

AGRICULTURE AND INNOVATION

Soil and scheduling – Study tests farmer appetite for technology

There are a myriad of technologies available to farmers to improve agricultural output, but do they actually use them? And what motivates the use of some technologies over others? This is what a recent study by researchers at Stellenbosch University set out to find out. Article by Marlene de Witt and Willem de Clercq.



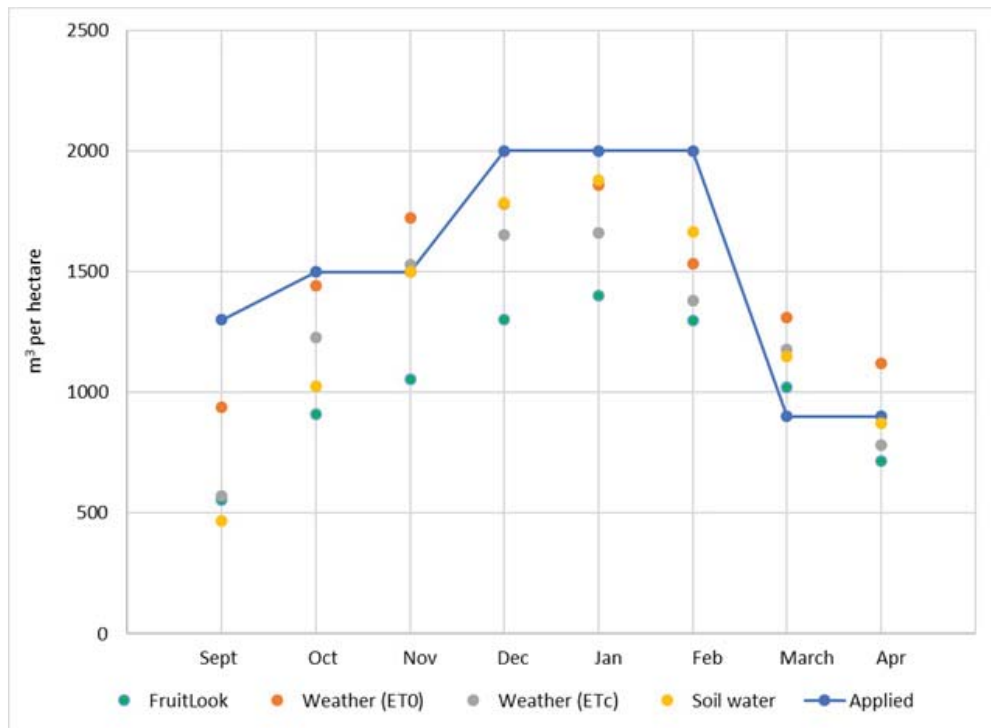
The Breede River flowing through orchards and vineyards just outside of Bonnievale.

When one considers the newest technological developments at agricultural shows it is clear that developers are aiming to enable farmers to do everything on the farm from their smartphones. Sensors, satellite imagery and automated drones exist that allow farmers to press a button and get their fields sprayed, switch irrigation on and off and identify problems, and provide detailed pictures of their fields. The rate of technological development in agriculture is astounding.

Of course, monetary cost plays a significant role in the adoption of these technologies. But is cost the main factor standing in farmers' way to become fully automated? Do they really want to sit in their offices and farm from behind a smartphone?

There aren't nearly as many studies looking at the uptake of technology as there are new tools on the market. Yet, a misunderstanding of local market needs and wishes may be a key barrier to the realisation of agricultural water savings in our catchments. There is little value in the development of new products if farmers are not using the innovative products already available to them.

It is a logical assumption to make that South African farmers would turn to technology to improve their water efficiency, so they can remain profitable with less water. Particularly in the Western Cape where the recent droughts cost farmers dearly. There is a myriad of local and international irrigation efficiency



This graph shows the monthly water requirements as determined by the soil water probes, FruitLook and the weather station. The line shows the water the farmer applied in these months. The values provided by FruitLook are approximately 30% lower than the amounts applied, meaning that according to FruitLook the farmer over-irrigated by 30%. This is most likely caused by the effect of shade netting on the satellite service. The farmer irrigated close to weather station water requirement estimates.

technologies available to South African farmers, and Western Cape farmers also have access to the free, government-funded, remote-sensing product, FruitLook, which reportedly can save farmers up to 30% of water (for more information go to www.fruitlook.co.za)

Given the impact of the recent drought, and with extensive access to technological developments, including a free remote-sensing service, the Western Cape is a good area to investigate if farmers use the technology at their disposal to inform their irrigation decision-making. This is what researchers from the Stellenbosch University Water Institute set to find out in a recent Water Research Commission (WRC) study (**project no. 5/2788/14**) in the greater Robertson area.

The study investigated whether farmers use technology available to them, what drives them to adopt technology, and what the limitations are that prevent them from adopting new technology. These questions focused on irrigation scheduling, in particular, as scheduling is one of the most important methods to irrigate efficiently. Scheduling is the process of determining the water requirement of crops and applying irrigation as and when the plants need it. Furthermore, farmers were asked whether they've heard about or used FruitLook – since it is a free service, monetary cost is not a barrier to its adoption, therefore its use or non-use would shed light on other limiting factors.

The Stellenbosch team conducted this research as part of an international project called “OPERA” (Operationalising the increase of water-use efficiency and resilience in irrigation). OPERA is one of the first projects of the European Commission Water-JPI (Joint Programming Initiative) projects of which South

Africa was part. The Water-JPI aims to promote collaboration between research institutions globally to tackle water challenges. In the OPERA project, Stellenbosch partnered with institutions in the Netherlands, Italy, France and Poland. Each country conducted interviews with stakeholders to examine technology uptake for irrigation scheduling.

