CSIR C3
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Bringing fourth industrial revolution technologies to agriculture.

# PROVIDING SA AGRICULTURE WITH DIGITAL SOLUTIONS FOR BETTER YIELDS AND CROP

A precision agriculture information system to unlock smart agriculture

*Addressing a problem and responding to market demand*

## A growing population and climate change threaten food security in SA

South Africans' future access to safe food is in question as the country's population is predicted to grow by 43% by 2035. To ensure food security, food production needs to increase at the same rate.

Field crops make up 23% of South Africa's total farming income at an approximate worth of R69 billion; account for the largest portion of cultivated cropland in South Africa; and employ some 124 000 people – about 16% of the total commercial agricultural workforce.

Maize is the most important staple food in South Africa and the broader southern African region. The farming of maize is increasingly challenged by climate change and variability, the emergence of new pests and diseases such as fall armyworms, increasing costs of inputs and decreasing interest of younger generations to partake in farming.

Smart agriculture involving the use of fourth industrial revolution (4IR) technologies is a means to mitigate the challenges faced by the country's agricultural sector.

*The technology on offer*

## An information system that pinpoints variability in crop growth conditions for best decision-making

Precision agriculture is a management strategy that uses a range of technologies to gather, process and analyse remote sensing data (obtained from a drone or satellite) to guide targeted actions that improve the efficiency, productivity and sustainability of agricultural operations.

The CSIR has developed a unique precision agriculture information system for crops such as maize, potatoes and vegetables. It provides regular farm-based information on the spatial variability of crop growth conditions to foster precision farm management and supply chain management decisions throughout the agricultural value chain.

The precision agriculture information platform, accessed via the internet on desktop and mobile platforms, is being commercialised via CSIR C$^3$.

## Levels of Earth observation products (data) for precision agriculture

| Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|
| Processed satellite or drone data:<br>• Atmospherically corrected images<br>• Vegetation indices, i.e. indicators of crop health<br>• Regional vegetative drought severity levels<br>• Regional rainfall and temperature data | Soil and crop variables:<br>• Soil moisture and nutrient maps<br>• Growth stages<br>• Crop cover and biomass maps<br>• Crop nutrient and water use maps<br>• Weed infestation maps<br>• Pest or disease detection<br>• Yield forecast | Temporal and spatial anomaly detection:<br>• Soil moisture and nutrient stress levels<br>• Biomass growth deficiencies<br>• Crop nutrient and water use deficiencies<br>• Weed, pest infestation levels<br>• Performance benchmarking | Management recommendations:<br>• Planting, e.g. timing and planting density<br>• Fertiliser application (time, place and rate)<br>• Irrigation application<br>• Disease, pest and weed management |

The system utilises Earth observation, climate change modelling, big data and data analytics to support decision-making in land-use planning, to predict yields and inform markets, and to monitor pests and diseases. The system provides actionable information on soil and crop condition to farmers at a farm scale and in near real time.

