Performance Assessment of Tail-end Farmers' Practices on Improved Irrigation Networks in the Nile Delta of Egypt

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1. Introduction

The water and agriculture policies are affected by different natural conditions and human activities presenting challenges and gaps under the current operations of water and land sectors. Egypt is one of the countries facing great challenges due to its limited water resources mainly because of its fixed share of the Nile water (55.5 km^3/year) and its aridity as general characteristic. The Nile River is the main source of water for Egypt, which is running about 1,000 km before it separates into two branches and creating the Nile Delta. The Nile Delta system is one of the most ancient agriculture system in the world, which characterizes the traditional irrigation system in the old lands is a combined gravity and water lifting system through three levels as main, branch, and tertiary canals. Under the new improved system in last level, it is raised to above-ground level or set under pressure in order to allow for improved distribution along the irrigation networks in the old land in the Nile Delta.

Farmers expected to have better water delivery services so they will receive the right amount of water on time. Although there might not be water saving through this process in some areas, stability of water allocation will provide water in the canal for farmers at the tail-end who were formerly deprived of their fair share. Farmers complained of water shortages at the canals tail and relied on neighbouring drains unofficially for supplementary. But, irrigation with deteriorated water affects crop productivity. On the national level, established system will be of great importance in the future, when the water distribution system will be more complicated and better scheduling will be needed to prevent from wasting water.

This study aims to evaluate water delivery performance in irrigation networks by farmers' practices in their locations in the farm, especially in tail-end location in branch canal and tertiary canal levels by using the performance indicators that are proposed by Molden and Gates (1990).

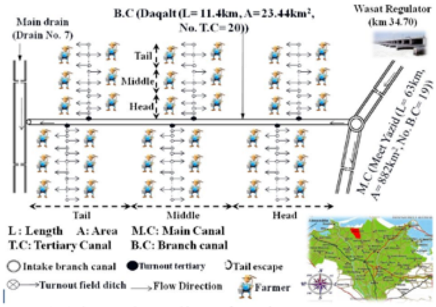

Fig.1 Schematic outline of study area

Table1 Evaluation criteria of each indicator

Measure	Performance Classes		
	Good	Fair	Poor
P_A	0.90 - 1.00	0.80 - 0.89	< 0.80
P_F	0.85 - 1.00	0.70 - 0.84	< 0.70
P_E	0.00 - 0.10	0.11 - 0.25	> 0.25
P_D	0.00 - 0.10	0.11 - 0.20	> 0.20

This study was carried out to evaluate fields' practices throughout irrigation seasons of 2003 and 2004 in Wasat command area. This area is located on the northern edge of the middle Delta and it is fed from the tail reaches of the main canal (Meet Yazid). Due to 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 who plant more paddy field than which government allowed. This area is famous for its rice production, which contributes to 40% of rice production in Egypt.

2. Materials and Methods

In this study, branch canal (Daqalt) was selected as a sample of an improved irrigation system. Six tertiary canals (meskas) were selected in this system; two meskas were selected from each of head, middle, and tail of the branch canal, respectively. In addition, six fields were selected from each selected meska where distributor as follow two in head, two in middle and two in tail, as shown in **Fig.1.** Water delivery performance at farmers' practices was quantified by according to the indicators of adequacy (P_A), efficiency (P_F), equity (P_E), and dependability (P_D). From the computed performance indicators values, performance was classified as "Good", "Fair", or "Poor" according to evaluation criteria given by Molden and Gates (1990), as shown in **Table1**. These indicators evaluation of irrigation management performance are required to collect different data items from farmers in their fields. The data of the selected fields were collected in three main sheets, which are: (i) *Calibration Sheet*: it describes the pump characteristics in lifting point, (ii) *Irrigation Time Sheet*: it describes the data's irrigation hours for selected fields in each tertiary canal, and (iii) *Cropping Pattern Sheet*: it describes the data's cropping pattern of the selected fields.

