fruitlook SEASON FOR CHANGE:

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This is the second article in the FruitLook series.

For more information about FruitLook visit

www.fruitlook.co.za

Today we live in a world of interconnectedness, the dawn of the 'Internet of Everything' and shifting technological frontiers. Even the use of robotics on farms are on the (not so distant) horizon.

Will the orchard of the future be managed through wireless centre networks?

Are machines changing the face of farming in the future?

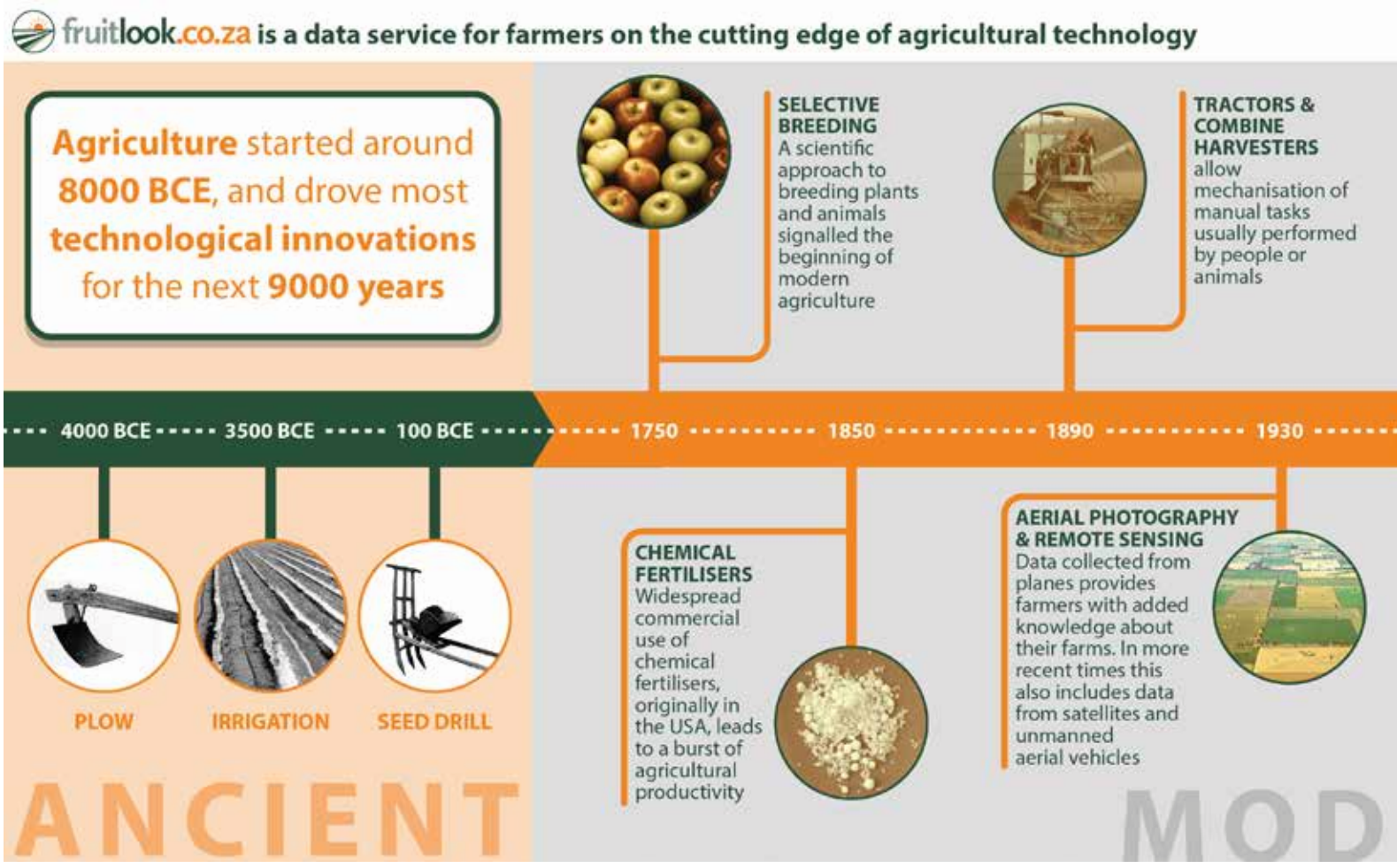
"The speed of technological change will necessitate local producers to rethink their investment and skills if they don't want to be left behind," says Martin Butler, senior lecturer in Information Systems Management at the University of Stellenbosch's Business School. He is a Research Associate at the Institute for Future Studies.

Every farm has again become frontier country in the technological wild. How do you navigate farming in this (frequently digital) landscape?

