A Study of Comprehensive Assessment of Farmers' Irrigation Practice in Egypt
- A Case Study of Irrigation Improvement Project in Egypt -

Water Use and Management Lab. Ahmed MOHSEN ALY

Key word: irrigation improvement, water delivery performance, irrigation time

1. Introduction

Water is one of the most important inputs to the economic development for countries because the size, type, and location of the economic activities depend on the quantity, quality and location of the available water resources. The less the water resources and the more the water demands are the most serious problems in the world. This is the case in Egypt.

Egypt is facing the less water resources challenges by applying policies to improve the performance of the water resources system and its development. Irrigation Improvement Project **(IIP)** is one of the most important attempts in Egypt to implement more effective on-farm irrigation technologies for modifying traditional irrigation system and saving water by improve the existing delivery system in Nile Delta of Egypt with a total area of about 1.05 million ha by the year 2017.

This study aims to evaluate the irrigation improvement project **(IIP)** and to define its impact on water delivery performance on farmer's practices in the field. This study was carried out to evaluate the improved irrigation system and to compare with other unimproved system through irrigation seasons 2003 and 2004 in Wasat command area **(Fig.1)**. The Wasat area is located on the northern edge of the middle Delta and extends from the outskirts of the city Kafr El-Sheikh to the end of the irrigated area bordering Lake Burullus. This area is fed from the tail reaches of the main canal (**Meet Yazid**). Due to its location at the tail of the feeder canal system, El-Wasat command area suffers from inadequate water supplies. This problem is exacerbated by the tendency of farmers to plant more rice than is allowed for in the water allocations.

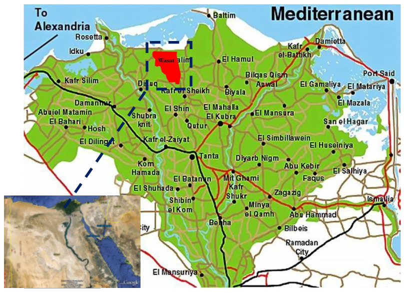

Fig. 1 Study area in Nile Delta

2. Performance Indicators Evaluation

In the study sample **(Fig.2)**, two sample branch canals **(B.C)** were selected for evaluation that are an improved **(Daqalt)** and an unimproved **(Basis)** branch canals. Six tertiary canals **(T.C)** were selected on each the sample branch canal, and six farmers were selected at each the tertiary canal. Group of performance indicators have been selected for the evaluation that are related to this study goals and objectives. This evaluation concern on the performance of water delivery in the old lands in Nile Delta of Egypt after the introduction of some element for the development such as; applying continuous flow in branch canal and converting the multi users for lifting points for tertiary canal to single lifting point.

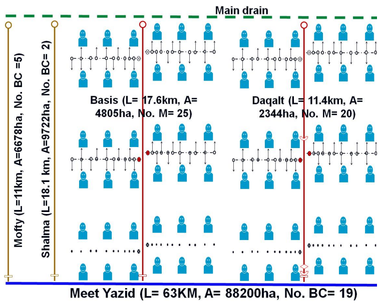

Fig. 2 The study sample

3. Methodology

The evaluation of irrigation management perforamcne the indicators required colletting different data items from irrigation system as; water level, routine discharges and crop pattern for branch canals, pump operations for tertiary canals, and irrigation events at selected farmers. **Table 1** presents the summary of data collection and time schedule.

Table 1 List of data collecting through this study

No.	Type of Measurement	How to measure?	Location	Time	Field
1	Water Level	Automatic Recorder	Through canal	Continuous	Branch Canal Study
2	Gate Operation	Manual Recorder	Head Regulator Canal	Twice Daily	
3	Discharge	propeller-type current meters	Canal Head / Middle	4 / month	
4	Calibration Pump	Ultrasonic Flow Meter	Meska Head	Seasonally	Tertiary Canal Study
5	Collect Pump Operation Data	Questionnaire Sheet	Meska Head	Daily	
6	Collect Field Irrigation Data	Questionnaire Sheet	Selected fields	Daily	
7	Crop Pattern Data	Irrigation Districts	Region Study	Seasonally	All

4. Performance of Improved Branch Canal

This section is designed to evaluate and measure numbers of indicators that directly related to operate improved branch canal. The indicators of evaluation concern branch canals system for water delivery performance, and evaluation new control gates.

