Sustainable agriculture for the future

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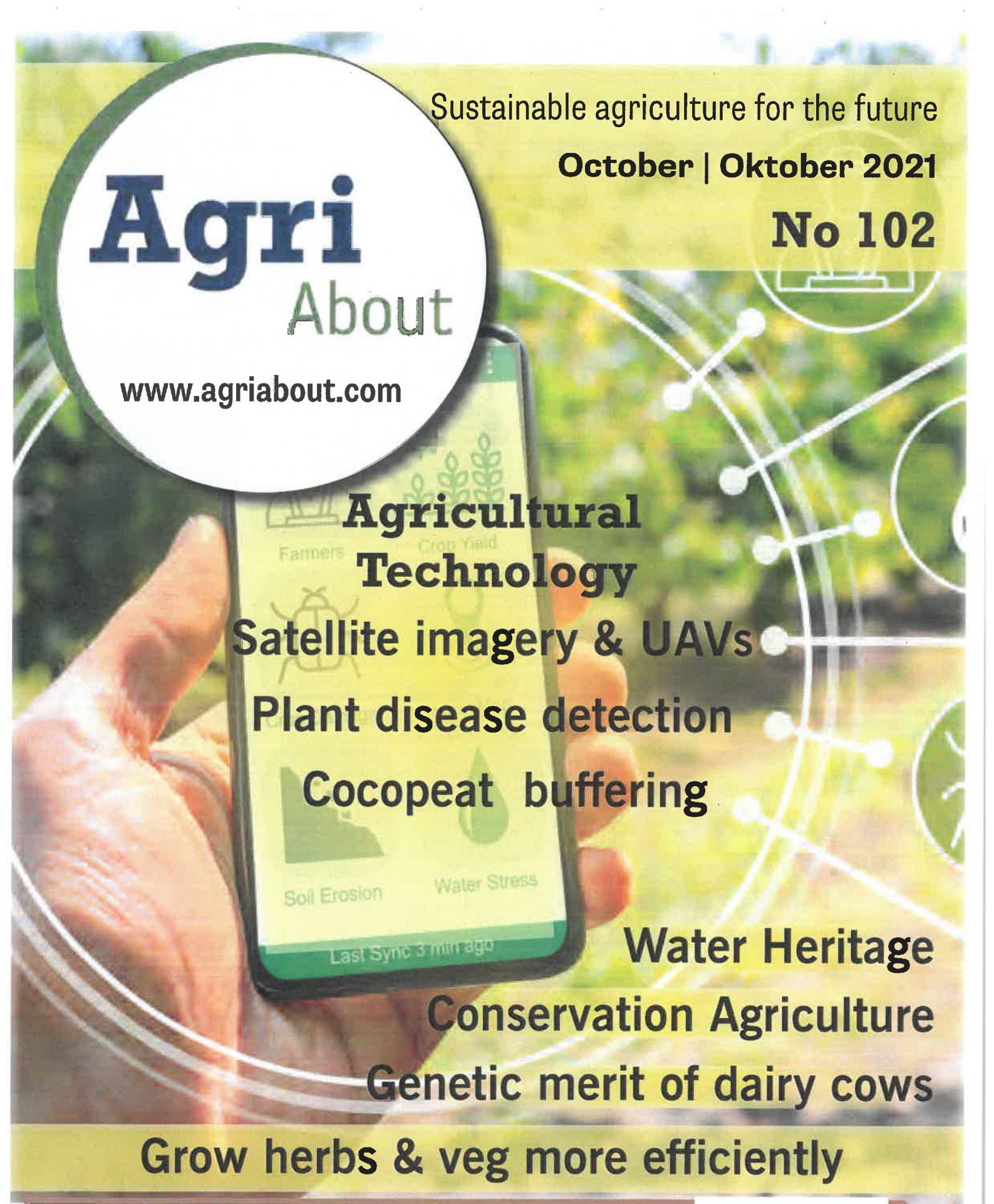

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Application of Satellite Imagery and Unmanned Aerial Vehicles (UAVs) in Crop Production

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Remote sensing technology has evolved considerably over recent decades, resulting in the development of a new generation of applications. Multiple platforms have been developed to improve efficiency. The advancement in technology has yielded the availability of high-resolution data with greater opportunities for agricultural applications. The main benefit of such technology is the non-destructive capture of information/data from wider geographical regions in a systematic manner, without the need for physical sampling. The advantage of using satellite imagery is that a large area can be covered in a single image. It has multiple applications in crop production, including:

- Yield prediction
- Crop type identification
- Crop growth and phenology assessment
- Leaf area index (LAI)
- Plant height measurement
- Weed management
- Disease identification and management
- Nutrient management

The Agricultural Research Council (ARC) has undertaken various research projects using satellite imagery, from sensors such as MODIS, Landsat, and SPOT. For example, MODIS is used for the monthly Umlindi newsletter, which gives an overview of vegetation status, rainfall and fire conditions at district and national level. This is mainly due to its coarse spatial resolution that ranges from 250-500 m. Figure 1 illustrates the use of MODIS imagery to map vegetation conditions at national level.

