Development of a Decision Support System for Irrigation Management at Gezira Scheme in Sudan

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ABSTRACT

Irrigation management is critically important in Gezira Scheme, where a large area should be fully utilized with different type of crops . The main objective of this research is to develop a knowledge base decision support system for managing irrigation at Gezira Scheme. In particular, it has collected and organized a huge data about area , climate, soil, crops and irrigation network, and hence it has developed a Visual Basic program for accessing this database and performing all necessary calculation. As a result the developed system can easily provide any crop requirement, season planning, scheme general and system specific information. These include computation of water requirement, irrigation scheduling (number, quantity, time and interval of irrigation), and area to plant any crop in a specific period according to the available water in the main canal.

Keywords

DSS, knowledge base, irrigation management, Gezira scheme

1. INTRODUCTION

Water scarcity and competition is the main issue in developing countries as far as water resources development and management is concerned. The per capita availability of water is decreasing day by day due to population growth. The demand for water is rising for increased food production, further industrial development, better standards of living, etc. Applied technology to irrigation systems is the appropriate method to offer sustainability to agricultural production, considering the rational use of the available water as a central variable[1]. The optimum management of available surface and subsurface water resources, with respect to quantity and quality, is urgently needed in view of the increasing demands, limited resources and soil salinization [1]. New technologies and improvement of on-farm water management are essential to solve these problems [2]. Information systems are methodologies aiming at supporting decisions. Two main type of information systems are used in water resources planning and management: geographical information systems (GIS) and systems analysis[3]. Systems analysis is a broad methodology of using models for solving engineering and management problems by decomposing them into interdependent processes of different nature[3]. Systems analysis can be applied to a very large number of problems in irrigation and agricultural water management. These comprise on-farm decisions, project operation and management, water, resource planning and allocation, water quality management, environmental impacts assessment. In any case an optimal solution is searched but the optimal result can be expressed in particular forms or satisfying specific requisites. Very recent review papers by [4], [5], [6], give a complete information on systems analysis methods and their application in water resources.

2. Material and method

Water management is integrated discipline comprising engineering [Hydraulics], agriculture [Agronomy], agro climatology, soil, physics, socioeconomics and environmental science [7].

All these disciplines interact actively in the course of water management in an irrigated scheme.

Calculation of Crop Water Requirements The crop water requirement depend on climate and crop factors. For crops grown on clay soil the CWR is just the water needed to cover the water losses through evapotranspiration. Deep percolation blew the root zone is almost zero in clay soils. There are no leaching requirements as there is no salt problem in Gezira. The water balance equation become very simple.

The full water balance equation is as follows [8]

$$\Delta S = I + P - ET - RO - D - L$$

Where ΔS : change in soil moisture, I: Irrigation , P: Rainfall, ET: Evapotranspiration

RO: Run off, D: Deep percolation, and L: Leaching requirement.

Under the condition of Gezira clay soil the water balance is very simple the run off (RO) is negligible as the land is flat with a slope of 10 cm/ km. The deep drainage (D) is almost zero. There is no salinity problem in Gezira , the leaching requirement (L) is also zero. So the water balance equation 1 can be simplified as follows [8]:

$$\Delta S = I + P + ET$$

In the dry season (November - April), the rainfall (P) is zero. Thus equation 2 becomes:

$$\Delta S = I + ET$$

Within an irrigation cycle $\Delta S = 0$, as after each irrigation the soil moisture level reaches saturation .Therefore the net irrigation requirement equal the evaptranspiration. So to determine the net irrigation requirement (I) has only known the evapotranspiration(ET).

Calculation of Irrigation Schedule The important characteristics is the readily available water (RAW) [8]

$$RAW = TAW * D * P$$

3. System design

System Software has been designed into four moudles:data entry, irrigation management, ganaral information,and system informaton The crop water requirement, irrigation scheduling,are determined in irrigation management module as shown in Figures 1,2 .The system development by using visual basic program[9] because it has several features that has been selected as the best program for building the system.

