DRAINAGE WATER REUSE STRATEGIC OPTIONS AND MEASURES TO ALLEVIATE RISK OF FAILURE (EGYPT)

OPTIONS ET MESURES STRATÉGIQUES MESURES DE RÉUTILISATION DES EAUX DE DRAINAGE POUR PALLIER LE RISQUE DE DISFONCTIONNEMENT (ÉGYPTE)

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ABSTRACT

The Egyptian total water requirements of all socio-economic sectors are estimated at 73 BCM/yr. A gap between fresh water resources and the country's requirement already exists. Moreover, there more stress in the fresh water would lead to wide this gap. The possibility of increasing the fresh water resources from conventional sources is doubtful. In the meantime, non-conventional sources such as desalination or cloud seeding are also infeasible and expensive. In addition, water requirements of different sectors increase rapidly with time due to rapid population increase; ambitious agricultural expansion, and elevated living standards. Therefore, the fast and economic way to bridge such gap is to reuse the available and possible water resources more than one time. The objective of this paper is to assess the status of drainage water reuse practices, challenges in the country, recommend measures to alleviate risk of failure and present the future strategic options to enhance drainage reuse practice. The potential strategic options for drainage water and treated wastewater reuse would include; sustain current reuse practice, re-introduce the stopped reuse project, introduce new reuse projects and enhance treated wastewater reuse practice

The reuse practice subject to several potential risks such as uncertainty of water availability for reuse due to unaccounted of other usage, introducing measure for water save or change in water allocation, water quality deterioration, introducing drinking water supply downstream reuse mixing site, changing cropping pattern within drainage catchment. Measures to alleviate risk of failure for drainage water reuse practices would include six elements. First is to develop national atlas for objective uses for the water ways including irrigation and drainage system. Second is to redefine water availability for reuse practice at hydrological drainage catchment considering unofficial reuse and avoid double counting. Third is to locate the new drinking water supply intakes and wastewater treated effluents in coordination with Ministry of Water Resources and Irrigation. Fourth is to define the priorities for water quality improvement considering Ministry of Water Resources and Irrigation vision. Fifth is to review the reuse practices at hydrological drainage catchment to avoid any contrast while the last measure is to conduct environmental impact assessment study.

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1. Introduction

Since the completion of the High Aswan Dam in 1970, irrigation has become possible throughout the year (perennial). All agricultural lands are more than double cropped (more than 200% cropping intensity). Among the main constraints to agriculture production in Egypt is the rise of the water table causing water logging and salinization. Therefore, drainage becomes obvious to control water table level and soil salinity. A system of open main and branch drains has been constructed since the start of the 20th century. This network of open drains solved the problem of water logging and salinity partially.

Currently, the total water requirements of all socio-economic sectors are estimated at 73 BCM/yr. The agriculture sector alone requires about 82% of this amount. A gap between fresh water resources and the country's requirement already exists. Reuse of drainage water holds great potential for saving valuable freshwater resources for competing prime uses that require more stringent water quality standards. It provides a reliable supply of irrigation water and rich nutrients to cropped fields. The Egyptian case in the field of water reuse is unique for the following reasons:

- all surplus water is returning to the system.
- in Upper Egypt, seepage, agriculture drainage water, sewerage water are returning back to the Nile and reused in the Delta area.
- downstream Delta Barrage drainage water, sewerage water and groundwater in the Delta is reused directly or by mixing;
- all sewerage water is drained to the agricultural drains;
- there is no special end systems for sewerage or industrial wastewater;
- the flexibility in water distribution is very limited since there is no intermediate reservoirs between Aswan and the sea; and
- a lot of activities requires marginal or low quality water where drains should end to the areas where such activities take place.

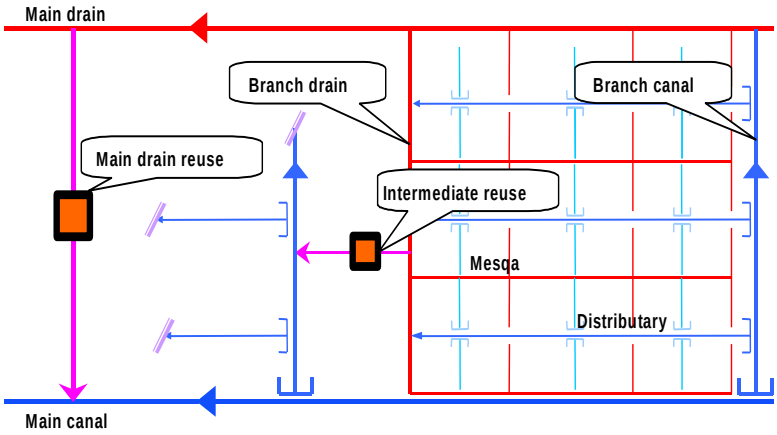
There are many systems of reuse practices which would contribute to the overall resilience of the Nile Delta agricultural and livelihoods system. The objective of this paper is to assess the status of drainage water reuse management and challenges in the country and recommend measures to alleviate risk of failure.

