#7595 A PRECISION IRRIGATION APP FOR SMART WATER MANAGEMENT BY FARMERS: "IRRISMART"

A. Abouabdillah*, and R Bouabid
National School of Agriculture of Meknès, aabouabdillah@enameknes.ac.ma

ABSTRACT

In a context of climate change and water scarcity which is globally recognized, Morocco is one of the countries that are facing already insufficient water supply for irrigation in order to sustain productivity and food security. Therefore, there is a strong need for adapting agricultural practices and developing new technologies for efficient and smart irrigation management to make best use of available water and maximize productivity per unit of consumed water. Recent studies have shown that water use by farmers in drip irrigation systems exceed in many cases the recommended crop requirements. This is due mainly to the limited knowledge of farmers for the irrigation parameters in relation to crop requirements, climatic demand and soils conditions. This work aimed to develop a Smartphone application that integrates all components of the soil-water-crop-atmosphere continuum to provide precision irrigation to farmers, managers and other potential users in order to help them better manage irrigation water and improve profitability per unit water used. The application allows the farmer to enter specific climate information or use information provided from nearby weather stations or satellite data. The application uses suitable crop coefficients (Kc) adjusted to the climatic context and gives the user the possibility of fine-tuning them according to crop cycle in order to obtain appropriate ETc values. Daily water needs are calculated using soil conditions, crop planting and drip irrigation system characteristics. The user receives then a daily water irrigation scheduling program for the chosen crop (amount and frequencies). A wide list of crops is available. The application keeps track of past water requirement and can provide a forecast of the needs for upcoming days.

Keywords: precision irrigation, drip irrigation, smartphone app

INTRODUCTION

In arid regions, water is a major constraint for crop production, given the dramatic increase in demand for this resource on one hand and the consequences of climate change on the other hand. Irrigation has known a considerable development in Morocco in recent years. However, the question of rational use of irrigation water is still of concern, even in drip irrigation systems.

It's well known that there is a limited knowledge on irrigation parameter determination (ie: frequency, timing, quantity). In fact, studies carried out on irrigation within Fes-Meknes region (Abouabdillah et al., 2019; Assouli et al., 2019) have shown that the applied irrigation water by the farmers, under the drip system, in many cases exceed the recommended crops water requirements. Another study conducted in the Ain Taoujdate region (Benouniche et al., 2014) showed that 100% of onion producers in the region over irrigate their crops and apply quantities of water that far exceed the crop water needs recommended by FAO (Allen et al. al., 1998).

Rational water management is an essential component of agricultural development. It necessarily involves the adoption and improvement of localized irrigation techniques (in particular the drip irrigation system) and the development of new methods of irrigation

management. In order to be effective, irrigation must be conducted in an adequate and smart manner. There are three main aspects related to smart irrigation management. First of all, knowledge on crop water requirements, secondly, irrigation frequency (number of irrigations) and then the irrigation duration. However, it should be clearly state that having this information available for farmer in time is even more crucial for better decision making.

This work aimed to develop a Smartphone application that integrates all components of the soil-water-crop-atmosphere continuum to provide farmers, managers and other potential users with precision irrigation parameters, such as daily irrigation calendar, in order to well manage irrigation and as consequence save water, and improve profitability.

MATERIALS AND METHODS

IrriSmart app was developed based on proven scientific algorithm combined with IT technology. The four components of the continuum were considered. The climate is considered to estimate the reference evapotranspiration "ET0" by either of the two suggested methods: the first one is based on Penman Monteith formula using the climatic parameters measured by meteorological stations available in the area of Fes-Meknes, (three stations). While the second method based on satellite data using climatic parameters generated from an open source satellite server. The generated climatic parameters cover the whole country with 1698 different locations assigned mainly to the administrative districts as well as all significant different altitudes within the same district. As a result, daily climatic demand is attributed to each registered field from nearby location data based on its geographic coordinates.

Regarding the crops, a large list of vegetable crops practiced in the country was included in the app. Once the crop is chosen, a crop coefficient "Kc" model is assigned using data from FAO 66 or using new crop coefficients (for other crops) that have been developed in the area (Abouabdillah et al., 2019; Bergui et al., 2020; El Jaouhari el al., 2018). Furthermore, the assignment of the Kc depends on the phenological stage of the crop determined by the date of sowing which is identified by the app user. The modification of the crop coefficient as well as the duration of the phenological stage is available on a professional version of the application, for more knowledgeable users.