Time is money

The research team interviewed 29 farmers, aged 28 to 79 years. Twenty-four of them (83%) use some form of technology to schedule their irrigation. This is a promising figure, as in 2006 a study by Stevens (2008) showed only 18% use of technology. Interestingly, younger farmers are only slightly more interested in exploring new technology than older farmers, but there is no relationship between the actual use of scheduling technology and age. Farm size also plays no role.

The two things farmers in all five countries mentioned as the main factors preventing them from investing in more technology, are cost and administrative issues. In South Africa these mean the cost of the new technology, as well as the cost of having to change existing infrastructure in order to achieve further gains in efficiency (i.e. to make a block more water efficient, one might have to change the layout of the block and hence its entire irrigation system, to make it more aligned to soil types).

The administrative barrier in South Africa is the lack of storage dams. Without storage dams, the farmers have to use the water as and when they receive it from the irrigation scheme. “Farmers have the fear that ‘if I don’t use it, I’ll lose it’; they will rather use their water out of fear that it will be taken away,” one farmer said.

Only when they have storage dams will it make financial sense to invest further in technology that will enable them to apply more discretion in their scheduling to optimise water use.

Because monetary cost is not a factor with the uptake of FruitLook, the conversations about its use or non-use were very interesting. Although 25 out of the 29 farmers had heard about FruitLook, only three have used it. It turns out the time-cost is as important, if not more important, than monetary cost of a product. Most farmers said it was too time-consuming to set up their fields in FruitLook so they didn't complete the task. The programme also does not provide advice, which means the farmer has to spend time to interpret and apply the information. Farmers said they want products that interpret data for them, providing them with simple management advice on how to address the identified problems. As one farmer put it: "We need an app in which you can put all your information and it throws out a solution for you... the *why* and *how* is needed."

Another perceived drawback of FruitLook was the delay in receiving information – because it's a satellite service, farmers get weekly information. "If something went wrong, FruitLook shows you a week later, then the damage has already been done," said one farmer. "You can only look in hindsight with FruitLook and make changes accordingly. But our irrigation system uses 12 computers, it will be half a day's work to make slight adjustments to the entire schedule if FruitLook shows something's wrong," said another.

Information is everything – or is it?

"We take it, as a given, that the more information decision-makers have, the better off they are. But what does the Goldman algorithm say? Quite the opposite: that all that extra information isn't actually an advantage at all. In fact, that extra information is more than useless. It's harmful. It confuses the issues." — Malcolm Gladwell, Blink

A key barrier to technology uptake that emerged from the conversations, is the amount of information farmers deem to be useful to them. Although 83% of the farmers use technology for scheduling, they all use only one type – soil water measurement – and three quarters of them use the same product. They use this product mainly because of its perceived accuracy, and because it has an easy-to-use management interface that visually tells them what is happening in their fields on an hourly basis.

Farmers are unlikely to use many different technologies to help them with the same decision-making process. While they believe that having information to inform their decision-making is important, having too much information is not practical and too time-consuming, because they will need to take time to compare all the data and advice before taking their decision. Using a new technology means having an additional dataset that needs interpretation. They struggle to see how they can connect all the bits of information from different products into a logical decision-making framework. Therefore, many of the farmers said that they will only use FruitLook, or any other innovative new technology, if the information somehow links to their existing technology (soil probes).

For technology developers, this means either creating a product that will replace the need for the technology farmers are currently using, or creating something that complements and directly speaks to the data generated by their existing technology.

Data integration

Based on farmers' desire to have data from different technologies and platforms integrated, the researchers explored whether it is possible to compare the outputs of the farmers' probes and FruitLook for a holistic picture of their plants' water requirements. Since there are numerous weather stations in the area that farmers can subscribe to at a relatively low cost, this data was also added to the comparison. Seeing the datasets of all three technologies in one document or graph could provide the farmers with an opportunity to cross-check the results to ensure accuracy and, as such, contribute to water saving.

The comparison was made between the soil water loss profile as captured by a soil water probe in a block of plums; evapotranspiration (ET; evaporation from soil plus transpiration from plant) as captured by satellite imagery in FruitLook for the block in which the probe is located; and ET measured by the closest weather station – all measured in mm. These values were aligned in Excel.

Although much work is needed to refine the approach, the results showed that soil water readings, weather station data and remote sensing data could in fact be aligned and compared. The comparison showed fair correlations between all values, but FruitLook's reported water requirements were much lower than the weather station's and the probe's. Which means if the farmer used FruitLook only, he would probably have applied too little water. This finding can most likely be attributed to the fact that the block studied is situated under nets, illustrating that remote sensing cannot be used as a reliable estimate with shade netting. This is problematic seeing as the use of nets as water saving effort, is growing rapidly in the province.

The independent assessment of technology uptake in this study showed that while farmers are interested in trying new technology and uptake is certainly much higher than a decade ago, efforts should be made to integrate the information offerings of different products. Farmers' time plays an equally important role as monetary cost when it comes to their decision to use or not use a new technology. And while developers try to develop products to allow farmers to farm from their cell phones, the interviewed group of farmers are resolute in their view that they still want to go out into the field every day, not losing their traditional way and relying on their experience of their farms.

- To download the report, *Operationalising the increase of water-use efficiency and resilience in irrigation (OPERA)* (WRC Report no. 2788/1/20) Visit: <https://bit.ly/37Qu0Jr>