Modern Technology Helps Farmers Save Water

An internationally acclaimed irrigation scheduling system, which has assisted small-scale sugarcane farmers in northern KwaZulu-Natal to improve their water use efficiency, is now being evaluated for wider implementation.

The ***MyCanesim*** system, which was developed through funds from the Water Research Commission and the South Africa Sugarcane Research Institute (SASRI), uses the potential of sophisticated information communication technology combined with participatory methods to assist sugarcane growers to save water while improving their crop yields. The system received the WatSave Award in the category 'Innovative Water Management' from the International Commission on Irrigation & Drainage last year.

Developer Dr Abraham Singels, a principal scientist at SASRI, explains that deciding how much and when to irrigate are important decisions that sugarcane growers have to make. "These decisions can have a direct effect on the profitability and sustainability of irrigated sugarcane production. Over-irrigation can lead to problems such as waterlogging, leaching of nutrients and excessive weed growth, while too little irrigation can cause severe yield losses."

He reports that several computer decision-support systems have been developed over the years to assist farmers with irrigation scheduling. The rapid progression of communications technology (including cellphones and the Internet) enables quick transfer of large volumes of data and information. "Unfortunately, these systems have mostly proven impractical and complex. As a result the uptake of these systems by the farming community in general has been very disappointing," notes Dr Singels.

This is specifically true for small-scale farmers who do not have access to expensive monitoring equipment, computers and the Internet to assist in irrigation scheduling. The challenge, therefore, has been to provide practical and useful advice to farmers using

state-of-the-art technology such as crop growth models and weather stations.

GOOD ADVICE IS ONLY AN SMS AWAY

To address this problem Dr Singels developed a centralised, automatic crop modelling system that provides simple, real-time and field-specific irrigation advice to sugarcane growers. "The system provides farmers with access to the power of modern technological advances without the hassle of having to learn how they operate," he explains.

The ***MyCanesim*** system comprises:

- A database of model inputs and outputs;
- A sugarcane simulation model (***Canesim***) that estimates the recent, current and future water balance, crop status and yield for a number of positions in a field;
- An irrigation scheduling and advice module that determines the ideal irrigation schedule based on the water balance of various positions in each field, and automatically generates and disseminates irrigation advice and yield estimates using mobile phone text messages; and
- An Internet-based user interface for advisors and extension staff to enter or edit field, crop and irrigation system data; and to view or download field reports. The interface has a friendly layout with an expandable menu tree.

Daily weather data are downloaded automatically from automatic weather stations, situated throughout the South African sugar industry. The SMS messages are sent to the farmers (in their mother tongue) whenever an action is required. The content comprises a suggestion to start, stop or continue irrigation for their field, with an estimate of current and final sugarcane yield. A confirmation SMS is sent at least once a week to reassure the farmer that the system is working.

In turn, advisors and extension officers receive a weekly summary (faxed or e-mailed), containing information for each field in a given scheme on the current irrigation action (irrigating or not), the expected date of the next action (stop or start), the expected date of the last irrigation, current cane yield and irrigation totals to date. In addition, reports containing detailed information, such as current and future cane yield, sucrose content and soil water deficit can be downloaded from the website.

SUCCESSFUL PILOT IMPLEMENTATION

The system was implemented on a pilot scale on two small-scale irrigation schemes at Pongola and Makhathini, in northern KwaZulu-Natal, using semi-permanent and portable overhead irrigation, with an average cycle between seven and ten days. The project started with seven farmers in 2004. After initial scepticism, growers closely and enthusiastically started following the advice. Today, there are 49 farmers actively using the system. Together, these farmers cultivate over 500 ha of sugarcane.

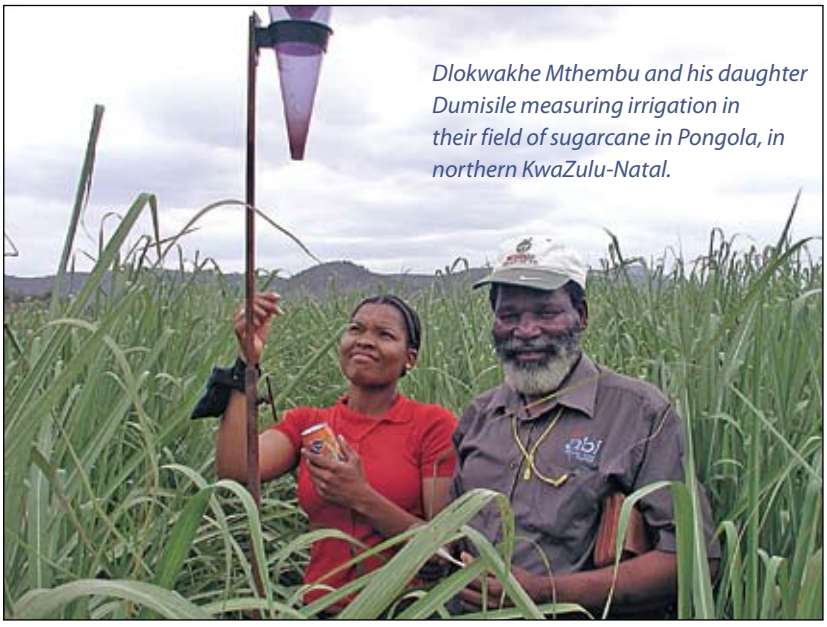
A participatory approach was adopted to ensure relevance and practicality. Farmers, extension staff and mill cane supply management contributed to the design of the Web interface, the advice and the reports generated by the system. Problems and progress were discussed at regular implementation and evaluation workshops.

