# SOME ASPECTS TOWARDS ON-FARM EFFECTIVE IRRIGATION MANAGEMENT

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## INTRODUCTION

Agriculture has always been the core of the economic development and is considered as the main activity for a large sector of the population. It contributes to one fifth of the gross domestic income and consumes over 80% of the total water supply. Although Egypt's effects in birth control have been acknowledged by the international community, the population still gained great momentum and will continue to grow. The population growth and escalated living standards have put more stress on water and land resources. Degradation of these resources due to heavy socio-economic exploitation adds up to the water security problem. The Ministry of Water Resources and Irrigation (MWRI) is formulating the national water policy for the 21$^{st}$ century to face the challenge of water security. The policy's overall objective is to utilize the available conventional and non-conventional water resources to meet the socio-economic and environmental needs of the country. The formulated policy focuses on three major aspects: demand management, resources development; and environmental protection.

The new strategy of the Egyptian government is determined on expanding the inhabited area from 4% to 25% of the national territories. Agriculture expansion by creeping out of the Nile valley and Delta added more loads to the Nile system and did not redistribute the congested population.

**The following table gives a comparison between supply and demand at present and in the future (1997-2025).**

| Use | 1997 | 2025 |
|---|---|---|
| **Irrigation** | 48.0 | 64.0 |
| **Municipal** | 4.0 | 7.3 |
| **Industrial** | 4.0 | 7.3 |
| **Others** | 3.0 | 2.4 |
| **Total** | 59.0 | 81.0 |
| **Available** | 60.0 | 60.0 |
| **Difference** | -1.0 | -21.0 |

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## SUPPLY-DEMAND

The above table shows that water demand particularly for agriculture would be tremendous. The gap between supply and demand in the future will widen, the difference is expected to be a deficit of almost 21.0 billion $m^3$ by the year 2025. The country has to develop a series of harsh measures for the covering of this large deficit by:

1- Implementing upper Nile Projects meant for reducing evaporation, evapotranspiration and seepage losses; and the development of the low cost techniques for the desalination of saline water.
2- Improving water use efficiency both for the irrigation of agricultural fields, for domestic uses as well as for industrial requirements. Agriculture being the largest consumer should beer the hardest measures such as rehabilitation of conveyance and distribution networks and control structures, change of management options (i.e. downstream control instead of upstream control and continuous flow to replace irrigation rotation), the use of modern irrigation systems, wherever and whenever possible, recycling of land drainage and treated waste waters, change of cropping patterns, use of short duration varieties of crops, use of drought and low water quality tolerant crops…….etc.
3- Conservation of water bodies from the effect of pollutants and contamination through the improvement of treatment technology in one hand and the use of separate conveyance networks for low quality water in the other.

## ON-FARM WATER MANAGEMENT

On the light of demand management sector policy, management of irrigation water raised up to have the first priority as a result of the fact that agricultural irrigation consumed more than 80% from the total available water. Therefore, the aspects of effective water management at field level become a must.

So, means of on-farm irrigation management could be considered at the same time as important ways of resources development. The overall objective of such policy is to maximize the crop yield per each unit of applied water.

This target could be achieved by several means such as:

a- Determination of the actual irrigation water that should be applied depending upon the actual plant-water needs e.g. neither excess nor less of water applied. Excess or less water leads to decreasing in the crop yield.
b- Irrigation scheduling should be based on the actual water needs during different physiological stages of the growing crops.

c- Select the proper irrigation method on the basis of the local environmental conditions of soil, crop and climate.

d- Agricultural aspects owing to rationalize irrigation water at farm level.

## a- DETERMINATION OF ACTUAL IRRIGATION WATER

This aspect is computed by multiplying the reference evapotranspiration “ETo" with crop coefficient “Kc”. Values of ETo in a specific area are considered as the maximum crop-water needs in such area and reflected the local environmental conditions under enough or optimum soil-water status. While “Kc” is the ratio between the actual or water consumed by a crop and “ETo". Therefore, computation of irrigation water is based on:

### 1- Determination of a local method for reference evapotranspiration “ETo”:

In this regard, a study was carried out at north Nile Delta region by **Ibrahim (1981)** to evaluate some methods for calculating potential evapotranspiration “ETp" through irrigation with different amounts of irrigation water which computed from the different methods under the local conditions. The main objective of such study was to create a simple, practical method for computing “ETp” that fit the local conditions which leads to maximization of crop yield per unit of applied water. The studied methods were:

- Modified Blaney-Criddle
- Radiation
- Modified Penman
- Rijtema
- Thronthwaite
- Jensen-Haise
- Evaporation Pan
- Turc

- The direct method of actual water consumed by crop based on soil moisture depletion “S.M.D.” in the effective root zone.

Therefore, following is the suitable equation of ETp for north Nile Delta (**Ibrahim, 1981):**

$$\mathbf{ETp = 0.8\ Ep + 0.1642 \qquad cm/day}$$

As Ep represent the Pan evaporation.