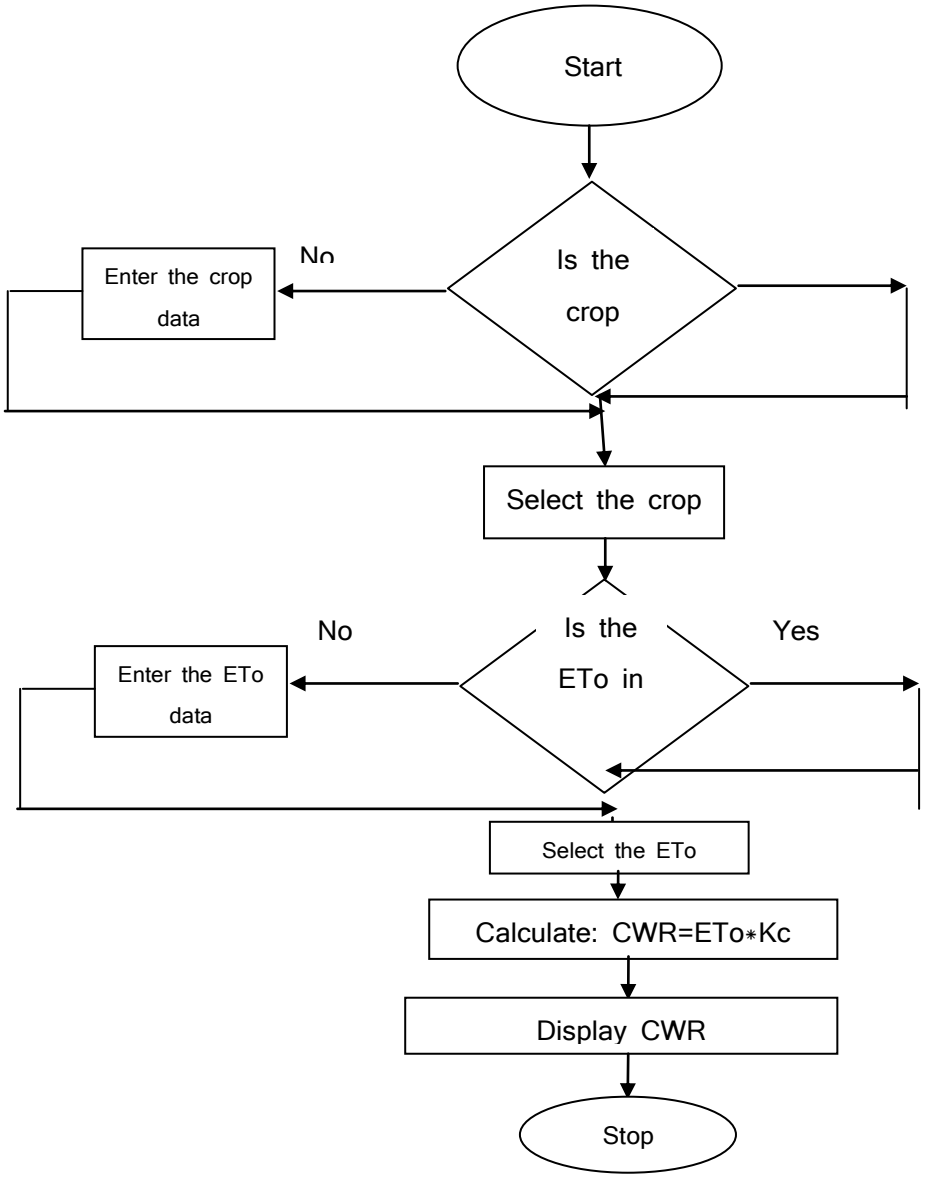

Fig 1: Calculation of crop water requirement

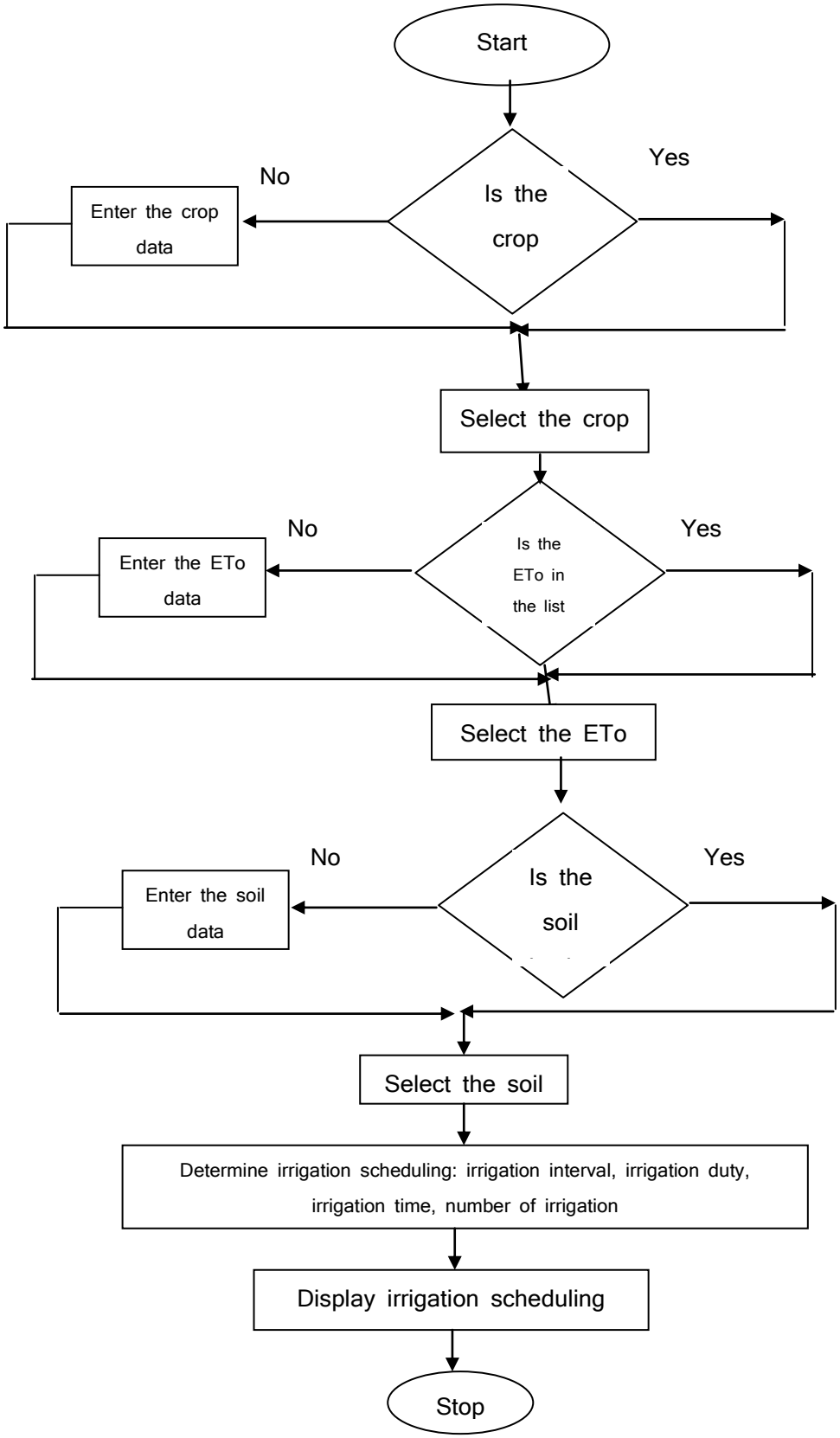

Fig 2: Determination of irrigation schedule

4. Result

The system main is screen considered as a background for all system widows, it is composed of menus and command buttons, so the user could enter to the system in different ways as seen in Figure 3. The screen of crop data entry show in Figure 4. The real computations for CWR using ETo of Wad Medani station show in Figure 5,. The system automatically calculates the irrigation schedule, as shown in Figure 6.