*Value proposition and competitive advantage*

## A farmer-friendly platform information system to optimise yields

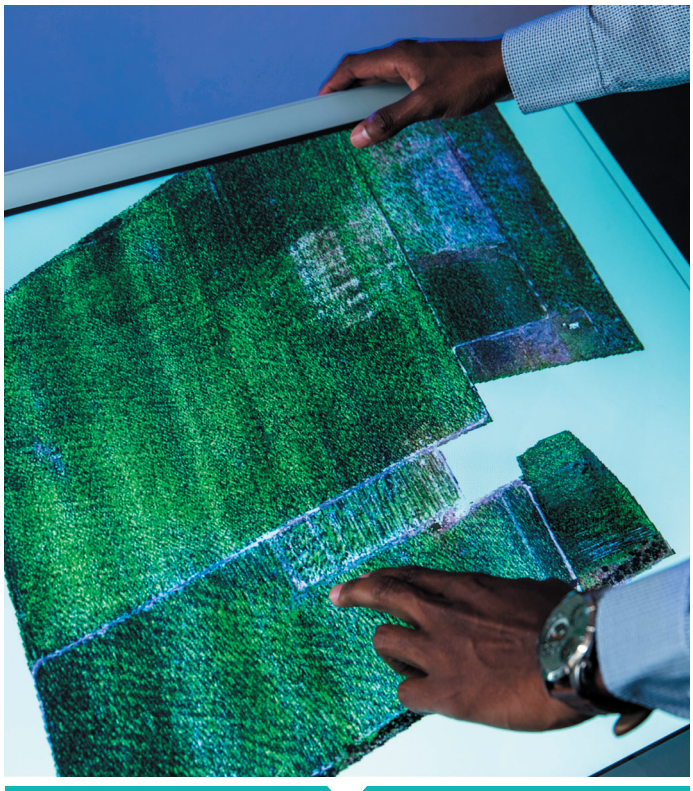
The CSIR-developed precision agriculture information system provides a holistic approach to support agricultural practices on farms, compared to other precision agriculture platforms in the market that provide limited information.

The system is a simple, farmer-friendly platform that can be used by emerging farmers. Feedback from piloting the system among these emerging South African farmers suggests that system uptake is promising.

In addition to precision agriculture information, the platform provides actionable solutions and approaches to address challenges at various levels of the agricultural value chain.

The system enables a farmer to:

- Monitor crop performance throughout the growing season;
- Manage crops effectively based on specific bio-physical parameters;



Raw satellite image of a crop field.

- Determine agricultural practices based on weather and climate information;
- Identify early-stage agricultural problems followed by timely implementation of corrective measures; and
- Decide on inputs and resources.

South Africa currently does not have a platform that provides actional insights on soil and crop biophysical/biochemical conditions at the farm scale that meets the specific requirements of small- to medium-scale farmers.

*Market opportunity*

## A broad agricultural user base

Based on market interactions, the potential markets for the CSIR-developed system include government departments such as the provincial departments of agriculture, farmer associations, emerging farmers, commercial farmers, farmer support programmes, agricultural businesses, insurance companies, and banks.

*Business opportunity*

## A flexible business model to suit agricultural users

The platform creates value by providing information that supports the broad agricultural use base. The business model consists of:

- Subscriptions: A monthly or annual fee is charged for the use of the system, with the customer base mainly consisting of farmers.
- A pay-as-you-go option: Users select specific services and are charged accordingly. This is costed based on the user selection, with the customer base mainly comprising farmers.
- Licensing: The system can be licensed to users, who will mostly be associations, organisations and government departments.
- Advertising: Once the user base has significantly grown, an advertising function can be included. Companies will be charged for advert placement.