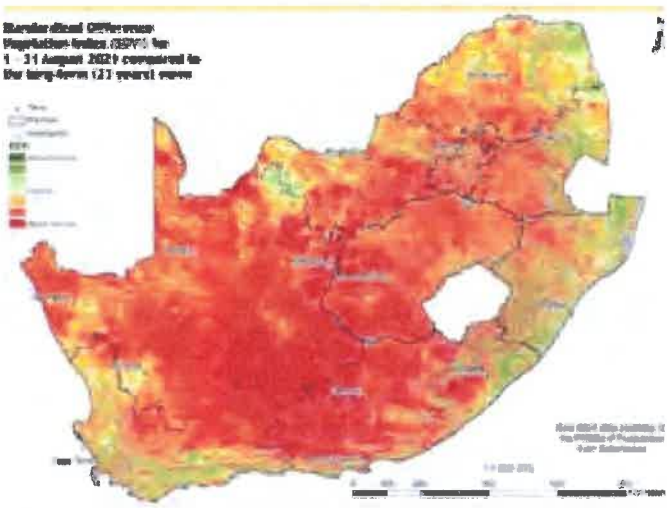

Figure 1: Vegetation conditions at national level.

MODIS satellite imagery is also used in a model that shows the location of active fires across the country (Figure 2).

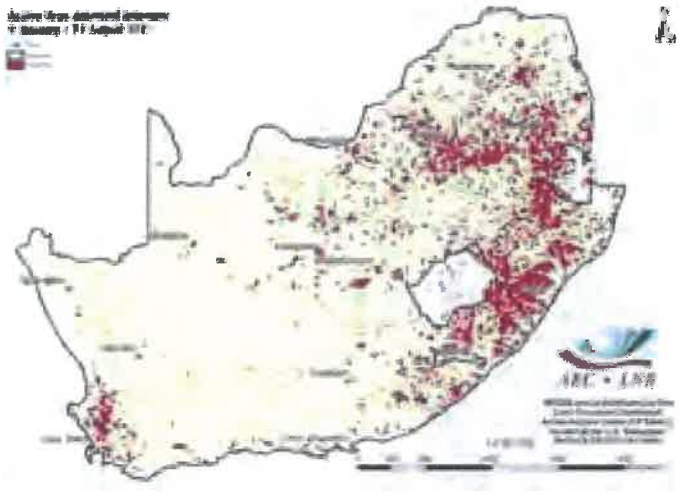

Figure 2: Location of active fires at national level.

In a current research project, Landsat 8 and Sentinel-2 data is being used to estimate crop type planted area statistics on small-scale farms in former homeland areas in the Eastern Cape and Limpopo provinces (Figure 3).

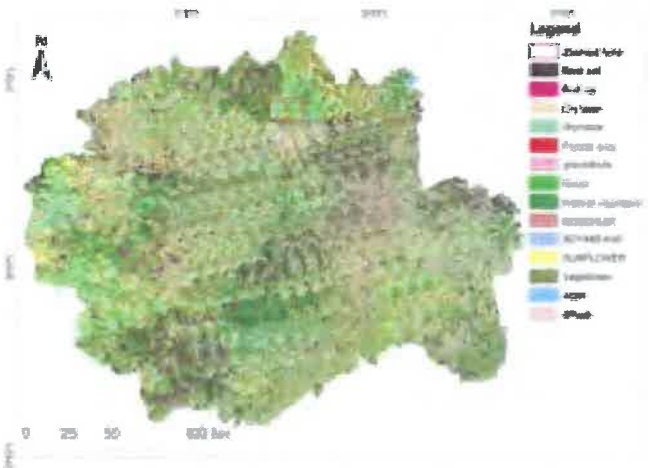

Figure 3: Sentinel-2 and Landsat 8 data crop type map for Limpopo Province.

The ARC participated in a European Space Agency (ESA) consortium demonstrating the applications of Sentinel-2 and Landsat 8 (real time data) for the 2016-2017 growing season (Figure 4).

Figure 4: Coverage of the South African demonstration site by the Sentinel-2 and Landsat 8 earth observation missions.

