Performance Assessment of Government Managed at Main Irrigation Network in the Nile Delta

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1. Introduction

The global water crisis is reaching a peak and increasing intensity due to the pressure of environmental degradation and high demand for food by increasing population in all over the world. This crisis affected negatively on the available water resources. An array of serious threats resulting from climate change in Egypt, the most important is the rise in sea level that could affect the Nile Delta area. Therefore, the Egypt's government has permitted cultivation of paddy fields in Delta's area to annexation and compressor having the largest fresh water as possible to stop the overlap of sea water, which these particular areas characterise with a low-level contour[1]. Even so, these areas consume around 25% of Egypt's quota from Nile flow. So, the water management in the Nile Delta, the scarcity of water irrigation, and high-profit paddy field cultivation considered as the major challenge to form crop map of the Egypt.

The improvement of main irrigation systems in the Nile Delta is one of the most important attempts in Egypt to implement more effective irrigation technology by improving the existing irrigation networks. One of the objectives of this improvement is to increase the reliability of irrigation water supply to meet the water demand more efficiently and effectively by installing automation gates in branch canals' level. Such development and changes will have impacts on the decisions of water management and use. Therefore, performance of water delivery systems needs to be defined and assessed under these conditions before and after improvement. This paper highlights the water management in Nile Delta zone in Egypt and presents the operation criteria and mechanisms in operation of the irrigation system by using performance evaluation tools that are proposed by Molden and Gates (1990)[2]. This paper discusses to evaluate main irrigation network system by irrigation districts of government's practices to improve water management in the Nile Delta through irrigation season (2004) before improvement system and irrigation season (2007) after improvement system in *Wasat* command area that is located in the Nile Delta of Egypt, as shown in **Fig.1**.

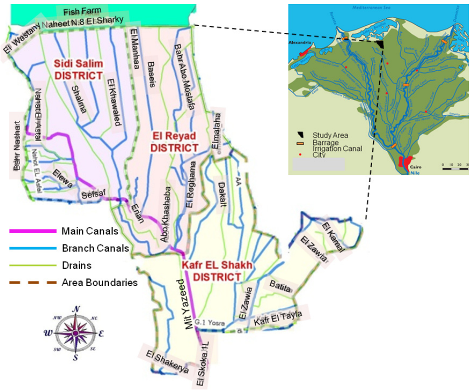

Fig. 1 Layout of irrigation networks in Wasat command

2. Materials and Methods

Study area: *Wasat* command area, within the *Kafr El-Shakh* governorate, is located on the northern edge of the middle Nile Delta. In this study, was measured performance of irrigation networks through three irrigation districts that fed from the tail reaches of the main canal (*Mit Yazeed*). Owing to its location at the tail of the feeder canal system, the *Wasat* command area suffers from inadequate water supplies. This problem is exacerbated by the tendency of farmers to plant more paddy rice area than they are licensed to (50%)[3]. Each irrigation district was selected irrigation system (branch canal) to represent behavior of operation.

Water Delivery Performance: Water delivery performance through irrigation networks level of irrigation district was determined according to the indicators of adequacy, efficiency, equity, and dependability. [2]

$P_A = 1/T \sum_{T=1}^{T} \left(1/R \sum_{R=1}^{R} p_A \right)$, where $p_A = Q_D/Q_R$, if $p_A > 1$ $p_A = 1$ or if $p_A < 1$ p_A ……………[Adequacy] ……………………..(1)

$P_F = 1/T \sum_{T=1}^{T} \left(1/R \sum_{R=1}^{R} p_F \right)$, where $p_F = Q_R/Q_D$, if $p_F > 1$ $p_F = 1$ or if $p_F < 1$ p_F …………… [Efficiency]..................................(2)

Where; Q_D: water delivered
Q_R: water required
R: region

$P_E = 1/T \sum_{T=1}^{T} CV_R(p')$, where CV_R= Spatial coefficient of variation of ratio Q_D/Q_R over the region R … [Equity] ……..(3)

$P_D = 1/R \sum_{R=1}^{R} CV_T(p')$, where CV_T = Temporal coefficient of variation of ratio Q_D/Q_R over the time T..… [Dependability].(4)

