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Opinion

Agricultural Sector in South Africa

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South Africa's average annual rainfall (~495 mm) is lower than the global average (~840 mm) and more than 60% of the country's water resources are used for agriculture. The agricultural sector is very sensitive to climatic variability and change and to extreme events such as droughts whose frequency and severity is increasing. Therefore, it is essential to invest in building the resilience of farmers e.g. through increasing the area under irrigation to mitigate against the effects of climate variability and change as outlined in the National Development Plan (2030) and in the Irrigation Strategy for South Africa (DAFF, 2015).

The increase in the irrigated area has to be achieved with the existing water resources given that about 98% of the surface water are already allocated (WWF, 2018). It is therefore critical that water is used efficiently for the sustainability and growth of the country's agricultural sector. Competition for water between different sectors of the country's economy is also increasing. This is compelling water resources managers to find solutions to alleviate the pressure on the water resources.

The second National Water Resources Strategy for South Africa (NWRS 2, 2013) cites irrigated agriculture as one of the most inefficient sectors with respect to water use. The NWRS2, 2013 estimates that between 30 and 45% of water allocated for irrigation is wasted either through leakages, poor irrigation scheduling, or other non-beneficial uses. Over the years, the WRC has supported many projects on the water use of crops in different parts of the country. This was in an effort to avail information to develop tools that can assist water managers and growers to optimise irrigation water use efficiency (Annandale et al., 2011).

Crops studied include cereals e.g. maize (Jarmain et al., 2014), irrigated pastures e.g. rye and kikuyu grass (Fessehazion et al., 2012), sugarcane (Olivier et al., 2009; Jarmain et al., 2014), and tree crops e.g. citrus (Gush and Taylor, 2014), deciduous fruit trees e.g. apples (Volschenk et al., 2003; Gush and Taylor, 2014; Dzikiti et al., 2018), subtropical fruit trees such as macadamia and pecan nuts (Gush and Taylor, 2014), and wine grapes (Lategan et al., 2016), among others. There have also been national scale studies that have estimated the extent of the irrigated land area in the country and the associated water use by the crops using remote sensing methods (e.g. Van Niekerk et al., 2018).

The site-specific studies collected the water use data using internationally recognized methods which include micrometeorological techniques (e.g. the eddy covariance, scintillometry, surface renewal methods, etc.), soil water balance approaches, remote sensing, and various sap flow techniques in the case of tree crops. In addition, a number of models have also been developed. Examples of the WRC supported irrigation models include BEWAB, PUTU, SWB, SAPWAT 3 & 4, and MyCanesim. The uptake and use of these models has been limited due to a range of factors, which include the complexity of the models, large input data requirements, etc.

A survey of 332 irrigation schemes in South Africa by Stevens et al (2005) indicated that objective irrigation scheduling was being practiced by only 18% of farmers. The rest relied on intuition, experience, and confidence built over many years of farming. Therefore, there is a need to further synthesize the existing field data on crop water use that has been collected throughout the entire country over the years to develop simple user-friendly tools that can be used for irrigation scheduling, irrigation planning, irrigation system designs, water allocation planning etc.

Crop factors are examples of how the existing water use and weather data can be processed and used to provide accurate information for irrigation decision making. Furthermore, the extensive network of automatic weather stations owned by the Agricultural Research Council (ARC), South African Weather Services (SAWS), and individual farmers ensure that daily weather data are readily accessible to most farmers, catchment managers etc.

Therefore, a comprehensive and accurate database of crop factors can add value to the existing basket of tools used for water resources management in crop fields. However, there are several factors that complicate the development of this database. The first relates to the very limited actual measured ET data on key crops in the country. For those crops whose ET data exists, but it is patchy, gap filling methods need to be developed to derive crop coefficients over entire growing seasons. The second problem relates to the huge variability in the crop factors even for the same crop type, but in different fields. According to Allen et al (1998), crop factors are not easily transferable between fields and adjustments need to be made e.g. for differences in canopy cover, vegetation height, soil types, irrigation systems, and management. For these reasons, a strong case can be made to develop a dynamic crop factors database, which allows users to enter their site-specific information to get representative crop factors. This database can be in the form of a computer model in a web-based platform or a smartphone application, which allows decisions to be made on the go.

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