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EVALUATING THE IMPROVED IRRIGATION NETWORKS IN EGYPT

El-Gamal, T. T.
Water Management Res. Inst., National Water Res. Center, Delta Barrage, Egypt, P. C. 13621/5 Tel. (+202) 42189458 Fax. ((+202) 42189561; email: elgamalt@yahoo.com

ABSTRACT

This study summarizes the results of evaluating the improved canals in Egypt. These results constituted a part of an evaluation programme that was conducted by Water Management Research Institute (WMRI) to evaluate the first phase of the Irrigation Improvement Project (IIP1).

This part of the evaluation programme was built on measuring specific hydraulic indicators, such as Relative Water Supply (RWS) and Water Use Index (WUI) in improved and unimproved canals to assess achieving the targets of the improvement project. The programme concluded that most of the targets were not achieved yet illustrating that the main reason was the inappropriate operation of the system.

The study illustrated that the chance to achieve the improvement targets should be mainly through the effective operation of the system. The introduced operation system was the continuous flow system, with which water supply will be provided to different branch canals continuously and on volumetric basis and an internal rotation will be applied between lifting points. The monitoring results showed that the actual applied system is a hybrid system between rotational system and continuous flow system. Under this hybrid system, the branch canals are open almost continuously, but water is distributed based on maintaining specific water levels downstream the head regulators without calculating the water volume or implementing an internal rotation between the lifting points. This system encourages farmers and especially head farmers in rice regions to use more water.

The main recommendation of the study was to conduct intensive investigations to adapt the continuous flow to another suitable system that fit with the current circumstance of the irrigation networks and the current capacities of the irrigation directorates and Water Users Associations (WUAs). This introduced system might be an adapted version of the rotational system. The other recommendations include forming the improvement targets in a shape of certain responsibilities to encourage irrigation directorates achieving these targets and having certain strategies to face the environmental problems.

Keywords*:* Irrigation Improvement Project, Continuous flow, Water saving, Equity of water distribution

INTRODUCTION

The implementation of the first phase of Irrigation Improvement Project (IIP1) has begun in the middle of 1990's, and in 2002, an evaluation programme has been conducted by Water Management Research Institute to evaluate this project. The evaluation programme has been applied between 2002 and 2008 in Mit Yazid and El-Mahmoudia command areas (Kafr El-Sheikh and El-Behera governorates) and it had few components to assess different targets. The main component was Canals and Drains Monitoring Study (CDMS), which concerned assessing the hydraulic performance of the irrigation networks in the improved areas and its positive effect on water saving, equity of water distribution, and irrigation efficiency. Besides assessing the enhancement in these fields, the evaluation programme checked the ability to apply the continuous flow effectively in different branch canals.

As a sustainable project, IIP had, besides the constructions, different operational and institutional interventions including applying the continuous flow in branch canals and the establishment of Water Users Associations (WUAs). Applying the continuous flow means releasing the water continuously and on the volumetric basis, which should be defined for different branch canals rationally based on the served areas and cropping pattern. The released water downstream the head regulator should be distributed between lifting points through the internal rotation "Motarefa". The WUAs have their role in distributing water between lifting points and between farmers in the same lifting point.

While the establishment of the lifting points and the construction of the new structures were almost completed, the operational and institutional situations were not adapted for the new system yet. The delay in adapting the operational procedure and farmers' irrigation practices lead besides restricting the achievement of IIP targets, to the fall down of the some technical interventions, such as the automatic gates.

The current study concluded that most of the targets of irrigation improvement project were not achieved yet mainly due to the inappropriate operation of the system, and it recommended the following to help the improvement projects achieving their targets:

- ❑ Conducting intensive studies to adapt the continuous flow system to another system fits with the current capacities of irrigation directorates and WUAs.
- ❑ Forming IIP targets in a shape of certain responsibilities to change the reaction of the irrigation directorates towards the improvement project;
- ❑ Checking and fixing different implementation problems; In addition, there should be available budget to improve the capacity of WUAs and to help the farmers in the maintenance of their lifting points until fully acceptance of the project.
- ❑ Controlling high consumption crops such as rice crop to its design quota to ease the operation of the improved system;
- ❑ Confronting the environmental problems such as the accumulation of the solid waste; this should be done in a collaborative manner between different agenizes and through different axis such as improving the society, improving the cultural, and implementing the law;

Irrigation Improvement project

Historical background

Egypt is a gift of the Nile and it destination was always linked to enhancing the utilization of its water. Since the beginning of perennial irrigation in the middle of nineteenth century until the construction of the high dam, the concern went towards better control of the River Nile. After the construction of the high dam and the fully control water resources, the interest went towards controlling the demand and increasing the efficiency of water use in Egypt. The higher availability of the water with the weakness of controlling the system and different social changes decreased irrigation efficiency. According to Gamal Hemdan [3], the consumption increased by 10.0 billion m^3 after the construction of the dam without any significant change in the cultivated area. In other source, Ministry of Water Resources and Irrigation [8] stated that average water supply per feddan increased from 6900m^3/year to 8000.0m^3/year due to the misuse of the water after the construction of the dam.

