Water use efficiency

Benefits flow from SA water innovation to irrigation schemes, farms

South Africa has been at the forefront of many innovations for irrigation and water management through research and development over recent decades. In particular, the Water Administration System (or WAS) has been hailed as one of the best examples of research-based innovation for water saving in the sector, both locally and internationally. Article by Jorisna Bonthuys.

WAS is used for water distribution management and the calculation of canal and dam operating procedures. It has been developed and refined with mainly funding from the Water Research Commission (WRC).

From Vaalharts tot Hartbeespoort users employ it to save time, money and water.

Says Dr Gerhard Backeberg, the WRC's Executive Manager: Water Utilisation in Agriculture, "Over a period of 25 years, WAS has evolved in response to local irrigation water user requirements and to manage water use on demand."

The system was designed for those irrigation schemes that operate on the demand system and distribute water through a network of rivers, canals and pipelines. The system helps to provide just the right amount of water at the right time and place, with the least water loss.

The WAS has grown over the years, since starting as a simple water ordering program in 1986 at the then Loskop Government Water Scheme, into the fully fledged integrated water distribution management system that it is today. Research was done to link the WAS with farming risk and irrigation scheduling modelling so they can be used as tools to minimise distribution losses and maximise efficient water use. This was followed by a technology transfer project to show how the different models can be implemented from catchment to scheme as well as to farm and field scale.

Currently, this system is being used by all the major irrigation schemes as well as some smaller irrigation boards. Notes Dr Backeberg, "This uniquely South African information system brings about a reduction in water losses and offers a low-cost option to achieve real water savings. It speaks to our national water realities in a practical and cost-effective way."

NB Systems

Water control officers at the Vaalharts irrigation scheme actively use WAS to manage water use at South Africa's largest irrigation scheme.

Enabling irrigation through better measurement

As is the case in many countries of the world, the local agriculture sector is under pressure to increase its water use productivity. In the case of irrigation schemes, efficiency gains can result in water savings if the conditions of water use entitlements are met.

Water has to be measured for sustainable production, Dr Backeberg points out. This is often a tricky task, given the nature of the flow of water from an irrigation source to the farm.

This journey is often long and intricate. Water is released from storage dams or reservoirs through canals, or abstracted from rivers, or pumped from boreholes or tube wells. On irrigation schemes, it is then distributed through a network of canals and pipelines to reach individual farms. At the farm level, water is stored in irrigation dams or applied on fields by using different irrigation methods, depending on crop water requirements and the local soil water conditions.

Says Dr Backeberg, "There is a linkage in the flow of irrigation water from scheme to farm to field level. In this process, the focus should be on maximising the consumptive and beneficial fraction of water for food production as well as the non-consumptive and recoverable fraction of water for alternative uses within the water balance framework."

This uniquely South African information system brings about a reduction in water losses and offers a low-cost option to achieve real water savings."

"The efficiency of operating a canal distribution network or irrigation scheme is often determined by losses caused by spillage, leakage and evaporation. WAS provides relevant water intelligence on all these levels."

According to Dr Nico Benadé from NB Systems and the original developer of the system, the WAS can help reduce water distribution losses from 40% to 20%. Dr Benadé, a civil engineer and programmer, provides services support for this system. On irrigation schemes such as Loskop, in Mpumalanga, and the Lower Olifants River, in the Western Cape, this level of water saving has consistently been achieved over many years. Substantial annual reductions in water losses have also been recorded on the Vaalharts irrigation scheme, which is the biggest in the country.

The benefits of improved measurement and adjusting management practices accordingly can be huge. With an average authorised water allocation of about 8 000 m^3 per

NB Systems

Dr Nico Benadé received the WatSave Innovative Water Management Award from the International Commission on Irrigation and Drainage in 2006 for his development and continued implementation of the WAS.

Lani van Vuuren

Loskop Dam. The WAS was initially implemented at the Loskop irrigation scheme but is now implemented on 21 schemes across the country.

hectare and reducing average water losses from 40% to 20%, this amounts to average water savings of 1 600 m^3 per hectare per year. The non-consumptive and recoverable fraction varies from 50% to 90% of water savings, thus from 800 to 1 440 m^3 per hectare per year, depending on amongst others the state of infrastructure and management levels. The total volume of the non-consumptive and recoverable fraction of water savings is related to these variables and the total irrigated area on which reduced water losses can be achieved.

The system also has many water management abilities that could make life easier for its users. Among its capabilities, the WAS calculates water releases from rivers and canal networks, taking lag times and water losses into account.

Its benefits include the improved control of water orders and releases, distribution and water use, the management of date and time-related flow data collected from electronic loggers and improved overall management of irrigation schemes. The WAS also promotes efficient water use at the farm level by enabling water supply of the required volume at the requested time.

Says Dr Benadé, "WAS reduces human errors that could cause significant water losses in irrigation schemes. It improves irrigation scheme management, financial administration and productivity. This enables users to manage irrigation with greater precision and on demand. Above all, it saves water."