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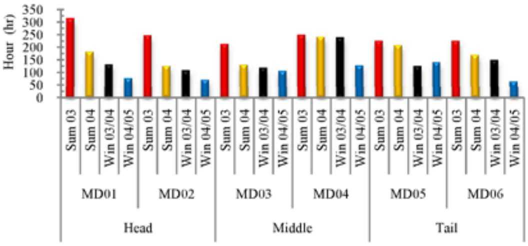

Fig.2 Field irrigation time (hr) at meskas locations

Table 2 Seasonal crop pattern in study area

Season	*Crops (%)*	Tertiary Canal: Head 2003	Head 2004	Middle 2003	Middle 2004	Tail 2003	Tail 2004
Winter (Win)	Alfalfa	41.6	40.6	42.2	31.5	60.6	31.1
	Wheat	54.6	49.4	36.4	32.1	20.2	34.1
	Sugar Beet	3.8	-	21.4	-	19.2	2.3
	Other	-	10.0	-	36.4	-	32.5
	Total	100	100	100	100	100	100
Summer (Sum)	Cotton	24.2	42.2	29.2	31.3	23.0	25.6
	Rice	75.8	47.8	67.5	61.7	63.5	61.8
	Maize	-	10.0	3.3	7.0	13.5	12.6
	Other	-	-	-	-	-	-
	Total	100	100	100	100	100	100

3. Results and Discussions

3.1 Cropping pattern and irrigation hours The major crops in irrigation seasons in the study area are presented in **Table 2.** The cropping pattern of main crops in improved system were decreased and changing to other crops in the following winter seasons, while for summer seasons, it was stabled except head location. The calculations of crop water requirement by CROPWAT model were used in this study, which employs FAO Penman-Monteith methods to calculate reference crop evapotranspiration (FAO, 1992). **Fig.2** shows summation of irrigation hours for each meska from the selected fields. The irrigation hours in summer season are higher than winter season because paddy field is grown in summer season. Moreover, the irrigation hours were decreasing with the following irrigation seasons due to decreased crop area with high water demand, especially the paddy field in head location of irrigation system.

Table 3 Water delivery performance at famers through its locations in branch and tertiary canal levels

Indicators		Fields' Position for Branch Canal: Sum 03	Sum 04	Win 03/04	Win 04/05	Fields' Position for Tertiary Canal: Sum 03	Sum 04	Win 03/04	Win 04/05
Adequacy	**(P_A)**	0.41	0.44	0.73	0.76	0.41	0.44	0.92	0.80
Efficiency	**(P_F)**	0.99	1.00	0.59	0.68	0.99	1.00	0.73	0.69
Equity	**(P_E)**	0.09	0.14	0.18	0.25	0.20	0.05	0.24	0.25
Dependability	**(P_D)**	0.27	0.24	0.75	0.88	0.25	0.22	0.50	0.75

3.2 Average values of performance indicators Average values of water delivery performance for fields' practices in both levels (branch and tertiary canals) through both irrigation seasons are given in **Table 3**. Averages P_A values were less than 0.8 in summer season. It is means that system performance is evaluated as "Poor" due to the location of whole study area at the end of irrigation networks in the Nile Delta and high intensity of rice cropping more than 50% the area that government allowed. For both levels, P_F values was "Good" in summer seasons. These results do not mean the water use is efficient but water shortage occurred. But in winter season, the performance was "Poor" and "Fair" in field's position for branch and tertiary canals, respectively. This result means the efficent of operation in tertiary canals was better than other level. P_E values were classed as "Good" in fields' position in branch canal and "Fair" in tertiary canal through summer season 2003. But, the situation has changed to opposite in the next season. This is due to the role of water user associations and the participation of farmers together in the operation and management of irrigation system at the level of tertiary canals. P_E values in winter seasons were classed as "Poor". This is due to irrigation event among farmers applying in the timing of one. P_D values were all classed as "Poor" in the whole irrigation seasons. This is due to change of cropping pattern among farmers and resulting in a difference in the dates of irrigation among them.

4. Conclusions

The water delivery performance for farmers in tail locations of branch canal level was worse than farmers in tail location of tertiary canal level. The main reasons for this result are water shortage in study area during irrigation seasons and absence of crop production planning among different locations of tertiary canal, especially rice cultivation in summer seasons. It was concluded that irrigation improvement has a positive effect on farmers' practices in their farms through tertiary canal level due to the role of water user associations. The poor performance of branch canal in improved system are due to variations cross sections from design, the bad situations of some old structures and large amount of trash and/or weed thrown in to branch canal. Therefore, it is essential to expand the responsibility of water user associations from tertiary canal level to branch canal level in the future.

References

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