Improved Irrigation Planning a Mouse Click Away

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The latest version of the celebrated SAPWAT program to be launched later this year promises to be a powerful and user-friendly irrigation water planning tool, writes developer Pieter van Heerden.

With some 60% of South Africa's water use being in the agricultural sector it is important that water supply planners, irrigation scheme managers, system designers and irrigation farmers have access to reliable methods for estimating the irrigation requirements of crops. In the early years, guidance was provided by the so-called 'Green Book' titled ***Estimated Irrigation Requirements of Crops in South Africa***, published in 1985. This publication became the accepted methodology for determining irrigation quotas.

HISTORY OF SAPWAT

In 1992, the Food and Agriculture Organisation (FAO) of the United Nations published CROPWAT, a computer program to help agro-meteorologists, agronomists and irrigation engineers to carry out standard calculations for evapotranspiration and crop water use studies and, more specifically, the design and management of irrigation schemes. The program proved very simple to use, even by first-time computer users with little or no training.

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CROPWAT became the internationally accepted irrigation planning methodology and still maintains that position. However, it never came into general use in South Africa. A report on the expert consultation on procedures for revision of FAO guidelines for prediction of crop water requirements indicated that there was a need to develop crop factors based on calculating evaporation and transpiration separately to cater for non-standard crop growth situations and irrigation practices. This was particularly important in South Africa and other countries where emerging farmers with limited resources required specialised support.

The Water Research Commission financed a project by MBB Consulting Engineers to develop a procedure to succeed the Green Book. In consultation with Martin Smith of the FAO it was decided to start with CROPWAT and to concentrate on separating evaporating and transpiration as well as on upgrading procedures to cater for 'modern' irrigation methods such as micro, drop, centre, pivot and short furrow irrigation while maintaining CROPWAT's simplicity and user-friendliness.

Naturally this had to be in context of South African crops, soils and practices utilising extended databases and relevant research data. SAPWAT – a computer program for establishing irrigation requirements and scheduling strategies in South Africa was finally released in 1999, and by and large achieved the envisaged objectives. The program has gained general acceptance in South Africa.

SAPWAT is not a crop growth model. It is a planning and management tool relying heavily on an extensive South African climate and crop database. It is general in applicability in that the same procedure is used for vegetable and field crops, annual and perennial crops and pasture and tree crops.

It is possible to simulate wide-bed planting, inter-cropping and different irrigation methods. In addition, the effect of soil water management options, such as deficit irrigation, can be evaluated.

It extended the applications provided by CROPWAT and facilitates so-called 'designing for management'. It creates a 'computer game' atmosphere that promotes consultation and interaction between farmers and advisors.

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UPDATING THE PROGRAM

Pieter van Heerden, the developer of SAPWAT 3, became frustrated when applying SAPWAT to a wide range of conditions because exporting results was a chore, and in many cases involved utilising external spreadsheets. To solve this problem he developed, under the auspices of the International Water Management Institute, the PLANWAT program in dBase that made it possible to manipulate and process SAPWAT-generated output applicable all the way from a single vegetable bed to a 10 000 ha water user association.

He also added the methodology required to estimate the volume of runoff that could be harvested from a household plot in the rural areas during the rainy season as well as the storage volume of water required to see the garden through the dry season. In addition, a crop budgeting routine was added to assess the influence of various cropping systems on irrigation water requirements and on gross income, expenses and gross margin.

SAPWAT 3 integrates an upgraded version of PLANWAT with the latest SAPWAT crop irrigation requirement engine. One of the shortcomings of CROPWAT and SAPWAT was that calculations were based on long-term average climatic data. Included in the SAPWAT 3 weather database is 50-year daily weather data for more than 2 000 quaternary drainage regions for South Africa as produced by the University of KwaZulu-Natal. The user can estimate year-on-year irrigation requirements for any sub-period of the 50-year data set and can compare different periods with each other to investigate the effect of wet and dry years.

All data tables, except the climate table, are open for adding or editing data by the user so that data can be adapted to local situations. The climate data is based on the internationally accepted Köppen climate system and SAPWAT 3 uses weather station data to place a weather station and its associated region in a climate zone. In addition, crop data is adapted for different climate zones.

The new program also provides for:

- Storage of data on different hierarchical levels to simplify irrigation water planning, use and analysis of use on different levels;
- Comparison of the effect of different irrigation strategies on evaporation loss;
- Comparison of the effect of different irrigation strategies on irrigation water requirement;
- Comparison of year-on-year variation in irrigation requirement due to year-on-year variation in climate;
- The influence of irrigation systems and their efficiencies on irrigation water requirements;
- The influence of soils and their characteristics on irrigation water requirements; and
- The effect of various cropping systems on irrigation water requirement and on gross income, expenses and gross margin.