In the late of 1970's a research project (Egyptian Water Use and management Project – EWUP) was conducted by water management research institute with the cooperation of few American universities, and during this research project, the concept of Irrigation Improvement Project was emanated. After EWUP, irrigation improvement passed through three research and pilot projects namely Regional Irrigation Improvement Project (RIIP), United Nations Development Project (UNDP), and USAID-IIP, which was implemented during the period from 1989 to 1996 in eleven canal command areas. The first phase of irrigation improvement project (IIP1) was the last implemented step yet.

The main objectives of irrigation improvement project were to improve the water use efficiency and to enhance the equity of water distributions between and within branch canals. The project uses new irrigation concept (continuous flow) and new tools (downstream control structures and distributors) to achieve its targets. Institutionally, the project established water users associations to help in water distribution. Currently, the improvement project is continued through other phases (IIP2 and IIIMP) to cover the entire command areas of Mit Yazid and El-Mahmoudia canals.

Expected improvement in the irrigation network

Expected water saving

It was expected that the implementation of the improvement project with the application of the continuous flow would result in considerable amount of water saving as could be found in the following:

- ❑ In one of the EWUP experiments [2], the results showed that the improved system with the application of the continuous could result of saving about 40% of applied water.
- ❑ In 1997, the Ministry of Water Resources and Irrigation introduced a strategic plan (1997-2017) and one of the elements was the implementation of irrigation improvement project. The ministry expected to improved 1.5 million feddan until 2025, which will result in saving 1070 million m^3.
- ❑ In the appraisal document of IIIMP [13], it was stated that water savings are expected to reach about 22% or 838 million m^3 per year at project maturity.

Expected enhancement of the irrigation efficiency

As a general though, it was expected that the implementation of irrigation improvement project would increase the overall irrigation efficiency to about 70%. According to Sanyu [9], and from the experiences in Bahr Tera command area, it was expected that irrigation improvement would enhance the irrigation efficiency from 56% to 66%. This would result from increasing on-farm efficiency from 65% to 73% and increasing Mesqa conveyance efficiency from 90% to 95%.

Continuous flow

Applying the continuous flow is a main component of irrigation improvement projects and it is the main difference between the traditional and the improved systems.

The origin of the concept

The current implementation of the continuous flow returned to EWUP project. Applying the continuous flow in EWUP project contained the re-shaping and lining of the branch canal with a fully control of the water supply at the head regulator in order to release the required water [2]. The idea of applying the continuous flow was re-discussed in another EWUP report and the authors stated that introducing the continuous flow was impractical as the re-shaping of branch canals' cross sections was economically impossible. The authors suggested adapting the rotational system to save water [4]. After EWUP period, the lifting techniques have changed from old fixed saqias to new mobile pumps. This changed the abstraction pattern and help farmers to concentrate the irrigation during specific period of the day [5]. During this period (UNDP project), the night storage methodology was introduced instead of re-shaping of the branch canals. The application of the continuous flow under the last concept was used since USAID-IIP project (1988-1996). However, the application was found to be problematic due to the lack of communication and coordination with the operators on the principles [6]. The same concept is still used in the current phases of the improvement projects.

The continuous flow in IIP areas

The application of the continuous flow might be applied in different ways. The first way is "on-demand" system, where water supply is mainly controlled by farmers' consumption. MacDonald [7] illustrated that "on-demand" operation at the head of the branch canal is clearly not possible for IIP areas, for the following reasons:

- The main system is managed on the basis of upstream control, and each irrigation directorate receives scheduled water allocations which have to be distributed equitably between different branch canals;
- Particularly in rice areas and in the peak summer months, the supply may be inadequate to meet the potential demand;

According to the same source, the application of the continuous flow in IIP areas means that water is delivered continuously to each branch canal and the deliveries to these branch canals are made in accordance with pre-determined volumetric water allocations. The proportional distribution between branch canals is defined according to the area served, or could be adjusted to take account of recognized differences in cropping patterns or other factors such as the local contribution of drainage water re-use.

The relation between applying the continuous flow and the achievement of the improvement targets

Achieving the improvement targets is mainly related to reducing water losses. According to MacDonald [7], most of conveyance losses were relatively small. This includes evaporation losses and leakage losses from defective tail escapes or aqueduct pipes. Seepage losses in view of high water table levels are also small especially during the rice season. Escape flow at the tail ends of branch canals and Mesqas, and regardless the concentration of the irrigation during the daytime and stopping the irrigation during night, is small as well. This conclusion was carried out during the UNDP study, which showed that overtopping of tail escapes occurred occasionally in winter and rarely or never in summer besides that, most of the Mesqas are relatively flat and they have closed ends. The results of the current monitoring programme supported this conclusion.

According to the same report, most of the irrigation water losses occur below the point of lifting including losses from the earth Marwas and field application losses. The losses increase in rice areas.