This project involved crop type classification and crop growth monitoring throughout the season for summer crops in the Free State, Mpumalanga, KwaZulu-Natal and North West provinces, and for winter crops in the Western Cape. Sen2-Agri crop type maps were generated for the main crop types (wheat, sunflower, maize, barley, soybean, and oilseeds) as well as grasses and fodder crops at 10 m spatial resolution (Figure 5). The system delivered two products during the season, in the middle and at the end of the season.

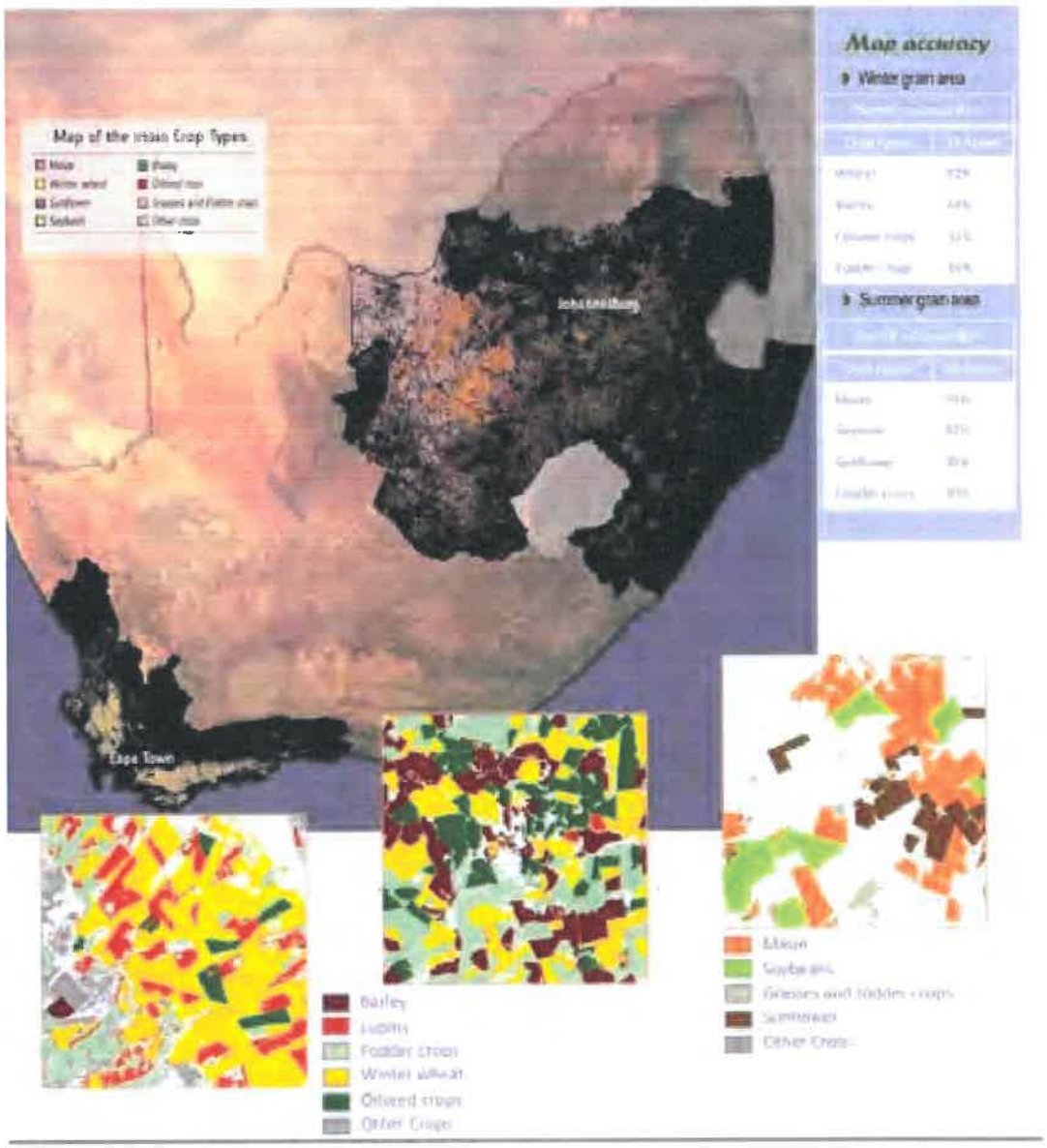

Figure 5: Sen2-Agri crop type map.