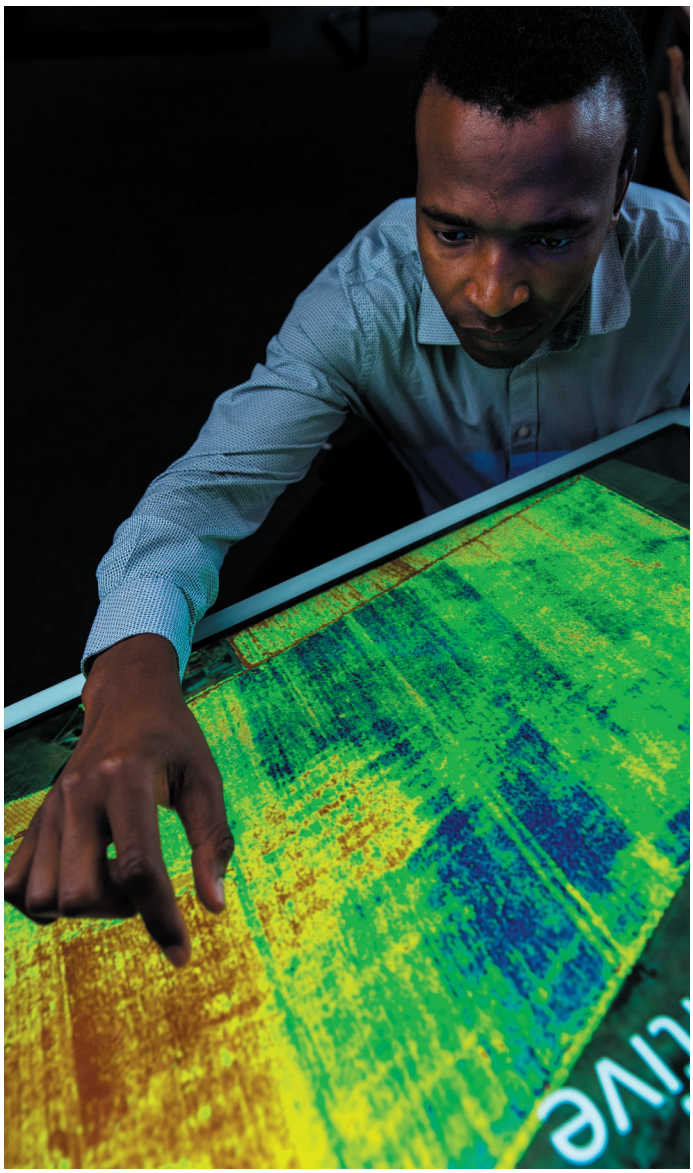
*Investment and return on investment*

## Invest to capitalise on the rise of 4IR and pressures to farm profitably

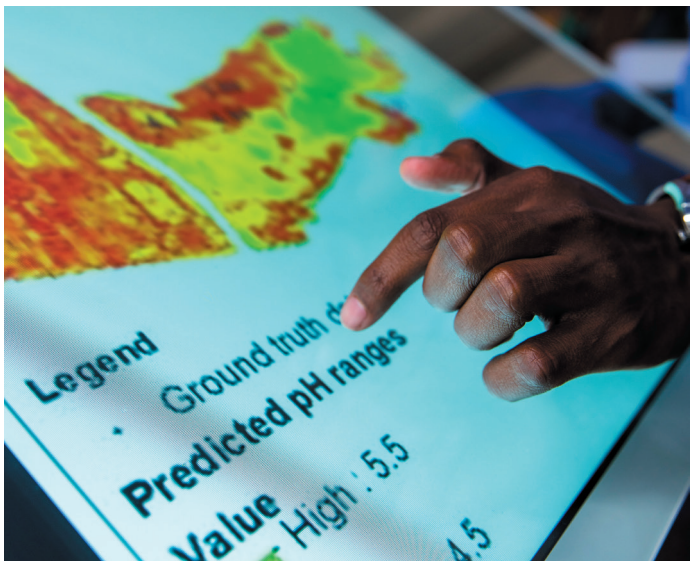
The platform requires an approximate investment of R2 million per year for the continuous monitoring and updating of the functionalities of the system, including related interpretations for ease of communication with emerging farmers and users; as well as for infrastructure related to Amazon Web Services, including storage, data processing, web service hosting and delivery to users.

The financial sustainability of the CSIR-developed precision agriculture information system depends on ensuring large quantities of agricultural land areas are observed and supported.

Based on existing business development plans, an agricultural land area of 1 000 000 ha will be monitored by year 10. Secondary services will be gradually included in the platform to enhance financial sustainability. These include advertising and extension services. The envisaged long-term outlook for the system is to provide an agricultural doorway to users, incorporating various functionalities.



Differences in crop health depicted across a field.




Estimates of soil pH levels across a field.

Calibration of a drone system.

Preliminary indications are that the sustainability of the system can be realised from year six onward.

## Milestones and timelines

A prototype demonstration will be ready at the end of year one; market testing and product improvement will be undertaken in year two; and product roll out will take place in year three.

## A team of experts in remote sensing and information and communications technologies

The technical team is highly experienced in algorithm development, modelling and software development.

## ENQUIRIES:

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