Given that no new on-farm irrigation techniques were introduced and Marwas were not improved during this phase, the possible ways to improve the hydraulic performance should be through the effective application of the continuous flow, which will help controlling farmers' consumption by controlling the flow at the head regulator and by applying the internal rotation "Motarefa"

Based on IIP literature, application of the continuous flow would result in water saving, as farmers tend to over-irrigate under the rotation system, due to uncertainties about water supply. It is expected that head farmers, in the rotational system, have preferential access to water in terms of the volume and the time [6 & 7].

MATERIALS AND METHODS

This study discusses the results of canal and drain monitoring study, which was a part of monitoring and evaluation programme for irrigation improvement project. This study assessed the performance of the water delivery system (main and branch canals) as well as related drain flows. A group of performance indicators that are related to the IIP objectives has been selected for the evaluation. The general methodology in CDMS was built on comparing the performance of the water delivery system in some improved and unimproved canals. The programme investigated sample canals and additional canals. Each command area had two sample canals represent the improved and the unimproved canals, and the whole lengths of these sample branch canals were monitored. In the additional canals, only the flow at the head regulator was monitored.

Assessing the indicators required measuring and/or collecting different data including recording water levels and gate openings and measuring the flow downstream the head regulators and in some points inside sample branch canals. Flow measurements were used to calibrate different structures and sections for the calculation of daily water supply values. Collected data included water supply at the head of the command areas and cropping pattern for different regions and canals.

The performance of the water delivery systems was evaluated based on Water Use Index (WUI) and Relative Water Supply (RWS) values. WUI value is the ratio between water supply and water requirements. Water requirements constitute water consumption for the irrigated crops with additional 10% for leaching. RWS values are the ratios between water supply and the irrigation areas for different branch canals and regions. RWS values were calculated on seasonally and half-monthly bases.

Besides the main calculated items (WUI and RWS values), many additional assessments and statistical analyses were used to confirm and to interpret the results.

Regarding the expected accuracy, the automatic-recorded data (water levels and gate openings) were the most trustable data. Some developed relationships for some sites had low correlation coefficients, especially while calibrating sections (Q-H curves). Cropping pattern were the least accurate data except while using satellite images results (summer 2006). The feedback from the drains was not considered while calculating WUI values and therefore some WUI values were always very low for some areas that depend mainly on the drainage water [10&11].

Studying areas

Monitoring and Evaluation programme was applied in Mit Yazid and El-Mahmoudia command areas. Mit Yazid canal (figure 1) off-takes from Bahr Shebin canal. It is 63.0 km long and its cropped area is around 195,800 feddans. Mit Yazid canal has four cross regulators. These regulators are Beltag regulator at km 21.600, El-Wasat Regulator at km 34.60, El-Mofty regulator at km 50.15, and El-Masharka regulator at km 59.50. There is a main branch (El-Zawia canal) at km (34.6).

The improved area is the area downstream El-Wasat regulator and it serves about 63,000 feddans.

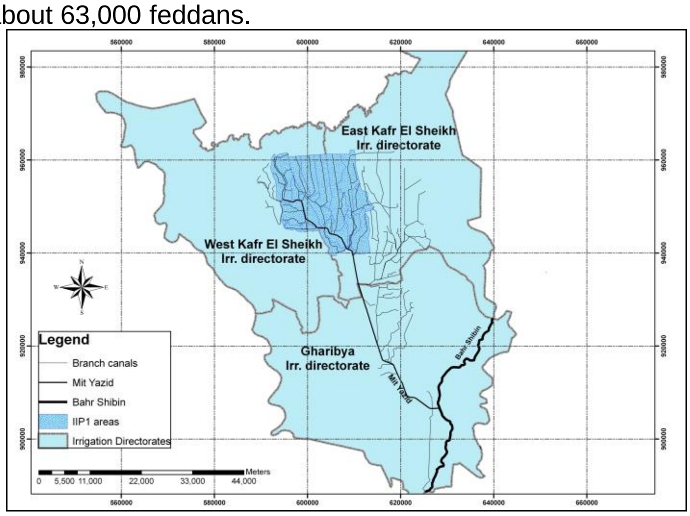

Figure 1: Mit Yazid command area and its improved area

In Mit Yazid command area, the sample canals are Dakalt canal as an improved canal and Basis canal as an unimproved canal. Both canals are diverting directly from Mit Yazid canal (km 41.070 and km 47.500 respectively). The served areas for both canals are 5336 feddans and 9068 feddans respectively. The additional canals include Shalma canal (km 50.15 on Mit Yazid canal - 16159 feddans), El-Masharka canal (km 57.0 of Mit Yazid canal - 1750 feddans), and the area downstream El-Mofty Regulator (12981 feddans). In the last few years, El-Masharka canal was replaced by Mars El-Gamal canal, which off-takes from El-Zawia canal (km 3.70), and serves about 10827 feddans. The investigation also includes four secondary drains serving the sample canals.