Artificial intelligence is already enabling computers to behave like they did in science fiction movies 40 years ago. "The indications are that fruit farmers will not be able to farm like their forefathers did given increasing resource pressures," says Butler.

Since the earliest times forward thinking farmers have been trying to increase their understanding and management of their crops (see timeline). In the last few decades local fruit farmers have benefited from many technological advances,for example, allowing mechanisation of processes like thinning.

Furthermore mass automation, customisation biometrics and genetics have offered some key areas of technological change. Precision farming (the idea of optimising every square meter of land) is on the rise due to new sensors,



brave new world of fruit farming

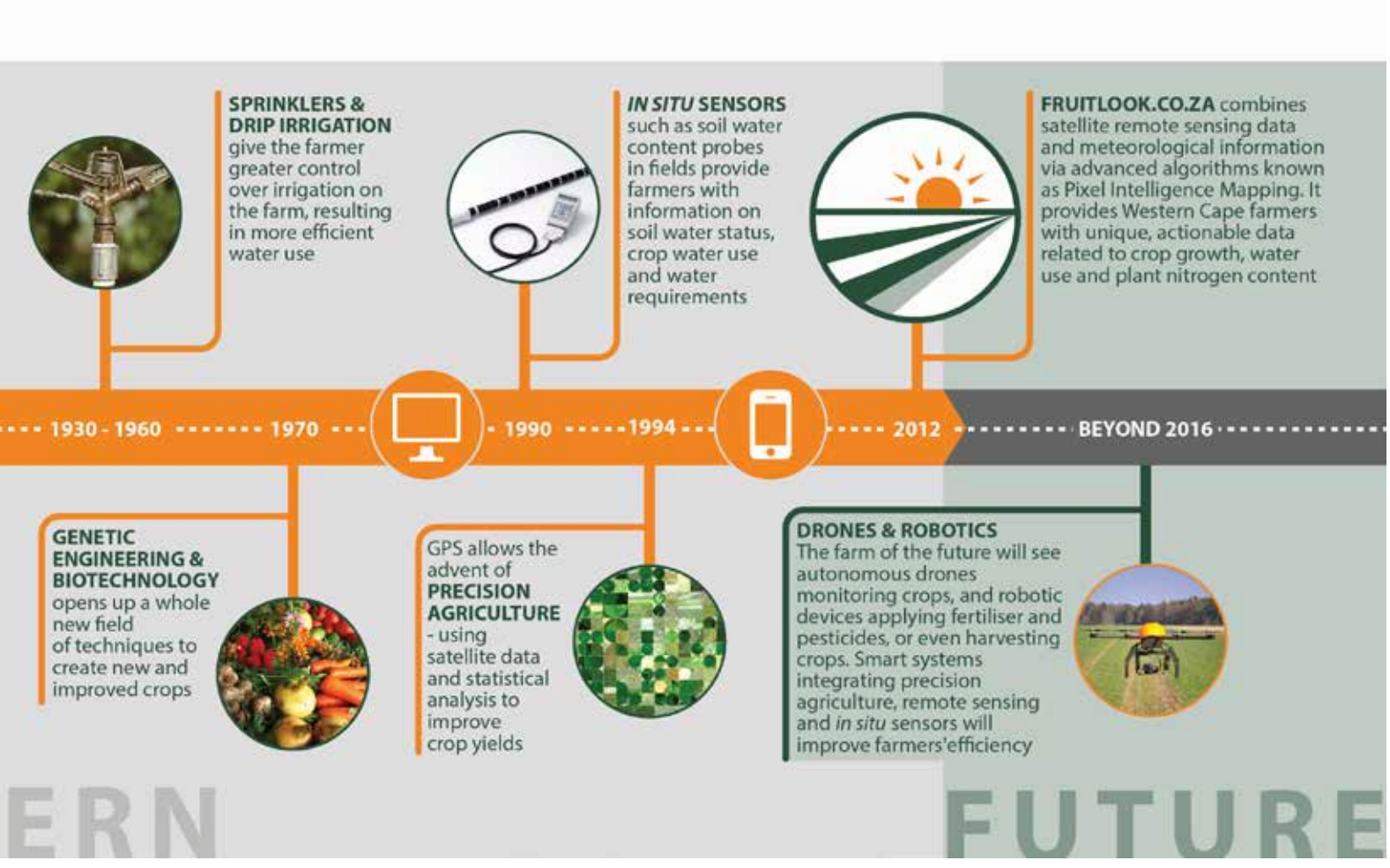
(airborne) imaging technology and mobile devices with sensory as well as location awareness technologies. Butler believes these and other technological advances can potentially steer the sector into a more computerised, information-based world.

Currently farmers are embracing various new generation tools to better understand their block development in space and over time. In recent years satellite remote sensing has proven very useful. These 'eyes in the sky' have already given rise to myriad of applications, mainly aimed at increasing yield and the need to produce more with less water.

