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Securing South Africa's Food Resources

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No farmer left behind

4IR for small-scale growers

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South Africa's top international award winning agricultural magazine

Technology to the rescue

Small-scale farmers need not be left behind by the 4th Industrial Revolution

Small-scale agriculture in South Africa has a rich history and diversity dating back to pre-colonial times, characterized by very low technologies yet standing the test of time. Although it was later enhanced with the adoption of machinery such as ploughs and irrigation systems, today the small-scale agriculture sector still exhibits low technologies and lags behind the commercial farming sector.

Despite its relatively small contribution to the overall agricultural output of the nation (<5% of GDP), the Agricultural Research Council (ARC) recognizes the all-important contribution of the small-scale agriculture sector on food security, livelihoods and the economy of rural South Africa. For over a century, more than 60% of the country's population has depended on small-scale farming for their livelihoods, and in most rural areas it is the only type of economic activity available. The diversity in crop varieties is abundant owing to South Africa's varied topography and climate, from coastal areas and plateaus to hills and wetlands. From the Western Cape to Limpopo, the harvest timelines are deeply rooted in culture and collective identities, making agriculture in South Africa exceptional. Yet, applications of modern agricultural methods have not kept pace with the country's needs, thus putting enormous pressure on our farmers and making modernization an imperative.

The ARC is convinced that with the right assistance, small-scale farmers can take a giant leap forward by adopting 4th Industrial Revolution (4IR) technologies, and this year the ARC has taken its game to the next level by

partnering with the CSIR, Wits University and Move Beyond Consulting (Pty Ltd). This collaborative team was in the Limpopo Province from 30 May to 3 June 2022 to demonstrate the value of Earth Observation (EO), Machine Learning/Artificial Intelligence (ML/AI), drone applications and other precision agriculture technologies to trainees using the Mphaila irrigation scheme at Thohoyandou as a farm learning school. Geoinformatics scientists from the ARC-Natural Resources and Engineering (ARC-NRE) have been validating 4IR technologies on this scheme over the last 3 years (Figure 1), demonstrating the value of EO technologies for spraying, disease monitoring and identifying sections of the farms that are stressed due to lack of nutrients or insufficient moisture availability to plants. The Mphaila irrigation scheme has 21 farmers on a 71 ha area who plant maize, tomatoes, peppers, butternut and baby marrows. Small-scale farmers who come together on schemes such as this make it is

easier for the ARC to equip them with 4IR technologies. The participants concurred that these technologies are indeed game-changers for small-scale farmers. Modern tools and methods are available and accessible for adoption, and with proper planning and assistance the rural farmers can latch on to the precision agriculture technologies. There is no reason why any farmer should be left behind.

The Thohoyandou ML4EO training week had two components: a classroom set-up and field demonstrations on drones and other digital data collection systems including data processing (Figures 2 & 3).

Drones equipped with cameras or LIDARs collected high resolution, accurate, digital data at individual plant scale. The data was processed using ML/AI algorithms to provide the detailed smart information required for farm management and activity planning, cutting operational costs in the process.



Figure 1: Aerial view of Mphaila irrigation scheme in Thohoyandou.



Figure 2: The Thohoyandou ML4EO training group in the classroom and field.

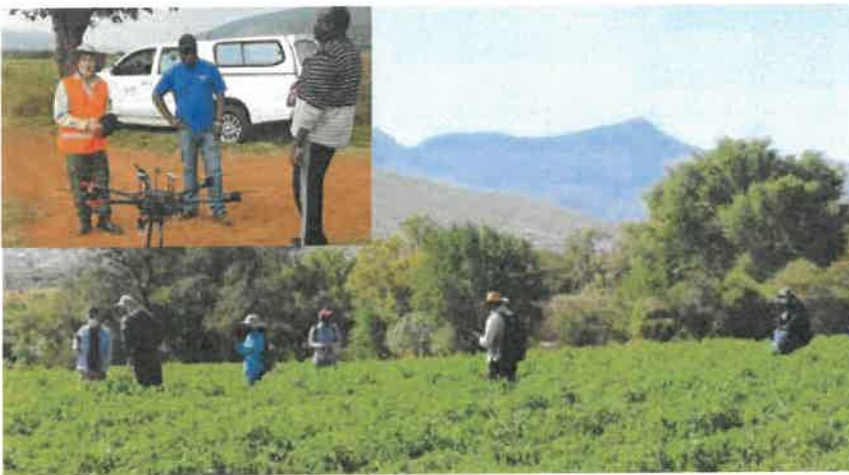


Figure 3: Participants collecting field measurements from a tomato crop. Inset: The ARC drone before take-off.

Regardless of agriculture's contribution to food security in South Africa, the country is yet to enhance productivity and efficiency in the small-scale sector to reach its highest potential. Several dimensions and concerns need to be identified, supported and equipped with 4IR solutions. Unsuitable methods for monitoring crops, irrigation and application of pesticides, as well as many other required farming operations should be modernized. Resources, especially capital, are inadequate and are not selected according to climate change conditions, or have not been exploited to their maximum potential – one reason why there is often a decline in the return on investment. Elsewhere, these

bottlenecks have unveiled and opened doors to multiple opportunities for growth and development in line with 4IR.

Farmers do not have accurate information about their land, soil fertility or potential risks surrounding their operations. Crop yields make or break a farmer's livelihood and extreme changes in climate, soil health, pest infestations, etc. have a profound impact on their productivity. Lack of knowledge of vital information can lead to:

- improper planning,
- under-resourcing,
- overutilization of scarce and expensive resources,
- incorrect yield estimates,

- inconsistent market projections,
- early or late seeding and harvesting processes, and
- the inability to mitigate risks.

One of the trainees at Thohoyandou said the following: "Wow! This process will turn traditional approaches 180 degrees concerning farm damage assessments. Now, this will with no shred of doubt, shorten response times in the face of a natural or any other kind of disaster. The ARC indicated it is possible that the high-definition visual data can be brought to your phone or computer and a clear picture of the extent of damage can be shown which will help you plan your next steps. The scientists from ARC are emphatic, they indicate these technologies meet your critical goals of improved crop yields estimation, detect nuances of in-field variability that can help you strategize around the condition and health of your crops."

Precision agriculture technology can transform traditional farming methods in immeasurable ways and is undoubtedly the future of the agrarian community. ■

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