El-Mahmoudia canal (figure 2) off-takes from Rosetta branch at km 194.2. The actual served area for the canal is 205,000 feddans and it is 77.17 km length. El-Mahmoudia has another source of fresh water, which is El-Khandk El-Shrike (km 16.30 on El-Mahmoudia canal). In addition, there is another source from the drainage water (Edco drain - km 8.5 on El-Mahmoudia canal). The operation of El-Mahmoudia is affected by high municipal water consumption especially at the end of the canal. Municipal ratios downstream Kafr El-Dawar regulator was between 70 and 80% of total water supply at this point. Many branch canals at the end of the El-Mahmoudia are closed frequently to offer the required level upstream municipal intakes.

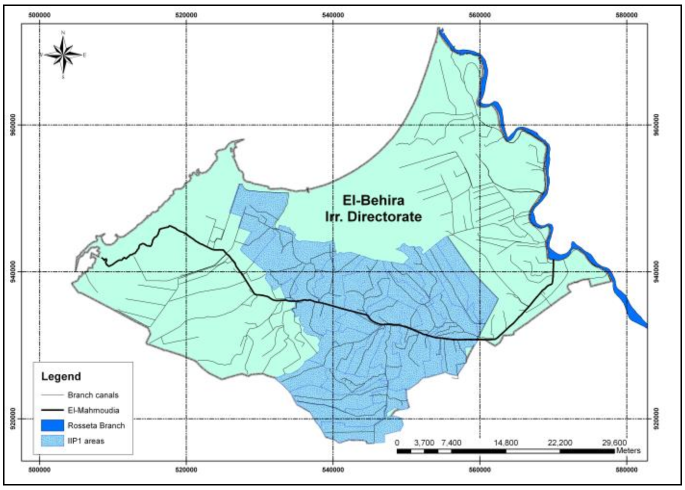

Figure 2: El-Mahmoudia command area and its improved area

All investigated canals are diverted directly from El-Mahmoudia canal. Sample improved canal was represent by Zawiet Naiem canal (km 21.5 - 2053 feddans) until summer 2005 they by Besentway canal (km 16.32 - 5345 feddans) and El-Berka canal (km 31.79 - 1828 feddans). Sample unimproved canal was represented by El-Nasri canal (km 32.30 - 7500 feddans). The additional canals include El-Herfa canal (km 16.30 - 11437 feddans), El-Qenawia canal (km 28.40 - 28,290 feddans), El-Karion canal (km 38.85 -

5370 feddans) and El-Saraniya canal (km 44.375 - 12399 feddans). Nine secondary drains, which were serving the sample canals, were investigated.

In all unimproved canals, the improvement process was taken place during the programme period except in Mars El-Gamal and El-Saraniya, which continued as merely unimproved canals.

A full description about different investigated canals could be found in [10&11&12].

RESULTS

The final findings from CDMS study in the evaluation programme could be summarized in the following points:

- ❑ There was a big difference between the cropping pattern in both command areas (Mit Yazid and El-Mahmoudia) especially for rice crop. In Mit Yazid, rice is the dominant crop even at the tail ends with their severe water shortage and high dependence on the drainage water (average rice ratios at this region were 55%). In El-Mahmoudia, rice ratios decreased significantly at the tail ends (less than 20%). This resulted in a considerable difference in WUI values at the tail end regions of both command areas although water shortage was the trend at both of them.
- ❑ Regarding the operation of the system
- ▪ All investigated branch canals were still operated using sluice gates and based on maintaining downstream water levels. Almost all automatic gates or distributors were out of service due to the interference with them and none of them was used in the operation of the branch canals although the investigation proved that they could function well in the absence of the external factors that handicapped them. The problem was in the heterogeneous between the design system with its design levels and the current operation system with high fluctuation in the levels.
- ▪ The distribution of the irrigation during the day (abstraction pattern) in the improved canals showed that irrigation density increase suddenly in forenoon hours while there was no irrigation during the midnight (figure 3). The trend was very close to the trend in unimproved canals meaning that the improved system did not affect farmers' irrigation practices.
- ❑ Regarding RWS and WUI values, which are the main items to evaluate the program
- ▪ For the entire command areas, there was gradual increase in water supply values at the head of Mit Yazid canal reached 27% from the year 1996-97 to 2007-08 (figure 4). For the improved area in Mit Yazid canal, average water supply during summer seasons increased from summer 2003 to summer 2007 by 21%. In El-Mahmoudia command area, the change in the values had no specific trend and this is likely due to the accuracy of the collected data especially the share of El-Khandk El-Sharki canal and Edko pumps station.
- ▪ Regarding water supply in branch canals, the statistical analysis showed that there was no significant difference between water supply values at the head of improved and unimproved branch canals (figure 5).