4.1. Data analysis

The discharge data in this study were measured by using current meter at selected monitoring locations on the selected branch canals. These measurements are applied at head regulator and intermediate cross section of branch canal. **Table 2** presents summary of calibration equations of sluice gates at the branch head.

Table 2 Summary of head regulators calibrations for branch canals

Canal	Calibration	Percentage	Calibration Equation	R2
Daqalt	Submerged	99%	$Q/H^{0.5} = 5.65\ G – 0.05$	0.84
Basis	Submerged	77%	$Q/H^{0.5} = 9.09\ G – 0.84$	0.87
Shalma	Submerged	32%	$Q/H^{0.5} = 12.63\ G – 0.22$	0.92
	Free	68%	$Q = 0.07\ D^{6.68}$	0.74
El-Mofty	Submerged	86%	$Q/H^{0.5} = 10.40\ G – 0.14$	0.87

Q: Discharge**,** *H*: Head difference of water level**,** *G*: Gate Open**,** *D*: Water level at DS **(m)**

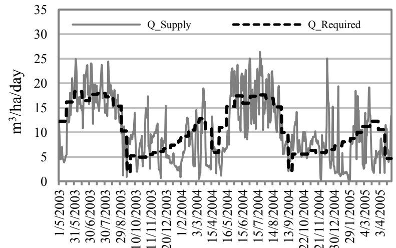

Fig. 3 Ratio Q_S/Q_D for Daqalt canal

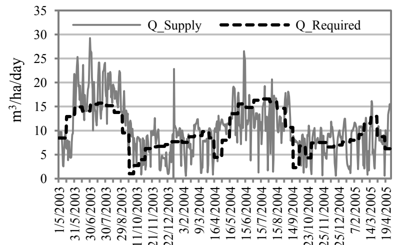

Fig. 4 Ratio Q_S/Q_D for Basis canal

The water supply of the irrigation seasons for Daqalt canal is shown in **Fig.3**. It shows that the water supply in summer 2004 was higer than in summer 2003, although water supply is fluctuating in high ranges. In winter season, the water supply rate for 2004/05 was more than previous seasons. For Basis canal **(Fig.4)**, the water supply in summer 2003 was high. However in the irrigation season of 2004, there was a shortage in water supply.

4.2. Performance Assessment

4.2.1. Water Delivery Performance of B.C System

Adequacy, efficiency, equity, and dependability of water delivery were measured using four indicators, proposed by Molden and Gates (1990). For main canal and branch canals system, the performance standard for the water delivery of adequacy, equity and dependability were relatively “poor”, while the performance efficiency was “good”. However, the trend values of performance indicators were gradually improved in the following irrigation seasons for improved canal.

From the performance indicators results, it was found for both improved and unimptoved branch canals are the same. Therefore, the improved items that installed in Daqalt canal are not effective and the function of continuous flow is not applying in improved canal. The main problem is imbalance of automatic gate that installed through intermediate sections. The values of four performances indicators were indicated systemic water delivery problem. This is due to the water shortage in main canal (Meet Yazid) during the irrigation seasons and other water delivery problems, such as; (i) the absence of crop production planning for different locations of branch canals, especially irrigated rice crop in summer seasons. (ii) there no water delivery plan for branch canals which based on the water level only.

4.2.2. Evaluation Automatic Gate in Improved B.C

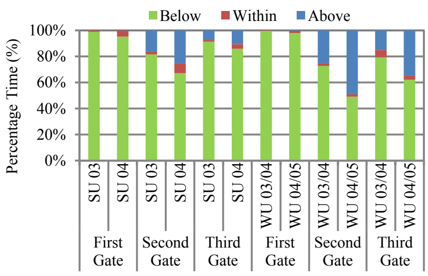

Fig. 5 Water level control by automatic gate

The evaluation of new control gate depend on the frequency counts of the time periods when the water levels immediately downstream of the new gates were below, within or above the control gate ranges. When the water level is below the gate control range that gate should be fully open. When the water level is within the gate control range the gate should be operational and should be able to control the water level as designed. When the water level is above the gate control range this indicates some problem in the operation of the gate as it should have been fully closed to prevent such high water levels. The results of this analysis are shown in **Fig.5** for Daqalt canal. The figure indicated that the water levels were above gate’s control range between 20-30% of the time, i.e. the new control gates were not functioning properly. This could be attributed to the following reasons: i) the gates were not balanced, ii) the free operation of the gates was restricted by tampering or accumulation of garbage underneath the gates, and iii) there was excessive leakage from the gates when they were fully closed.