These early pilot projects proved that the system worked well and that the advice from it had a significant impact on irrigation practices. For example, in Pongola, significant savings in irrigation water (in some cases up to 30%) were achieved. The main opportunity to save water proved to be during winter when the crop is small. These savings were made without cane yield being negatively affected.

IMPLEMENTATION CHALLENGES

Implementation of the system has not been without its challenges. First, irrigation advice is only relevant if farmers follow the advice, and that consequently there is a reasonable match between simulated and actual irrigation and water status. Dr Singels explains that there are various good reasons for farmers not to follow advice from time to time, for example, pump breakdowns, interruptions of water supply, and a need to wash in top dressed fertiliser.

To address this, the system has since been refined to accommodate a SMS reply from farmers when they cannot



Dlokwakhe Mthembu and his daughter Dumisile measuring irrigation in their field of sugarcane in Pongola, in northern KwaZulu-Natal.

or will not follow advice. The system interprets the reply in the context of the advice set and adjusts irrigation input data accordingly.

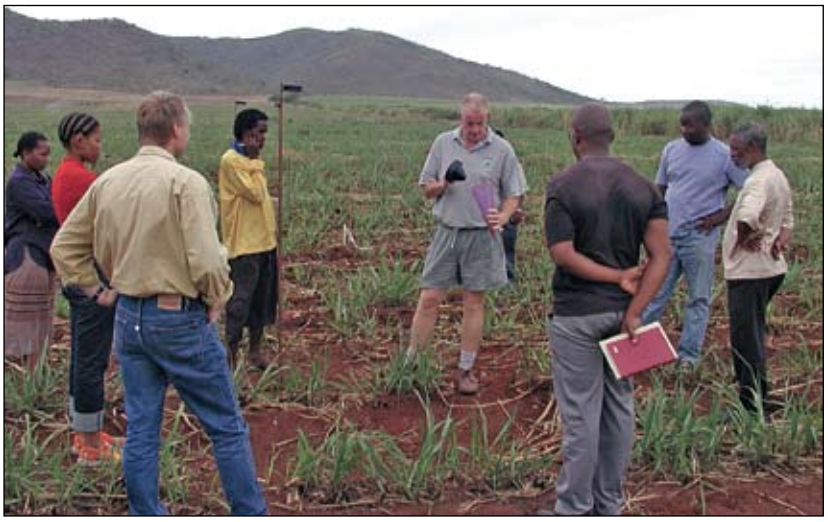
A challenge at the Pongola scheme was the fact that the majority of growers share pumps, and the associated costs with one or two neighbours. When all members of a pump group were not subscribed to the service, or did not receive similar advice, it often created conflict and non-adherence to advice. As a result, the system was adjusted to allow for synchronisation of advice for members of a pump group when the development stage of the different fields was similar.

The very low bandwidth Internet access (i.e. dial-up modem) made it difficult to use the system interface efficiently, while fax lines were not always operational. Internet access was not available at all in Makhathini. Interestingly, in neither Pongola nor Makhathini were cell phone coverage or ownership found to be limiting factors.

The five different options of irrigation advice

Advice	Context
Stop irrigation	The farmer was irrigating and the model indicates that he/she should stop.
Start irrigation	The farmer was not irrigating and should start irrigating.
Continue irrigation	The farmer was irrigating and should continue with the next cycle.
Do not irrigate	The farmer was not irrigating and should delay the start of the next cycle.
Terminate irrigation to dry off	No further irrigation required up to harvest.

The system also exposed other challenges faced by the small-scale sugarcane growers. For example, it was found at Makhathini that poorly maintained irrigation systems could only supply, on average, 50% of the crop demand and there was little opportunity for saving water. In fact, farmers should increase their applications to achieve economic yields.



Developer of MyCanesim, Dr Abraham Singels (centre with rain gauge), explains the technology to emerging sugarcane farmers.

Irrigation advice explained to a group of small-scale sugarcane growers.

IMPROVING ASSISTANCE

Through regular implementation and evaluation workshops, the project helped extension staff and farmers gain a much better understanding of the important factors that determined the crop water balance and how irrigation can be scheduled to impact positively on productivity and sustainability. The various reports available from the system provide concrete information (albeit simulated) for extension staff to benchmark irrigation practices, growth and yield of individual fields. This provided a good basis for discussion with farmers during field visits to identify agronomic practices that limited yields (such as poor crops stand, insufficient weed control, early cessation of irrigation, erratic movements of sprinklers and excessive sprinkler stand times), says Dr Singels.

A new pilot project was implemented with commercial growers. Although their situation and needs are different to that of small-scale farmers (for example, multiple fields per farm and drip and centre pivot irrigation systems), it has been proved that the system has the capability to deal with it. A project to implement the system for Mpumalanga sugarcane growers is also being explored.

"The initial success of the system shows that there is no reason why sophisticated technology cannot be used to assist farmers in managing sugarcane production," notes Dr Singels. "However, it is important that the complexity of the technology should be hidden from the users. The system shows great potential to be used as a tool to support extension staff to provide assistance to small- and large-scale farmers."