What makes the WAS unique is that it gives an overview of water resources from the dam or weir wall to an individual farm, tracking water flow, distribution and losses along the way. This is, for instance, done by calculating water releases from the main canal allowing for lag times and water losses such as seepage and evaporation. To do this the schematic layout of the canal network or river system is captured along with details such as the position of sluices and pumps, the canal or river slope, measure structures and canal capacities.

Currently, 21 major irrigation schemes implement the system, covering a total area of about 182 000 hectares.

User-friendly irrigation intelligence

WAS consists of nine modules that can be used partially or as a whole, depending on the requirements of the particular irrigation scheme and local conditions. This includes modules like water orders, water release, crop water use and water accounts. These modules are fully integrated, making it possible to cross-reference relevant data and information.

"At a time when innovative science and informed management practices are paramount, given recent droughts and South Africa's emerging water realities, the WAS is ideally placed to support irrigation scheme managers and water users in agriculture."

The system is applied for generating water use efficiency reports, water transfers between users, calculation of scheme water balances, dam information, calculation of water releases for distribution, billing systems and a bulk SMS system, amongst others. It has an easy to use system with step by step training documentation that can be accessed online.

The recent launch of the WaterAdmin website completes the development circle for country-wide implementation of the WAS, Dr Backeberg points out.

The website, with its dynamic reporting capabilities, provides support and a water use reporting platform for irrigation schemes that are using this administrator system for water distribution management purposes. It is now, for instance, possible for irrigation schemes to generate and upload their water reports onto the website using this system. The information can then be downloaded and imported into the iScheme database at NB Systems where a summary of water losses table is uploaded automatically.

Dr Benadé adds, "The integration of the WAS and the WaterAdmin website has created a platform that makes it possible to report on water losses nationally. The beauty of it is the fact that the whole process is automated. The only requirement is that an irrigation scheme must have the WAS installed, have good measuring stations in place and have access to the internet."

The system uses an open source database called Firebird (SQL-based) to build its datasets. It can be used in a small water office that manages only a few abstractions or to manage thousands of abstractions and measure stations at a catchment agency level.

Securing local water futures

For the past two years, the Strategic Water Partners Network (SWPN) has implemented a project to roll out the WAS at selected irrigation schemes across the country. This network – a partnership that involves government, business and civil society - wants to close the 17% gap between water supply and demand that is expected in South Africa by the year 2030.

The result of this work is that close to 110 million m^3 of irrigation water have been "saved" during the last two years, according to a recent notice. At 55 million m^3 per year, this saving is about half the annual water use of Nelson Mandela Bay Metropolitan Municipality and about 2% of the so-called water gap between water supply and demand (of 2.7 billion m^3 per year) expected in 2030. More importantly, continued efficiency in the agriculture sector will enable the creation of jobs in agriculture as envisioned in the government's National Development Plan. Further roll-out of the WAS is planned this year.

At a time when innovative science and informed management practices are paramount, given recent droughts and South Africa's emerging water realities, the WAS is "ideally placed" to support irrigation scheme managers and water users in agriculture, in particular for more water-efficient food production, Dr Backeberg argues. "WAS is a prime example of taking the science innovation process through the full cycle – from research to practical application to exploitation of its commercial potential," he says. "It remains a major challenge to achieve water savings by reducing distribution losses, and this system does that."

The Lower Olifants irrigation scheme is one of the oldest irrigation schemes in the countr where WAS is being implemented.

The Water Administration System in a nutshell

- WAS offers tailor-made, proven technology for irrigation scheme management.
- It is an integrated information management system used for water distribution.
- WAS is implemented on all the major irrigation schemes in South Africa.
- The system can reduce water distributions losses by up to 20%.

"WAS is truly an innovation which has progressed through the stages of research to technology exchange and then to practical implementation"

WAS has an estimated potential reach, or expanded implementation of up to 600 000 hectares of irrigation schemes nationally if the requirements of an investment in water-measuring devices, information technology and training of water managers are in place. Dr Backeberg believes WAS shows great potential to be rolled out as an integrated information system for canal water management and will help to enhance water use efficiency. "We know more water savings are possible by using this system," he says. "It already contributes to reduction in irrigation water losses, better control over receipt of water user charges and general improvement of all aspects of management of an irrigation scheme."

In some cases implementing this system does need a mind-shift from water control officers, Dr Benadé points out. "Some practices have to change to improve results and provide better services for users. This involves switching from a manual to a computerised information system. Skills development of water control officers remains relevant."

Dr Backeberg concludes, "WAS is truly an innovation which has progressed through the stages of research to technology exchange and then to practical implementation to increase profits. If its implementation expands, it can release more water savings back to agriculture or for other purposes, such as domestic or industrial water uses."

Visit www.wateradmin.co.za for information.