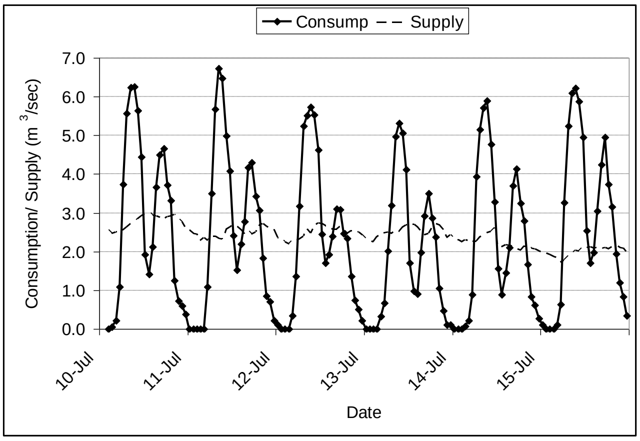

Figure 3: Water consumption and supply in Besentway canal during July 2007

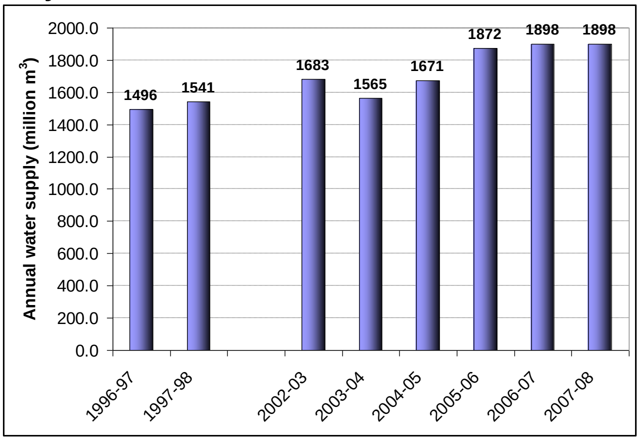

Figure 4: Annual water supply at the head of Mit Yazid canal

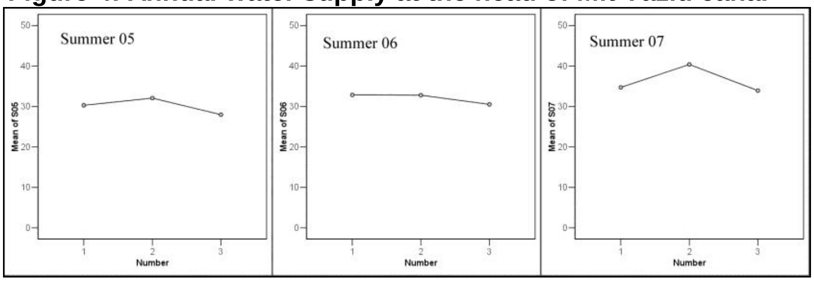

Figure 5: The mean values for water supply in Dakalt (#1), Besentway (#2) and Mars El-Gamal (#3) canals during different summer seasons

- Regarding WUI values, the results showed that most of summer values were between 1.4 and 1.7 for canals at the beginning of the improved areas. The values decreased at the tail ends and they were more constant in El-Mahmoudia command area. During winter seasons, WUI values increased and the steadiness of the values decreased.

- The results showed that the differences between head and tail regions were obvious than the differences between improved and unimproved canals (Figure 6). WUI values at the tail end were very low regardless its improvement status. It should be mentioned that the drainage water, which constituted big amount of water resources for tail end areas, was not accounted as was explained in the materials and methods.

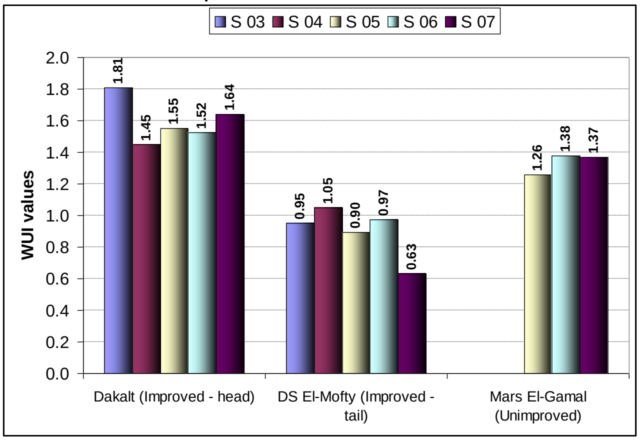

Figure 6: WUI values for some investigated canals in Mit Yazid command area

- There was a considerable difference between WUI values at the head and the tail regions of different branch canals. Figure (7) presents as example for the improved sample canal in Mit Yazid command area.

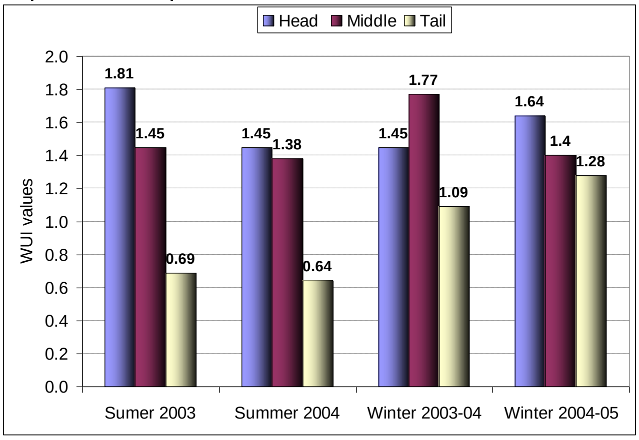

Figure 7: WUI values for different regions of Dakalt canal from summer 2003 to winter 2004-05.