The third component of the continuum consists on the soil role as a water reservoir for the plant as little attention is being paid to irrigation scheduling based on soil monitoring. The availability of water depends on soil water holding capacity; It is crucial to consider the available water content as well as the water holding capacity within the soil to be readily for the plant. As consequence, two options were considered in the app. The first one considers the soil proprieties indicating the percentage of clay, and sand, and then using the Saxston formula (saxstan et al., 2006) to estimate the soil water availability. While the second option, is based on the selection of a soil texture from a proposed list of various soil texture classes, where an average of soil water available is attributed (Keller et kameli, 1974)

The fourth component defining the irrigation duration is the system characteristics such as the dripper flow, and the line and dripper spacings, in order to determine the flow rate. Other parameters are estimated using a combination of other inputs such as the percentage of humidified soil, the efficiency and the uniformity of the system.

All these inputs are thereby organized in 5 steps, field identification, climatic simulation, crop choice and sowing date, irrigation system characteristics and finally soil characteristics.

RESULTS

The irrigation program, which is of most importance to the app user, is generated on daily basis based on the approach and algorithms used. All the data are saved on a cloud

server, and then sent directly to the user. Output data are summarized in five items: (i) daily crop water requirement "ETc"; (ii) water quantity to be applied for each irrigation; (iii) irrigations frequency; (iv) duration of one irrigation; and (iv) the total duration of irrigation per day. In simple terms, scheduling irrigation parameters are generated on daily basis and can be found by the user on a specific section assigned to each saved farm field providing the actual irrigation parameter and also the previously recorded ones. It should be also point it out, that in case of non-access to internet network, the app user can request to get the outputs via SMS. Up to this point, the IrriSmart app is under validation by users, and the results obtained raised great interest among farmers and other water management decision makers.

The new developed irrigation app IrriSmart, will contribute to a precision irrigation and a smart management of irrigation water leading to a significant water saving, mainly in the context of climate change and water scarcity that Morocco is facing.

REFERENCES

Abouabdillah A, Bouabid R, Bourioug M, Mrahli D, El Jaouhari N. 2019. Réponse de l'oignon (Allium Cepa) à l'irrigation déficitaire continue avec différentes fréquences dans la région du Saïs. Communication orale. Conférence: Exploitation des eaux souterraines et défis de la durabilité de l'agriculture irriguée Mercredi 10 juillet 2019 au Qualipole Alimentation de Meknès.

Allen RG, Pereira LS, Raes D, Smith M, et al. 1998. Crop evapotranspiration-Guidelines for computing crop water requirements-FAO Irrigation and drainage paper 56. FAO, Rome, 300(9), D05109.

Assouli O, El Bilali H, Abouabdillah A, Harbouze R, El Jaouhari N, Chaoui M, Bouabid R. 2019. Transition from surface to drip irrigation in morocco: analysis through the multi-level perspective. AGROFOR 3(3) https://doi.org/10.7251/AGRENG1803142A

Benouniche M, Kuper M, Hammani A, Boesveld H. 2014. Making the user visible: Analysing irrigation practices and farmers' logic to explain actual drip irrigation performance. Irrigation Science 32(6): 405-420. https://doi.org/10.1007/s00271-014-0438-0

El Bergui O, Abouabdillah A, Bouabid R, El Jaouhari N, Brouziyne Y, Bourioug M. 2020. Agro-physiological response of potato to "sustainable" deficit irrigation in the plain of Saïs, Morocco; Published online: 03 August 2020; E3S Web of Conferences 183, 03001, 3S Web Conf. Vol. 183, DOI: https://doi.org/10.1051/e3sconf/202018303001

El Jaouhari N, Abouabdillah A, Bouabid R, Bourioug M, Aleya L, Chaoui M. 2018. Assessment of sustainable deficit irrigation in a Moroccan apple orchard as a climate change adaptation strategy. Science of the Total Environment 642: 574–581.

Keller J, Karmeli D. 1974. Trickle irrigation design parameters. ASAE Transactions 17(4): 678-684.

Saxton KE, Rawls WJ. 2006. Soil Water Characteristics estimates by texture and organic matter for hydrologic solutions. Soil Sci. Soc. Am. J. 70: 1569-1578.