Currently the ARC has shifted its research focus on the generation of new technologies to develop agricultural applications using data acquired by Unmanned Aerial Vehicles (UAVs), also known as drones. The ARC-Natural Resources and Engineering has established a Precision Agriculture Platform that uses UAV-acquired imagery to develop precision agriculture tools and services, in line with the Fourth Industrial Revolution (4IR). UAVs have been successfully deployed in a variety of applications in precision agriculture such as:

- Weed mapping and management
- Crop type and area estimation
- Crop growth monitoring and yield estimation
- Crop health monitoring and disease detection
- Irrigation management

The following are examples of current ARC research projects which are using UAV data:

(1) UAV campaigns were conducted in different provinces to acquire high-resolution images that were fused with satellite imagery to cover larger areas to estimate crop planted areas for commercial, subsistence and smallholder farmers (Figures 6 & 7).

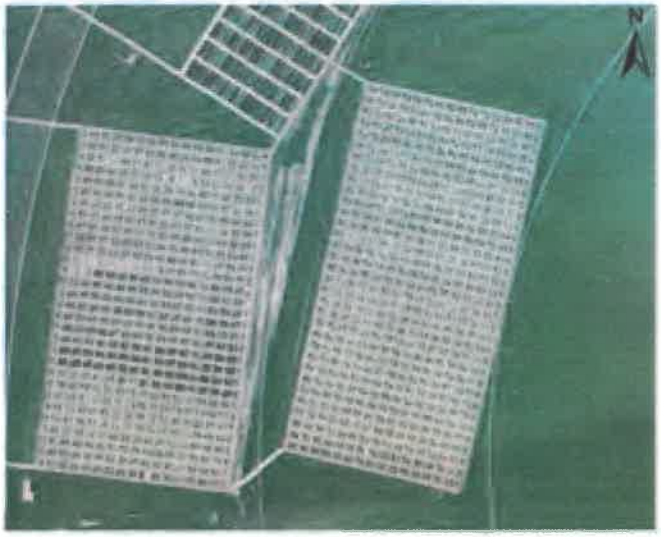

Figure 6: Multispectral UAV image.

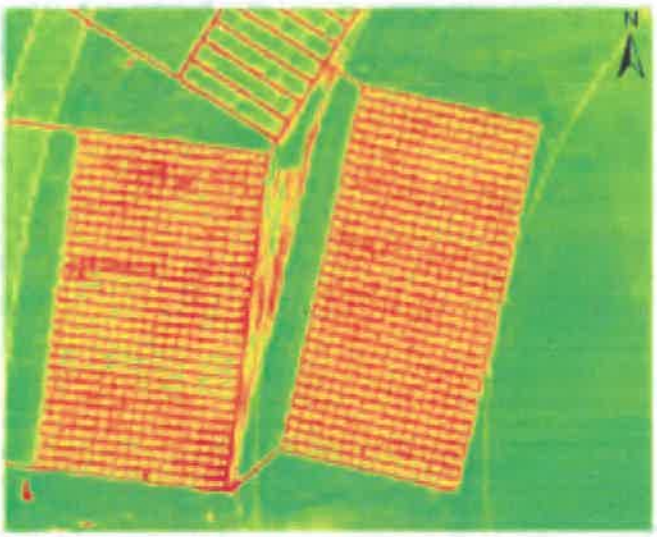

Figure 7: Normalized Difference Vegetation Index (NDVI) computed from multispectral image.

(2) Erosion modelling using multispectral 3D products for estimating the amount of sediments lost within the gullies in order to determine the volume of material required to reclaim the degradation (Figure 8).

Figure 8: UAV 3D imagery erosion demonstration.

(3) Peat fire detection and monitoring for natural peat fire occurrences in the Molopo peatlands where multispectral and thermal sensors were used to develop spectral indices to determine the chances of fire occurrence based on temperature changes and the NDVI relationship.

(4) Development of a system that uses UAVs to monitor crop irrigation water use efficiency for barley in North West Province (Figure 9).

Figure 9: Demonstration of UAV water usage monitoring in a barley crop.

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PROMOSIE

Besproeiingskoring se plek in wisselbou

Besproeiingskoring het 'n belangrike plek in wisselboustelsel saam met somergewasses soos sojas, droë bone, mielies en katoen in die noordelike besproeiingsgebiede van Suid-Afrika.

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Syngenta beveel 'n kultivarpakket aan vir goeie risikoverpreiding en produsente kan hul besproeiingskoringspakket uit die volgende produkte saamstel.

Van links Magda du Toit, kommunikasiekonsultant, Andries Wessels, Produkontwikkeling-bestuurder en Pieter Craven Verkoops- en bemarkingsbestuurder van Syngenta tydens die bespoeiingskoringboeredag op Makoppa naby Thabazimbi.