- The results showed that average WUI values became close to each other for most of the monitored canals while focusing on the highest consumption period between June and August. The differences normally happen during low consumption periods with low attention from irrigation directorates.

❑ Regarding the variation of water levels

- In main canals, the results showed that the levels were more stable in El-Mahmoudia canal, likely because of the municipal requirements at the tail end. In Mit Yazid canal, water levels increased sharply at the beginning of summer season and decreased sharply at the end of the season. The situation at the tail end had opposite trend (figure 8) due to the high consumption values that were associated with high rice ratios.

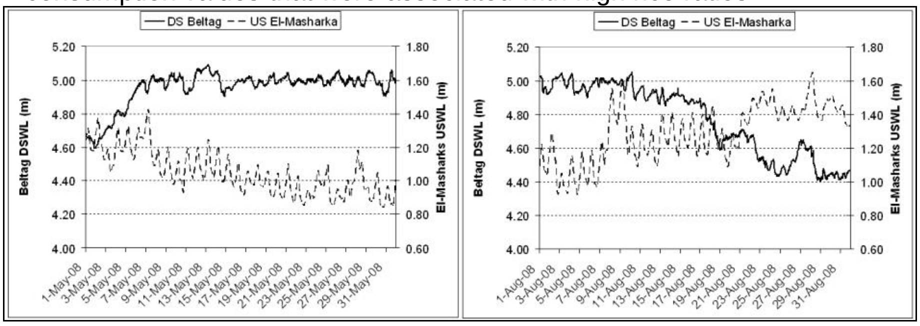

Figure 8: Water levels downstream Beltag (km 21.6 on Mit Yazid canal) and upstream El-Masharka canal (km 57.0) at the beginning and the end of summer season

- In branch canals, the results showed that there was a fluctuation in the water levels at different locations especially at the tail ends (figure 9). Considering average seasonal values, There was a considerable improvement in water levels at the tail ends of some investigated canals during the monitoring period especially Basis and Nasri-Habib canals. In addition, monitoring water levels were proving the malfunction of the automatic gates.

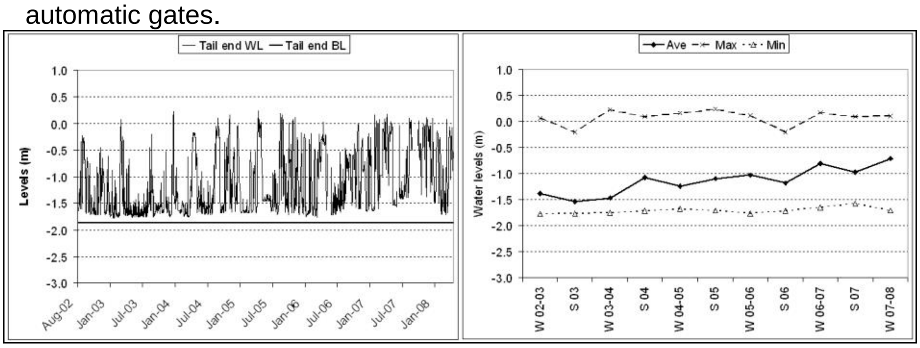

Figure 9: Average daily and seasonal water levels at the end of Basis canal

- Considering the change in the drainage runoff through consecutive seasons, there was no specific trend in the secondary drains. In the main drains, there was a gradual increase in the values, which was analogous to the increase of the water supply at the head of the command area. The drainage ratios, which are the ratios between drainage runoff for a unit area of the drain and average water supply for a unit area of the canal, were between 44% and 57% during summer seasons and between 38% and 64% during winter seasons. Some data was collected for the main drains in Mit Yazid command area and the results showed that the drainage ratios were between 55% and 75%.
- For escape flow at the end of the improved canals, the results showed that the average ratios were low. Escape flow normally happen in low consumption period, when water supply values were low. During high consumption periods, there was no escape flow. Considering water supply for the entire year, the ratios, as was calculated for Dakalt canal, were less than 2% of total water supply.
- Regarding water quality, some statistic analyses proved that there was no significant difference between the salinity values in the improved canals during the consecutive seasons. There was a significant difference between the salinity in the improved and unimproved canal but there was no significant difference in the secondary drains serving both types of canals.

The evaluation results

The previous results were used to assess the effect of the improvement project on water saving, the enhancement of the equity of water distribution, and the improvement of irrigation efficiency. It also used to investigate the effective application of the continuous flow.

The effective application of the continuous flow

Applying the continuous flow means that water is available continuously and it is distributed between branch canals in volumetric and rational basis. From the results:

- Water was not distributed based on the discharges and branch canals were still operated by maintaining downstream water levels.
- Water levels at different points of the improved branch canals, and especially at the tail ends, were far from the design levels. Water was not available continuously at the tail ends, which were still facing frequent water shortage events. Water levels at these tail ends were fluctuating in a trend close to the rotation system.
- The internal rotation between lifting points "Motarefa" was not implemented yet in any improved canal.