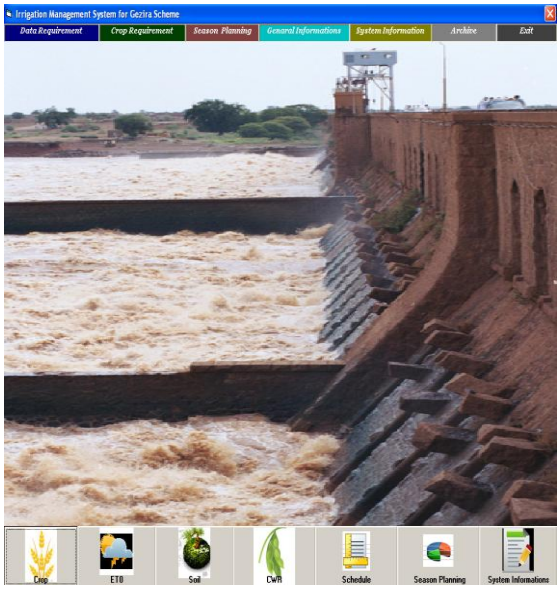

Fig 3: System main screen

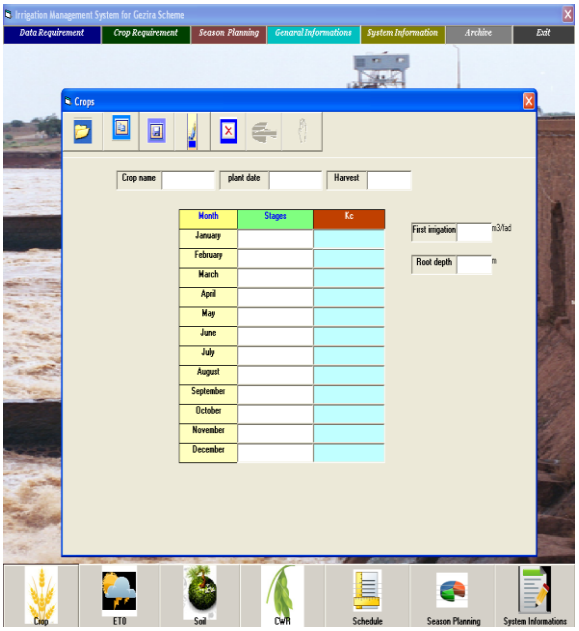

Fig 4.: Crop data entry screen

Fig 5: Calculation of CWR

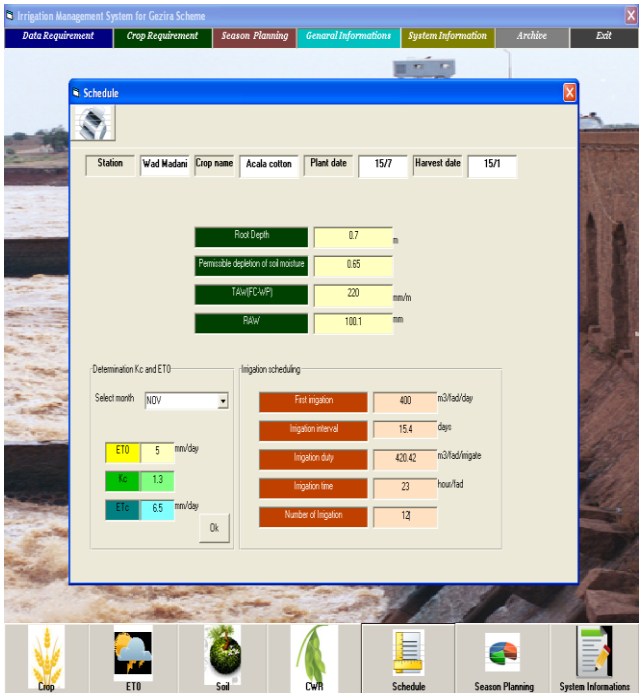

Fig 6: Irrigation schedule

5. Conclusion and recommendation

The study focuses on irrigation management at Gezira Scheme in Sudan, it calculation of crop water requirements in specific period in any season, determination of irrigation interval for any crop at any time, As recommendations for future research the system can be further developed to be a web based as well as integrated with a hardware for measuring actual canal water flows and controlling the gates.

6. REFERENCES

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