2. Reuse Practices In Egypt

Three types of reuse practices can be distinguished in Egypt as:

- **Gravity reuse** of drainage water, which takes place in canals or river branches receive drainage water by gravity. This takes place for instance in the Nile Valley, where nearly all drainage water returns to the Nile River.
- **National reuse project** is the practice of pumping part of the drainage water flow into the irrigation water system.
- **Intermediate reuse project** is the mixing of drainage water and fresh irrigation supplies take place at lower level- with a drainage catchment coinciding with a number of secondary canals.
- **Unofficial reuse** is practiced by individual farmers who decide, when and how drainage water will be used for supplementing their irrigation water. Unofficial reuse of drainage water normally takes place near the tail ends of the irrigation canals.
- **Reuse of wastewater treated effluent** is reuse of treated effluents for restricted crops, landscape, green belt and forests.

Figure 1 Typical reuse scheme in the Nile Delta



3. Factors Affecting Drainage Reuse Practices

There are many factors that may adversely affect the drainage reuse in the Delta region, including pollution, Water save and improvement project, rice area reduction, and the Toshka project (S.T Abdel Gawad and A. El Sayed 2008).

3.1 Reduction of Egyptian Water Quota

There are dam schemes under construction and design process in Ethiopia and Uganda. This situation will lead to remarkable impacts on the Egyptian water quota during reservoirs filling period while less impact during operation. Reducing the fresh water supply to Egypt will sure impact the drainage water quantity and quality. This is questionable to quantify the impact of each dam scheme upstream Egypt on the fresh water to Egypt and so the generated drainage water. Reducing the drainage water and deteriorating the quality as well will lead to significant impact on drainage water reuse policy and practice. Details hydrological and environmental impact assessment studies are needed priority to any intervention upstream Egypt.

3.2 Pollution

The quality of drainage water is threatened by the uncontrolled disposal of polluted effluents (domestic and industrial) and the improper disposal of solid and toxic wastes from agricultural and human activities. The high population densities and industrial activities in combination with insufficient sewerage facilities cause different levels of pollution load on drainage water to the extent that there is a health hazard.

3.3 Irrigation Improvement Project (IIP&IIIMP)

Egypt has launched an ambitious Irrigation Improvement Program (IIP) "later called Integrated Irrigation Improvement Management Project (IIIMP)", which includes the improvement of water delivery system, on farm-water management, irrigation methods and associated agronomic practices. The extension of these programs in the Delta will affect the generation and distribution of drainage water in the region. During 1989-97, Egypt has implemented these programs on over 350.000 feddans. According to the GOE plan, these programs will be extended to an area of 3.5 million feddans in the Delta by the year 2017.

3.4 Rice Reduction

Rice is one of the most controversial crops in Egypt. Farmers favor the crop because of its high production yields and economic returns. Water engineers are more inclined to reduce the area under rice so that the large amount of rice irrigation water can be used for other demands such as expanding irrigation lands. Rice is a land reclamation crop in the North to prevent the seawater intrusion, and rice area reduction mainly applies to the south Delta region. Therefore, only the effect of South Delta rice reduction on drainage generation needs to be evaluated. The drainage reduction by rice area reduction would be about 2,000 m3/fed. With a possible 500,000 feddans rice area reduction in the southern Delta, the expected decrease of drainage would be about 1.0 BCM.