Therefore, the continuous flow was not implemented effectively at any improved canal, although the head regulators were open continuously in many branch canals. There are many factors, which restricted the true application of the continuous flow [1]. The disability to apply the continuous flow in a proper way restricted the achievement of all other targets.

Water saving

As the continuous flow was not applied accurately in any improved canal, it is expected that water saving was not achieved as was discussed in section 2-3. The results showed the following:

- Water supply at the head of both command areas increased gradually since the beginning of the improvement project. The increase was a general trend in Egypt during this time and it does not reject the ability of the project to save water but it confirms that water saving was not existed.
- Statistical analysis reflected that there was no significant difference between water supply values during different seasons or between improved and unimproved canals. The difference in the values was mainly related to the location (between head and tail end canals)
- Drainage ratios are still high and they are still fluctuating in the average range of the unimproved system.

Therefore, there was no sign that the implementation of the irrigation improvement project was resulted in water saving.

Equity of water distribution

As was the case of water saving, enhancing the equity of water distribution was related to the enhancement of operating the system.

The results showed the following:

- There was a considerable difference between the head and tail regions of both command areas as could be observed from WUI values for branch canals in these regions. Tail regions were suffering from water shortages and they complete their requirements from surrounding drains. This is obvious in Mit Yazid command area.
- The results also showed that there was a considerable difference between the head and the tail ends of the improved branch canals.

However and regardless the disability to enhance the equity of water distribution, there was an improvement at the tail ends of some canals associated with the increase of the water supply at the head of the command areas. Moreover, there were some important points that should be mentioned, such as:

- The results showed that the equity between branch canals improves during high consumption period as the irrigation directorates try to solve different irrigation problems with insufficient water supply values.
- In another monitoring programme [12], questionnaires results showed that the equity was achieved more in the improved canals although there was difference between the availability of the water in head and tail regions in improved and unimproved canals. The report concluded that the difference was likely due to the elevation of the environmental problems in the unimproved canals.

It could be concluded that the equity was not achieved yet in the improved areas, as there was a considerable difference between WUI values in different canals and regions. However, the lifting points elevate some environmental problem that improved the situation and therefore decrease the gap between different regions. In addition, the necessity might encourage the irrigation directorates to enhance the equity of water distribution.

Overall Irrigation Efficiency

Overall irrigation efficiency is measured based on drainage ratios, which are the ratios between average water supply for a unit area of the canal and average run-off for a unit area served by the drain. Additional factor is the change of the salinity in the secondary drain, which should increase with the increase of the efficiency.

Two examples are presented; the first is the ratios between Dakalt canal and El-Raghama secondary drain. Both sites were monitored for few years and the results were the most trusted data between different investigated drains. The second sample was calculated between a unit area of Mit Yazid canal and the unit area served by some main drains (drain #7 and drain #8). The data were collected from irrigation directorates and its accuracy was not tested. The results showed that the drainage ratios between El-Raghama drain and Dakalt canal were between 44% and 57% during summer seasons and between 38% and 64% during winter seasons. It means that irrigation efficiency during summer season was in average of 50%. For the other sample, the results showed that the ratios were between 55% and 75%.

Moreover, the results showed that:

- ❑ There was specific trend regarding the change in the drainage water in the investigated secondary drains through consecutive seasons. In the main drains, there was a gradual increase in the values, which was analogous to the increase of the water supply at the head of the command area
- ❑ The change in the salinity values has no trend during the monitoring period. Moreover, statistical analysis showed that there was no significant difference between the salinity in the secondary drains serving improved and unimproved canals.

It means that there was no significant difference between the irrigation efficiency in improved and unimproved canals. This is consistent with the facts that the continuous flow was not applied effectively and no new on-farm interventions were conducted.

Conclusion

This study summaries the results of canals and drain monitoring study, which was a part of an evaluation programme that was conducted to evaluate the irrigation improvement project regarding water saving, the equity of water distribution and irrigation efficiency. In addition, the evaluation checked the effective application of the continuous flow. The programme concluded that the targets were not achieved yet illustrating the follows:

- ❑ Achieving the aforementioned targets, such as water saving is a matter of reducing water losses. Conveyance losses are relatively small and the highest water losses ratios were found downstream the point of lifting; including the losses from earth Marwas and on-farm irrigation losses.

- The contribution of the irrigation improvement project towards the reduction of water losses could be explained as follows:
  - The installation of lifting points should improve the conveyance efficiency, but as the conveyance losses were already small, the contribution in that regard is minor. The ability of lifting points to control farmers' consumption is limited as could be observed from the abstraction pattern in the improved areas, which still similar to the abstraction pattern in the old system.
  - The expected improvement should be achieved by the effective control of the flow. This control of the water should force the farmers to use the irrigation water in a wise manner and encourage them to introduce new techniques, such as land leveling and strip irrigation. The evaluation results showed that the continuous flow was not applied truly in any branch canal. The water was not distributed based on the volumetric basis between branch canals and there was no any water distribution inside any branch canal.
  - The current application of the continuous flow is a mixing between old fashion and the new proposed system. The head regulators were open continuously without controlling the discharges or internal distribution of the water. The system works by maintaining specific water levels downstream the head regulators and adapting them based on the situations at the tail ends. Likely, this hybrid system is worse than the old system as the continuous availability of the water encourages head farmers to use more water especially in rice fields.