FruitLook, an online tool that has received recognition internationally, has been gaining good traction in the local fruit sector since 2012. FruitLook is funded by the Western Cape Department of Agriculture and currently available free. It uses the latest remote sensing satellite technology to help farmers manage crop productivity, growth and water use more precisely (see graphic below).

Technologies like remote sensing and geographic information systems (GIS) are designed to help farmers get greater control over the management of farm operations and improve the efficiencies of resource use, says independent researcher Dr Caren Jarmain. “The full potential of individual and a combination of technologies are far from being fully grasped.”

She believes remote sensing technology integrated into precision agriculture represents “the most promising new frontier for the technology since applied environmental resource monitoring was initiated with Landsat in the early 1970s”. The current information age allows for integrating technological advances



into precision agriculture, she says. Precision agriculture was developed in the 1990's for arable crops and in mechanised fruit crops like grapes for wine making. It has only been evolving in the last decade for handpicked fruit crops.

FARMING FOR THE FUTURE, TODAY

When it comes to new technology context is everything, reckons Dr Albert Strever, a viticulturist doing research at the University of Stellenbosch. Spatial data has the potential to assist farmers to assess and improve their resource use. "The rise of computing power exponentially increased the ability to develop technologies based on artificial intelligence and capable of autonomous action. The local agricultural sector is only starting to deepen its understanding of the implications of these technological advances," says Strever.

However, the challenge is about much more than catching up with technology and using all kinds of nifty gadgets on farms, reckons Dr Elmi Lötze, horticultural researcher at the University of Stellenbosch. "Generating heaps of data for the sake of more data makes no sense without interpreting it. We need relevant technologies that are integrated in (fruit) farming practices to be really meaningful. A spade is not a useful tool if you don't know how to use it. The same goes for new technologies," says Lötze.

General Manager of HORTGRO Science Hugh Campbell believes that spatial information has the value of "representing relevant information in a visual format which allows for objective decision making". According to Campbell large chunks of data can be converted into a visual expression of what is happening in an orchard. "A spatial view of an orchard coupled with GPS allows you the option of optimising each tree in an orchard. If one looks at pest control, there is a growing need to manage pest on a wide-area basis. Spatial information allows one to effectively manage and plan at an individual tree, orchard, farm and regional level," he says.

FRUIT FARMS BECOME TECH-SAVVY

The face of farming has changed significantly over the past few decades and technological advances have taken fruit farming to a new level (see timeline on page 74).

Whether it is planning a new farm or harvesting fruits, new technology is constantly employed. Although drafting farm plans are nothing new, spatial data (whether elevation maps/ topography, slope and aspect and soil maps) is playing an increasingly bigger role. So says independent researcher Dr Caren Jarmain. "Many datasets are taken into account to produce farm maps nowadays and most of them are created digitally".

Part of farming is using a good medium (soil) for growing your crop. Quite often growth anomalies in blocks reflect soil differences (soil samples are often taken from distinctly different areas). Normalised difference vegetation index (NDVI) maps have been used extensively to identify "growth zones" in fields and sampling has taken place within these. Based on the soil chemical analysis corrections in nutrient/ mineral applications have been done.

"Plant breeding and genetic engineering has also resulted in a wide range of new cultivars available throughout the world. The most suitable combinations can these days be utilised in each orchard. This is paired with available rootstocks, farm plan details on aspect, slope, soils, etc.," says Jarmain.

Technology has also played a major role in the way in which crops (fruit or others) are cultivated. Jarmain says mechanisation is already playing an important role in thinning fruit trees and robotics will likely contribute to many aspects of farming in the future. "Simple systems of leaf sampling to determine nutrient deficiencies and corrections based on this, has become common practice in recent years," says Jarmain.

With computers and electronics being so readily available and part of so many systems, it is deeply integrated in water management system; whether through monitoring soil water content and managing irrigation. "Systems like FruitLook are utilising computers and combining there processing facilities with satellite information, which make a spatial view possible of water management in field and on farm level," says Jarmain.

"Harvesting of fruits is also influenced by spatial technology, by providing information on unique sampling zones. Research into the use of robotics for harvesting fruits is also advancing and will likely play a bigger role here in future."

It should be evident to anyone who has been following the Megaboer TV-series that successful farmers are those that operate close to the cutting edge of new technology, Campbell believes. "The new technologies like robotics and intelligent systems, satellite monitoring and other technologies provide unique opportunities to problem solving and increasing efficiency. This includes becoming more cost effective and improving worker safety," he says.

The challenge in a South African context is to utilise the aformentioned technologies to optimise activities and in the process increase labour productivity. The cost of implementing new technologies is also often a problem for local producers.

