DO	0.461**	0.405	DO						
Turb.	0.053	-0.031	0.296*	Turb.					
EC	0.454**	0.251	0.648**	0.200	EC				
TDS	0.455**	0.254	0.650**	0.205	-	TDS			
Na	0.469**	0.223	0.574**	0.152	0.956**	0.954**	Na		
Ca	0.348*	0.275*	0.530**	-0.193	0.814**	0.815**	0.795**	Ca	
Mg	0.368**	0.108	0.538**	0.141	0.933**	0.931**	0.897**	0.735**	Mg
SAR	0.336*	0.181	0.382**	0.198	0.817**	0.814**	0.920**	0.666**	0.698**

Note: The measurement was done by JICA Study Team during with October to November in 1998, and numbers of result are forty four(44) points.
** 1 % level of significance * 5 % level of significance