5. Performance of Improved Tertiary Canal

This section is designed to evaluate and measure numbers of indicators that directly related to operate improved tertiary canal **(meska)** and farmers' practices in the field. The indicators of evaluation concern the system for water delivery performance, irrigation time and operation efficiency.

5.1. Data analysis

The data of the selected meskas and fields were collected in three sheets, which are: (i) *Calibration Sheet*, which describes the pump characteristics, (ii) *Pump Operation Sheet*, which describes the pump operation, and (iii) *Irrigation Time Sheet*, which describes the irrigation time for selected fields for each meska.

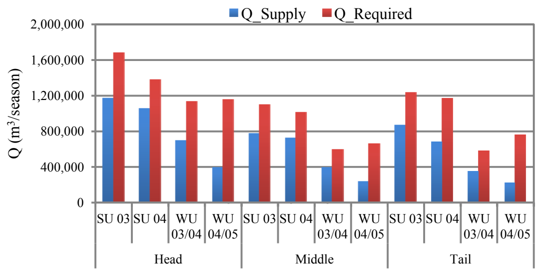

Fig. 6 Ratio Q_S/Q_D for improved meska in Daqalt canal

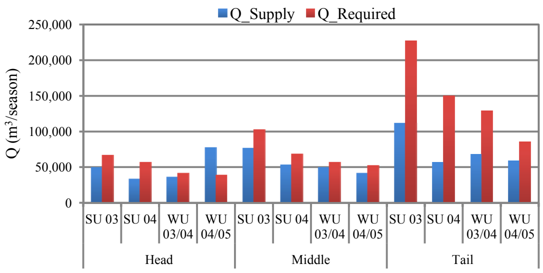

Fig. 7 Ratio Q_S/Q_D for improved meska in Basis canal

For meskas in Daqalt canal **(Fig.6)**, the water supply is stable in summer seasons and higher than in winter seasons. While the water requirement decrease in the following summer seasons and vice versa in winter seasons. However, there are clear water shortage through irrigation seasons. For meskas in Basis canal **(Fig.7),** the water supply in the tail location is higher than other locations of meskas due to use the water supply from drain through the irrigation seaons.

5.2. Performance Assessment

5.2.1. Water Delivery Performance of T.C System

Adequacy, efficiency, equity, and dependability of water delivery were measured using four indicators (Molden and Gates, 1990). For tertiary canals system in both branch canals, the performance standard for water delivery of adequacy, and dependability were relatively "poor", while efficiency was "good", and equity were "good" and "fair" for Daqalt and Basis canals, respectively. For farmers practices level, the water delivery performance of both branch canals of adequacy and dependability were relatively "poor", and for efficiency was "good" and equity was "fair" in all irrigation seasons. The performance indicators results are the same between the meskas and fields that located in both the branch canals. However, the performance for the improved meska is amost equal for all locations through irrigation seasons. The reasons for water delivery problem are these: (i) the absence of crop production planning between the farmers, (ii) there no water delivery plan between to fields, especially unimproved meskas; and (iii) the capacity of some fields is relatively small to demand.

5.2.2. Irrigation Time per Unit Area

From **Figs.8 and 9**, the irrigation times per unit area in Daqalt canal are lower than in Basis canal for all meska locations and main crops through irrigation seasons. In summer season, the average irrigation time for the improved meska is about 40% to 70% compare to unimproved one, and 60% to 80% in winter season. This is due to irregular irrigation time between the fields in meska and depends on the schedule of water user associations **(WUA)** through improved meska, and improved fields by their intake.