PICKING FRUIT OF SPATIAL ANALYSIS

If the theme of the 2000's was mass data capture, 2016 and beyond will be all about data driven design, reckons Butler.

This kind of "design thinking" is at the heart of FruitLook.

"It captures the physical nature of a vineyard or orchard in a spatial manner yet provides more than just pictures. FruitLook gives access to additional information about the physical world surrounding us," says Jarmain. This is because the satellites sensors capture details that are not always visible to the naked eye, she explains.

The online tool provides producers with spatial data based on the latest satellite information to analyse crop growth and water status over time and space. According to Jarmain one could say it is "Farming for the future in action" already and all of it is done without any effort on the producer's side."

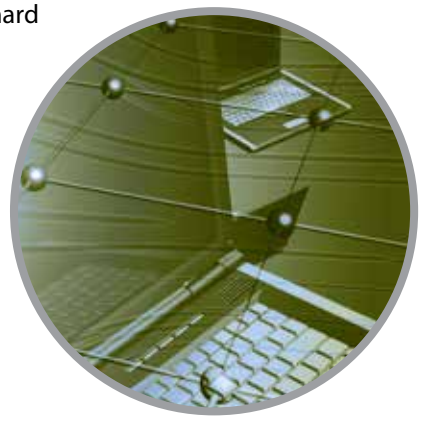
FruitLook derived data – it has a spatial resolution of 20 m x 20 m – can show the spatial variation in an orchard very clearly. However, it cannot directly explain the causes for variations visible, whether at field or regional level. The user has to make his or her own interpretation. "Farmers can relate to their orchards or vineyards and find the variation in actual crop water use very interesting and helpful," says Jarmain.

This is possible thanks to FruitLook's unique architecture that integrates satellite data with geographical data and weather information in complex models. Researchers verify the data through field measurements to ensure its credibility. All this information is then integrated into user-friendly maps and graphics.

According to Nelius Kapp, soil and horticultural scientist from Prophyta, FruitLook provides both grower and technical advisor with a "useful mechanism" to evaluate and interrogate the specific actions that have to be implemented in an orchard. "One of the biggest problems in the local fruit sector remains the lack of monitoring on farms. Many people are doing the basics (including leaf and soil analysis) but people don't know what is happening on a bigger scale," says Kapp. "Technology like FruitLook enables you to determine growth variation in your blocks and provides a more complete picture over time."

Mico Stander, soil scientist from Agrimotion, agrees. "FruitLook offers you a timescale to look at your orchard and see if there was a problem, for instance by looking at the biomass at a specific time compared to previous seasons. It is a technology that can help producers to farm more effectively."

FruitLook also allows a grower to see where an orchard or area of an orchard has been over or under irrigated. Campbell says the technology brings the the opportunity to save water but more importantly to ensure that an orchard stays within the required norms to optimise production. "The challenge will be the ability to address the deviations from the norm at a tree rather than at an orchard level."



Capturing information and assessing this data are crucial to determine best practices and achieve increased production. This has been the experience of Ernst Heydenreich, general manager of the fruit section of Oak Valley Estate in Grabouw. He uses it to determine the placement of soil moisture probes, detect drainage problems and evaluate irrigation post-seasonal.

This is why André Roux, the Western Cape Department of Agriculture's Director of Sustain-

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able Resource Management, believes FruitLook offers "valuable technological applications" for local farmers. "If you improve your farm monitoring, you can diagnose problems better and also act quicker," he says. "It can help detect and manage field variability to save costs and determine the reasons for this."

A BRAVE NEW WORLD OF FRUIT FARMING

Researchers, consultants and producers alike seem to have reached a consensus: technological advances like FruitLook are changing the face of local fruit farming.

"The brave new world of farming is upon us," says Prof Wiehann Steyn from HORTGRO Science. "A new technological wave is on the horizon." For the agricultural sector this could potentially lead to farm management practices which only require human interaction when necessary.

The next big technology wave to hit farming is said to be robotics enabling unmanned farming in orchards. Researchers like Prof Salah Sukkarieh from the Australian Centre for Field Robotics says intelligent robots harvesting in orchards and doing the work of a farm labourer is not entirely as far-fetched as it would seem. He has already designed a robot that can select the correct flower, remove other flowers with a jet of air and at the same time pollinate the selected flower with pollen. Although it will take many years before this kind of technology will be commercially available, the possibilities are potentially endless.

"There are many technological changes happening, but certainly mass censors, genetics, robotics and artificial intelligence hold a lot of promise," says Butler.

Is there then still a role for humans in the orchard of the vineyard of the future? "A huge role, but not doing the mundane," he believes. "Computers are incredibly fast, accurate and stupid. Human beings are incredibly slow, inaccurate and brilliant. Together they are powerful beyond imagination," says Butler.