T: time
Where $p' = Q_D/Q_R$, if $p' > 1$ $p' = 1$ or if $p' < 1$

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3. Results and Discussions

Cropping pattern: **Table 1** depicts as percentage of the cropping patterns for *Wasat* command area at the sample branch canals during two irrigation seasons consecutive (2004 and 2007). The rice areas in head location accounted for over 57% of the area during before improvement, and increased to 63% in 2007. In other side, the crop rate in middle and tail locations was fixed through irrigation season. For cotton crop, the increasing of crop at downstream of regulator of *El-Wasat* was luck for *Dakalt* canal, which its area of cotton was increased to 30% after improved against maize crop. Alfalfa is the most favorable winter crop to many farmers since it can either be used as fodder or sold for cash, especially in middle and tail locations. While in head location, this crop was decreased after improved systems. Wheat occupied from 28% to 44% of cropping before improved and after that it was decreased through all locations. Sugar beet is the third main winter crop due to its cash value as it is sold to the sugar factories there. Its rate was almost fixed.

Table 1 Irrigated crop patterns of branch canals in 2004 and 2007

Crops (%)	Head (Dakalt)		Middle (Baseis)		Tail (Shalma)	
	2004	2007	2004	2007	2004	2007
Rice	57	63	44	41	52	52
Cotton	19	30	14	18	32	38
Maize	13	3	17	4	8	3
Citrus	0	0	2	2	0	0
Other (Sum)	11	4	23	35	8	7
Total	100	100	100	100	100	100
Alfalfa	37	27	22	29	26	36
Wheat	40	28	28	20	44	36
Sugar beet	16	15	18	18	24	15
Citrus	0	0	2	2	0	0
Other (Win)	7	30	30	31	6	13
Total	100	100	100	100	100	100

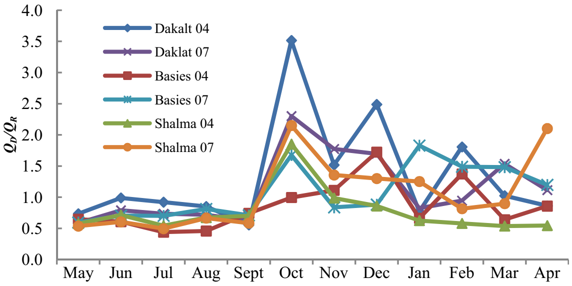

Fig. 2 Ratio of Q_D/Q_R for branch canals before and after improvement

Values of Q_D and Q_R: For the selected branch canals are given in **Fig. 2.** The water delivery in summer season was higher than winter season due to control for operation in regulators according to less water demand for winter crops. While in summer season, the gates were opened continuously owing to the greater demand by large proportion of paddy field. The water supply was increased after improved system at middle and tail locations of branch canals. It is noticeable that the water delivery for the branch canals after the development was equal of values among themselves, which indicated that the automation system through a network of irrigation water is distributed evenly among the districts of irrigation in the same time. While the system before development, the rotation system are given in the head of irrigation district provided its full capacity without taking into account; there are other districts of irrigation. Overall, the water requirement was higher than the water supply before and after improvement owing to the location area at the end of the irrigation system in the Nile Delta.

Values of the performance indicators: Average values of four performance indicators are presented for system before and after improved in **Table 2**. The average values of four performance indicators indicate a systemic water delivery problem before improved. The reasons are these irregularities in the use of a rotation system among irrigation districts due to the presence of a human in the operating and problems in operation of head regulators as damage or rickety and need to routine maintenance. However, for the system after improved, the using automation operation for water delivery among irrigation systems was improved water delivery performance by improved fair share among irrigation districts through irrigation periods and performed in a consistent manner may be considered dependable.

Table 2 Water delivery performance of irrigation

	Irrigation System			
	Sum 04	Sum 07	Win 04/05	Win 07/08
P_A	0.68	0.66	0.85	0.96
P_F	1.00	1.00	0.84	0.75
P_E	0.20	0.10	0.12	0.05
P_D	0.16	0.10	0.18	0.07

4. Conclusion

Based on the evaluation of indicators in this study, it can be concluded that the increase in the number of irrigation districts in one main irrigation network system is difficult to continuous monitoring of the water management and distribution among them by using rotation delivery system because there are not control points to distribute water among them and the most important elements of current control between irrigation district and next for equitable distribution under the dependence of water level.

References

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