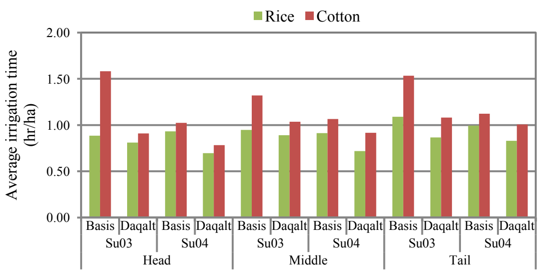

Fig. 8 Average irrigation time for summer seasons

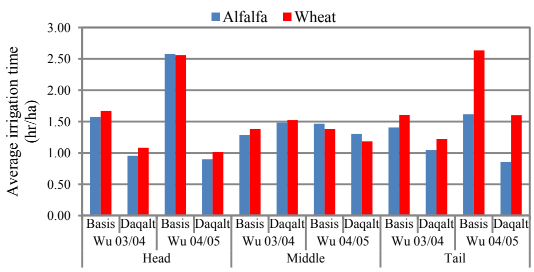

Fig. 9 Average irrigation time for winter seasons

5.2.3. Incidence of Night Irrigation

Table 3 shows the number of night **(N.I.)** and total irrigation **(T.I.)** in different location for meskas. For both canals, there are no night irrigations during summer season 2004. While the night irrigation is higher in Basis canal during summer 2003. During winter seasons, the night irrigation of the improved meska at tail or head is about 6% of total irrigations. For unimproved meska, the night irrigation at tail is about 3% and 9% at the middle.

Table 3 Summary night irrigation and total irrigation in different location of meskas in both branch canals

Canal	Season	Meska Head		Meska Middle		Meska Tail	
		N. I.	T. I.	N. I.	T. I.	N. I.	T. I.
Basis	Summer	18	130	40	225	87	351
Daqalt	2003	4	290	13	209	24	206
Basis	Summer	2	101	0	151	0	200
Daqalt	2004	0	179	0	204	0	179
Basis	Winter	6	67	6	108	5	166
Daqalt	2003/2004	4	96	1	98	0	98
Basis	Winter	2	64	0	89	2	111
Daqalt	2004/2005	4	63	1	76	4	72

6. Impact Improved B.C on Improved T.C and Farmers' Practices

In this section, the results of various components for the improved irrigation system are analysised to provide more insight the results, cross check the result and to understand the farmers' practices in the field. From the water delivery performance results for the improved irrigation system, three reasons made the water delivery performance in poor level for B.C, which incude the water shortage in the irrigation system, the function of automatic gate through branch canals, and applying the continuous flow. These three reasons have affected the improved T.C and conseqently affected the farmers' practice.

The relation between the operations time of meskas and irrigation time of fields is regular and stable throughout the irrigation seasons. For most of the time, the operation time of improved meskas were started at 7:00 am especially for middle and tail's meskas. The operation times of meskas at night were at the tail of meskas during summer seasons, while at the head of meskas during winter seasons. The time irrigation for fields is regular and stable throughout the irrigation seasons. The summer season 2003 was more regular in irrigation for farmers.

7. Conclusion and Recommendation

7.1. Conclusion

The water deliveries in main canal are less than the design values and restricted the implementation of the continuous flow in the improved branch canals. The low performance of the most branch canals due to the variation of the cross section from the design ones. Continuous flow is controlled in a manner similar to rotational supply. The new control gates are partialy not functioning properly because of tampering. Water distribution in the sample improved meskas was slightly better than that between the sample unimproved meskas. Generally, the water use efficiency at the improved meska level increased. Farmers' practices efficiency or the consistence of the average irrigation time for a specific crop at different locations was achieved in improved field.

7.2. Recommendation

The performance of water delivery system at the improved branch canals level can be achived by adapting the following recommendations: (i) modify the cross section as design cross sections and changing to canal lining through canal length; (ii) water user's association (WUA) has a positive effect on the irrigation time and equity water distribution between them. Therefore, it is essential to expand the responsibility of WUA from tertiary canal level to branch canal level; (iii) routine monitoring for new control gate and cleaning around it from the trash and constraints; and (iv) remove all old head regulators and cross regulators of branch canal and change the mode of operation of the branch canals from rotational system to continuous flow, and it will improve water delivery services to the farmers and it will give more flexibility to the water management system.

Reference

Molden, D.J., Gates, T.K., 1990. Performance measures for evaluation of irrigation water delivery systems. J. Irrig. Drain. Eng. 116 (6), 804-823.