3.5 Toshka Project

Toshka is the largest irrigation project in Egypt after the AHD construction. It is designed to develop half million feddans of arable land in the next 10 to 20 years (Shalaby, A. 1997). At a designed annual irrigation requirement of 8,000 m3/fed under the local climatic conditions, the project will withdraw 4 BCM of water from Nasser Lake. For simplicity, the Toshka effect on Nile downstream water allocation is expressed as a 2-4 BCM reduction in current AHD release. To evaluate the Toshka effect on drainage reuse in the Delta, scenarios of 2-4 BCM reductions of HAD release were simulated in a Nile water balance calculation. With the Toshka project, the reuse of drain water in the Delta will have to be maximized. Whether this will be realistically possible remains questionable. Fortunately, Toshka may take 10 years for full development, and the required drainage reuse expansion can be conducted in a series of steps, or may be partially replaced by other water management measures, in the course of the next decades.

4. Measures to Alleviate Risk of Failure

Measures to alleviate risk of failure for drainage water reuse practices would include several elements which will presented in the following sections.

4.1 Develop National Water Atlas

First measure is to develop national water atlas for objective uses for the water ways including irrigation and drainage system. There are no agreed clear objective uses of water courses in Egypt. There are several Ministries and entities get use and involved in water resources operation and interventions So, there is a need to clarify the objective uses and function of water ways in Egypt including irrigation and drainage.

4.2 Redefine Water Availability for Reuse Scheme

Second measure is to redefine water availability for reuse scheme for each hydrological drainage catchment considering unofficial reuse and avoid double counting. In many reuse scheme cases such as El Salam Canal Project, the drainage water to be mixed with the fresh water is over estimated. The lag time between the reuse study and implementation would take over 10 years. The assumed available drainage water for reuse mostly reduced due to unofficial reuse and other small scale reuse within the drainage catchment that did not count. Two options would be considered in such cases; first, is not to allow for any intervention could reduce water availability within the drainage catchment and second to have better estimate for water availability considering implementation schedule.

4.3 Locate Influents and Effluents in Coordination with MWRI

Third measure is to locate the new drinking water supply intakes and wastewater treated effluents in coordination with Ministry of Water Resources and Irrigation. In the past, many drinking water supply intakes constructed downstream mixing point with drainage water such as Ismalia canal feeding Suez Canal Cities that lead to shutdown one of the reuse pumping station (Mahsama Pumping Station). Other reuse scheme located upstream drinking water supply intakes are in operation such as Alexandria city along El Mhamoudia canal. This situation would lead to overload of water treatment plants or health risk for water consumers. In other cases, the treated wastewater effluents discharge into drains that flow into canals or River Nile (El Rahawi, Sabal and Tala drains into Damitta branch). The disposal of wastewater has significant negative impact on such reuse scheme that can be avoided if Ministry of Housing, Utilities and Urban Communities consult Ministry of Water Resources and Irrigation to come up with better alternative.

4.4 Define the Priorities for Water Quality Improvement Interventions

Pollution control actions should be aimed at the provision of adequate treatment facilities to those communities connected to sewerage systems and the provision of collection stations for the vacuum trucks. The collection stations could be connected to the existing treatment plants by forced mains or could be equipped with small treatment units. The budget for such intervention allocated through Ministry of Housing, Utilities and Urban Communities where they have their own priority areas. Fourth measure is to define the priorities for water quality improvement interventions considering Ministry of Water Resources and Irrigation vision. The areas with health risks of low drainage water quality is limiting factor for sustainable reuse project. One of the criteria to define priority area is the catchment of current and planned reuse schemes.

4.5 Review the Reuse Practices at Hydrological Drainage Catchment

Fifth measure is to review the reuse practices at hydrological drainage catchment to avoid any contrast. In some cases, several reuse types are practiced that may impact each other; national reuse Project, intermediate reuse project and unofficial reuse through different sector within MWRI and farmers. Intermediate reuse projects match with short term plan and fill gabs between supply and demand as rapid intervention while national reuse projects match with long term plan.

4.6 Conduct Appropriate Feasibility Study

The reuse schemes cost GOE millions and in some cases are shutdown with no possibility to get any benefits from the project. So, there is a need to conduct feasibility study including water quality assessment, matching with present and future usages of the receiving water body and environmental impact assessment for any future reuse scheme.

5. Strategies to Sustain Drainage Water Reuse Practices

Strategies to sustain drainage water reuse practices are developed including:

- Shift to drainage water quality management;
- Define priority actions to enhance reuse potential
- Apply pesticides: policies, controls, subsidies and extension advice
- Increase municipal sewerage and wastewater treatment
- Initiate cost recovery for urban sanitary services
- Local action plans on domestic sanitation in rural areas
- Treatment of industrial wastewater package
- Introduce low cost effective technologies

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