Advantages of using Ep:

- Pan evaporation reflects the local climatological conditions of thermal and aerodynamic factors that caused the evapotranspiration process.
- The easiest in computation “ETo” and the low cost in comparison with other methods which need agro-climatological stations.
- About 14% from the total crop water needs might be withdrawn from the shallow water table in the area which consequently leads to

improving soil aeration and soil drainage which ultimately reflected in higher crop yield.

- Increasing applied irrigation efficiency "Ea" to the range of about 90%.
- Maximizing crop yield per each unit of applied water. In other words, the highest crop-yield efficiencies could be obtained.

In case of un-availability of Pan evaporation "Ep", it is recommended to use; radiation, thornthwaite, modified Penman, modified Blaney & Criddle and Turc method with above mentioned order for computation "ETo" in middle north Nile Delta region.

Recently, an evaluation study showed that haergraves method gives acceptable results for computation "ETo" which almost similar with that obtained from the most world wide method of Penman-monteath. Keeping in mind that required data for thoergraves method are only air temperature "Ta" and soil radiation "Rs".

It is also useful to compute the radiation based on the features of the studied area instead of the values, which quoted from standard tables. In north Nile Delta region, a deviation of about 1% for the terarestrial or absolute radiation "Ra" in relation to that listed in standard tables leads to a deviation of about 17 and 28% for solar radiation "Rs" and net radiation "Rn" respectively.

## 1- Crop coefficient (Kc):

In this aspect, determination of Kc should be based on the local practical conditions of the situe and hence to evaluate the resulted values with that tabulated in FAO publications (**Doorenbos *et al.*, 1979**). Values of Kc for different crops are determined from the field experiments. For example, in north Nile Delta, seasonal Kc for soybean is 0.87 with a deviation of 4.82 % from that of FAO. While, it is 0.73 for sugarbeet with a deviation of 8.75 in relation to FAO values.

## b- IRRIGATION SCHEDULING

Growing period for any crop is consisted of different physiological stages of growth, which differs among them in connection with sensitivity to irrigation. Therefore, irrigation should be applied according to the critical growth stages e.g. skipping such watering leads to a remarkable reduction in crop yield and vise versa for the un-critical growth stages to irrigation. In addition, saving of irrigation water of the un-critical growth stages. For example, skipping irrigation of maize during emergence and teseling stages resulted in yield reduction of about 20 and 16% respectively. Meaningfully, irrigation at such two stages becomes a must. It case of enough water, sugarbeet should be irrigated during all stages of growth. On the contrary i.e. under deficit conditions, irrigation at the mid stage of yield formation might be ignored (**Emara *et al.*, 2000**). In general, time of irrigation could be implemented by several ways such as; at certain depletion of soil moisture in the effective root zone, irrigation rotation i.e. availability of water, tensiometers……etc. But irrigation scheduling according to the critical stages of growth is the most effective practical mean of watering rationalization and consequently, conservation of available water resources at field level.

## c- CULTURAL PRACTICES

Cultivation of short duration varieties of the highest water consumed crops such as rice and sugar cane is another effective aspect of irrigation management. Both abovementioned crops consumed almost one third of the total water allocated to agricultural irrigation. For example, short duration varieties of rice along with decreasing irrigation depth from the traditional of about 7.5 cm. above soil surface to 5.0 cm. resulted in saving an amount of irrigation water with about 1500 m3/fed or around 2.0 billion cubic metre for the national acreage level ($1.5 * 10^6$ fed., 1 fed. = 0.42 ha) as stated by **Abu El-Fotouh, 2001**.

Wide furrow cultivation accompanied with decreasing watering depth by one third lead to saving irrigation water by about 25% in comparison with that of normal furrow and traditional irrigation of 7.5 cm. as water depth above soil surface. This effect is owing to the less number of watering channels or pathways of a specific cultivated area in case of wide furrow cultivation.

## d- IRRIGATION METHOD

Irrigation method should be selected depending upon the local specifications of soil, plant, availability and quality of irrigation water and environmental conditions. Surface irrigation is recommended for the fine heavy clayey soils and accompanied with proper leveling. While pressurized irrigation systems are the most suitable methods for coarse texture sandy soils due to its high permeability. Proper design, evaluation and management of different irrigation methods become a vital way in rationalizing irrigation water.

## e- PUBLIC AWARENESS

Public awareness as well as water user associations are very important in widespread knowledge among irrigation stakeholders concerning on-farm irrigation management.

## f- USE OF MARGINAL WATERS

Usage of marginal waters such as drainage domestic and industrial waters increasing rapidly especially under the present status of water shortage.

## CONCLUSIONS

- Different aspects of on-farm irrigation management are the most effective ways in rationalizing agricultural irrigation.
- Tremendous efforts should be implemented towards effective on-farm irrigation management via, precisely amount of irrigation that should be applied, timing of irrigation, scientific of design, evaluation and management of different irrigation methods, crop rotation should be based on crop yield per each unit of water applied, growing of short duration and drought tolerant crops, cultural practices that lead to optimum use of irrigation water…….etc.

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