POLICY BRIEF

June 2021
The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

Operationalising the increase of water use efficiency and resilience in irrigation

A recently completed Water Research Commission (WRC) project developed an operationalisation model to increase of water use efficiency and resilience in irrigation (OPERA).

Background

Worldwide, significant progress has been made to utilise precision irrigation as a mean to increase water use efficiency or decrease the water footprint in irrigated agriculture. The progress is mainly restricted to advances at the plot scale and individual systems, such as installations for drip irrigation or central pivots. Specifically, closed systems (greenhouses) reached a very high level of maximising water use efficiency.

Integrating precision irrigation in the planning of water resource use at territory scale is still a challenge. Point information, such as resulting from sensors, is difficult to be transferred to a larger spatial unit. Remote sensing algorithms to estimate evapotranspiration are available but often not at sufficient resolution to obtain operational data at field scale.

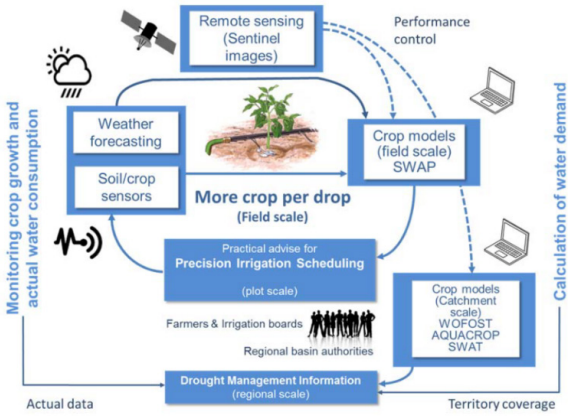
New market opportunities may allow farmers to shift more flexibly to alternative water saving crops. More experience needs to be gained in combining these technologies and scales so that they can serve the practical adaptation of water consumption: direct mapping of soil water as done with in-situ observations, air- or space-borne radar, crop water stress mapping by thermal infrared sensors and/or modelling of the crop/soil/atmosphere continuum.

When adequately fused with terrestrial measurements these mapping tools offer decision support for agricultural water management. Up to now the advance is often restricted to academic and experimental data collection and solutions are mostly supply driven. Acquiring data, analysis, fusion and modelling are yet merely scientific abstractions without a direct link to operational water management.

Aims and objectives

The objectives of the project were to:

- Achieve the following: Profile of farms in the study area in terms of size, crops, markets, and water sources.
- Better understand farmers' perception of technology and their appetite for risk and trying new technology.
- The uptake and use of FruitLook in the study area.
- Comparison of technologies used for irrigation, to determine if it would have been beneficial for the farmers to use more than one technology (with a particular focus on FruitLook as remote sensing product).



Linking weather, remote sensing, in-situ crop and soil sensors, crop and soil models, and stakeholders to synthesise case study results in a concept for an operational support of precision irrigation at field scale and water saving at catchment scale.

Major outcomes

The following outcomes emerged from the study:

- A better understanding of South African farmers' personal preferences for certain technologies to inform their irrigation scheduling decision-making was produced. These findings should be considered by anyone wanting to introduce a new technology or model into the agricultural market.
- An independent assessment of the uptake of FruitLook was done. Although there is widespread awareness about it, it is not being actively used in this area as desired by the developers, which suggests that it could fail if government should start asking a registration fee for it. The reasons for the non-use of this service as determined by this study provide valuable feedback for the developers of the programme to consider to ensure future success of the service.
- A simple methodology that could be used by farmers to view the results of their soil probes together with results from FruitLook and a weather station in the same document, to obtain a holistic picture, was developed. This has not been done before and although more refinement is needed and the equipment used are not calibrated for scientific analysis, this approach would be very useful for management purposes, allowing farmers to cross-check results and thereby ensure better accuracy in their decision-making regarding irrigation scheduling and total water application. It also suggests that small farmers could be supplied with one technology and taught how to extrapolate it for water budgeting purposes.
- The water budget approach developed here is also new and would be useful for irrigation scheme managers to change their water allocations methodology during droughts, in order to minimise crop losses in the catchment.
- The results also shed light on the importance of developing a way to correct remote sensing data for shade nets.