As a conclusion, irrigation improvement project will not be able to improve the hydraulic performance in the irrigation networks and achieve its targets without a firm control of the water. This required the following:

- The current capacities of the irrigation directorates and the new water organizations (WUAs and BCWUAs) and the ability of each group to fulfill its requirements towards the application of the continuous flow should be defined in the shadow of canals characteristics and farmers' attitudes. The chance to enhance these capacities and the requirements for this enhancement should be investigated. The conclusion about these capacities should be the base point to define the operation system. If there is no chance to apply the continuous flow in the right way, which is likely, it is better to replace the continuous flow with suitable version of the rotation system and adapt the other components based on that.
- One way to encourage distributing water based on the volume is to put it in legalization forms. Therefore, the first step to enhance the equity of water distribution should be distributing the water between irrigation districts based on the share of each district. Under this scenario, the responsibility of the irrigation directorate will be to receive the whole share of the directorate and divide it to the districts. This will achieve the equity between different districts in the directorate, and it will be the first step for the equity between branch canals.
- Besides the previous main points, the following additional points should be considered

- Fixing the implementation problems such as the excavation of some branch canals;
- Building capacities for new water organizations regarding the maintenance of their lifting points and improved Mesqas;
- Controlling high consumption crops such as rice ratio within the design quota in different branch canals;
- Treating the environmental problems such as the accumulation of the solid waste in different watercourses, this problem should be attacked through different axis such as improving the society, improving the cultural and implementing the low.

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تقييم شبكات الرى المطوره فى مصر

طلعت طاهر الجمل
معهد بحوث إدارة المياه وطرق الرى- المركز القومى لبحوث المياه

يلخص هذا البحث نتائج تقييم الترع المطوره فى مصر. وقد شكلت تلك النتائج جزء من برنامج التقييم والمتابعه الذى قام به معهد بحوث إداره المياه لتقييم المرحله الأولى من مشروع تطوير الرى (IIP1).

وقد أعتمد هذا الجزء من برنامج التقييم والمتابعه على قياس مجموعه من المؤشرات الهيدروليكيه مثل متوسط الإمداد بالمياه (RWS) ومؤشر إستخدام المياه (WUI) فى بعض الترع المطوره وغير المطوره وذلك لتقييم مدى تحقق أهداف مشروع التطوير. وقد أنتهى برنامج التقييم والمتابعه إلى أن معظم أهداف التطوير لم تتحقق بعد وموضحا أن السبب الرئيسى فى ذلك هو عدم القدره على إداره الشبكه بالصوره المطلوبه.

وقد أوضحت هذه الدراسه الأرتباط الوثيق بين تحقق أهداف التطوير والقدره على إداره الشبكه بالكفاءه المطلوبه. وخلال مشروع تطوير الرى تم إستخدام نظام التيار المستمر لإداره المياه بالترع الفرعيه. والمفترض خلال هذا النظام أن يتم فتح الترع الفرعيه بإستمرار مع توزيع المياه بين تلك الترع الفرعيه نسبيا وبناء على التصرفات مع تطبيق مناوبه داخليه بين نقاط الرفع داخل الترع الفرعيه. وقد أوضحت نتائج برنامج التقييم أن النظام المطبق بالفعل فى المناطق المطوره يمكن إعتباره كنظام مهجن بين التيار المستمر والمناوبات حيث يتم فتح الترع بإستمرار مع إستمرار إداره المياه بالترع عن طريق حفظ مناسيب الخلف بدون حساب للتصرفات أو تطبيق للمناوبه الداخليه بين نقاط الرفع. وقد شجع هذا التطبيق الخاطئ للنظام على زياده إستهلاك المياه خاصه فى بدايات الترع وفى مناطق الأرز.

وكانت التوصيه الرئيسيه لهذه الدراسه هو البدء فى إجراء أبحاث لتعديل نظام التيار المستمر الى نظام أكثر ملائمه لحاله شبكات الرى وإمكانيات القائمين على إداره تلك الشبكات سواء كانت إدارات الرى أو منظمات مستخدمى المياه. ويمكن أن يكون ذلك النظام المقترح عباره عن صوره معدله من نظام المناوبات. وأشتملت التوصيات كذلك على وضع أهداف التطوير على صوره مسئوليات محدده لتشجيع إدارات الرى على تحقيق تلك الأهداف، ووضع إستراتيجيات محدده لمواجهه المشاكل البيئيه.

قام بتحكيم البحث

أ.د / السيد محمود الحديدى	**كلية الزراعة – جامعة المنصورة**
أ.د / محمد ابراهيم مليحه	**مركز البحوث الزراعية**