Observed needs from the project

The project identified the following critical areas that need redress:

- New market opportunities may allow farmers to shift more flexible to alternative water saving crops.
- More experience needs to be gained in combining these technologies and scales so that they can serve
- the practical adaptation of water consumption: direct mapping of soil water as done with in-situ observations, air- or space-borne radar, crop water stress mapping by thermal infrared sensors and/or modelling of the crop/soil/atmosphere continuum.
- When adequately fused with terrestrial measurements these mapping tools offer decision support for agricultural water management. Up to now the advance is often restricted to academic and experimental data collection and solutions are mostly supply driven.
- Acquiring data, analysis, fusion and modelling are yet merely scientific abstractions without a direct link to operational water management. It was fund that the poor uptake of technology could also be related to farmers' perceptions of their current levels of water efficiency.
- Most judge themselves to be highly water efficient with little room for improvement left, which means that they do not believe that they need any additional technologies to improve.
- When faced with severe water restrictions they actively look for practical ways to save water, such as checking for leaks, distributing water to most profitable vineyards or orchards, installing pressure regulators and adjusting drip spacing.
- And although yields were good with the little water applied during the drought, the farmers all hoped to be able to apply more water again in the next season as the uncertainty over long-term impacts of low irrigation is too high a risk for them.
- The fact that they managed to have a good yield with less water was only enough to convince about half the farmers to continue irrigating less during the next season.
- Another relevant finding is farmers' willingness to change based on climate change predictions.

Most farmers are growing blueberries, for which there is a good export market.

Major findings

The following findings came out of the studies:

- The interviews revealed a high uptake (83%) of technology amongst farmers, but also that mainly one type of technology is being used in the area, namely soil water probes. Unlike many international studies, farmers' age and farm size did not have a significant link to technology uptake. It was concluded that post-installation service offering, as well as perceived ease of use and usefulness (value for money) are the main drivers behind farmers' uptake of the soil water probes. Significant efforts have to be made by the developers of new technology to simplify and personalise the product and service offering for farmers to adopt it in the long-term, which contributed to its success.
- The interviews also revealed that one key reason behind farmers' use of only one technology is that it would be too time-consuming and too much effort to use additional technologies that provide different types of output data, which also have to be interpreted and somehow linked together to inform decision-making. A general comment by farmers was that while information is important for decision-making, receiving too much scattered information is not useful, and that they would be more likely to use FruitLook (or any other new product) if it could be linked to their existing chosen technology.
- Based on the outcome of the survey, the most popular technology used by farmers for irrigation scheduling was soil water probes. The other two technologies that are freely or affordably available to the farmers are FruitLook and weather station data, both of which provide a form of evapotranspiration data to interpret as irrigation requirements. Therefore, for aim iii-a) of the study, the water loss profile of a soil water probe was compared to FruitLook and weather station data and differences or similarities in the results were discussed. FruitLook is readily available to all farmers with internet, while there are numerous weather stations in the area that farmers can subscribe to at a relatively low cost.

Recommendations

Based on farmers' feedback during the interviews, it can be concluded that the following are the main reasons for the successful uptake of soil water probes (specifically the Irricon probes) for irrigation scheduling:

- Farmers believe in its accuracy, as it corresponds with their field observations.
- It is affordable and they perceive it as good value for money. However, value for money is difficult to interpret, as Fruit Look is a free service and is not being used.
- The user interface is easy to navigate and use as an everyday management tool.
- Post-installation, personal service is highly important to the farmers. They use this probe because they can phone the developer and ask for help when needed, and he will come to their farm if necessary (the service is localised).

These findings are important for the developers of new technology as it highlights that good quality and affordability are not guarantees for uptake – post-installation service (localisation) and perceived ease of use and usefulness are important factors that need to be investigated and targeted to enable uptake. Based on the outcomes of the technology uptake survey, it was decided to compare soil water readings, FruitLook and weather station data. The purpose was not to do a scientific accuracy test, but rather to explore what farmers can do more with the technology already available to them, in a way that they will be able to do themselves.

Related project:
*Operationalising the increase of water use efficiency and resilience in irrigation (***WRC project no. K5/2788***).*
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