THE FUTURE OF THE WESTERN CAPE AGRICULTURAL SECTOR IN THE CONTEXT OF THE 4TH INDUSTRIAL REVOLUTION

LITERATURE REVIEW:

Smart Farming/precision farming

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1. Technology Overview and Detailed Description

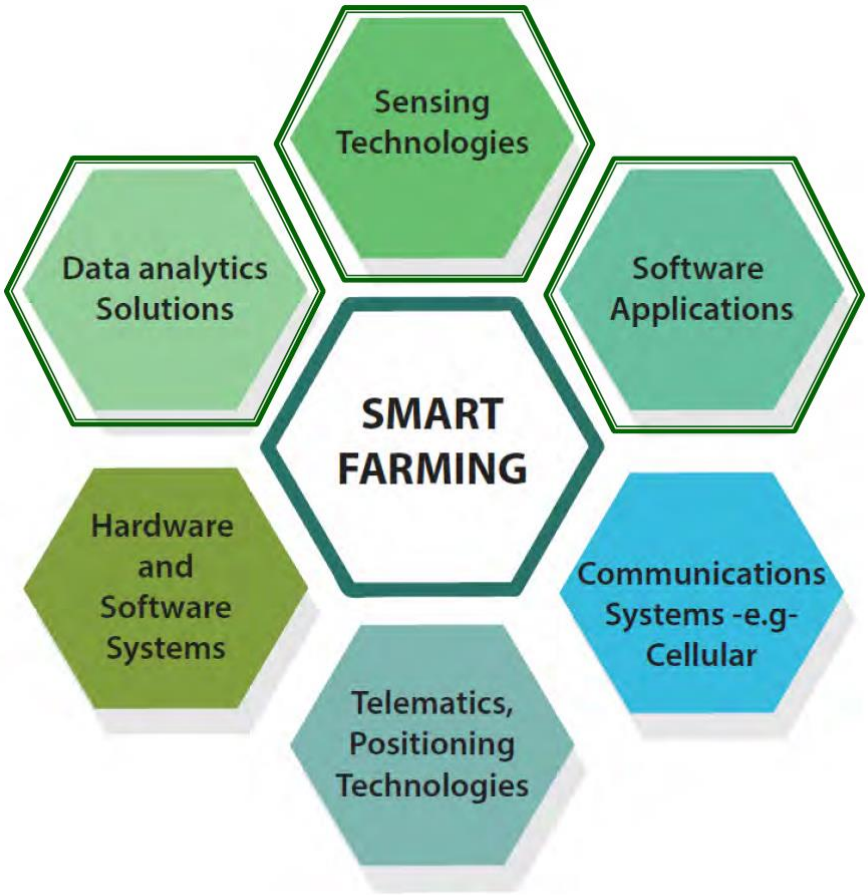

Figure 1: Credit: Beecham research

In future smart farming robots perform autonomously and sensors allow them to evaluate a situation and to take decisions. The data from these sensors can be used to compile ever expanding datasets ("big data")[1]. Smart farming is also known as satellite agriculture, location-specific crop management or precision farming/agriculture. It is agriculture in which the crop, animals and soil receive the exact treatment that they need.

Other than in traditional agriculture, in smart farming the farmer looks at the need per plant or animal instead of per field or herd. Taking into account the specific conditions of the soil, hours of sunlight and climate will optimise the yield. Effective smart farming is therefore based on data analysis. Treating the crops and animals as accurately and effectively as possible requires i.e sensors and other data value addition to determine the variation in soil, crop and animal behaviour. GPS is used to reference the variability. Smart farming also requires decision support systems - decision rules and models that will translate the measured variability into action which – while taking into account the economy and the environment – is tailored accurately to soil, plant or animal. The smart use of these core

elements (detection, decision rules, execution, evaluation) requires adapted technology, which is mostly dependent on other technologies[2].

Recent developments in smart farming include ever increasing data exchange between machines, management systems and service providers, development of injection systems, weed burners and specific implements for the crop rows. The greenhouse industry already uses robots, e.g. in the plant tissue culture, and GNSS (Global Navigation Satellite System), which allows positioning within a plot or crop with an accuracy of a few centimetres[2]. According to experts, the expansion of smart farming will result in increased production per crop, and more efficient production systems.

Precision farming utilises six ultra-modern technologies3:

- **Global Positioning Systems (GPS)**, which provides a navigation system to establish a position of a tractor or combine anywhere in a land within less than 2 meters on a latitude-longitude grid overlay.
- **Geographic Information Systems (GIS)** – GIS Computers capture, manage and analyse spatial data related to crop productivity and field inputs.
- **Variable Rate Technology (VRT)**, which provides "on-the-fly" control of field inputs.
- **Optical satellite imagery** – provides real-time monitoring of crop development and anomalies due to variation in soil potential, physical or climatic variables, pest and diseases, or nutrient deficiencies.
- **Satellite Imagery and Aerial Imagery –** can also include drone imaging
- **Near Infra Red (NIR) Ortho rectified Imagery**. This is becoming a very important technology – initially with timber and wine farmers but spreading to all farmers.

Information derived from these technologies allows farmers to:

- apply inputs such as fertilisers and seed at variable rates exactly where they are needed
- make more efficient use of these inputs

Notes:

- There is also a section in the AgriHandbook on Precision Livestock farming, a subdivision of precision farming. It refers to a Farmer's Weekly article.
- Stakeholders and role players are defined for precision farming in the AgriHandbook wiki.
- Disease simulation also demonstrates very well the smart farming cycle – see nfrec.ifas.ufl.edu/media/nfrecifasufledu/docs/pdf/Small-Smart-techologies-2017.pdf this publication also nicely outlines technologies such as the John Deere systems in a visual way.

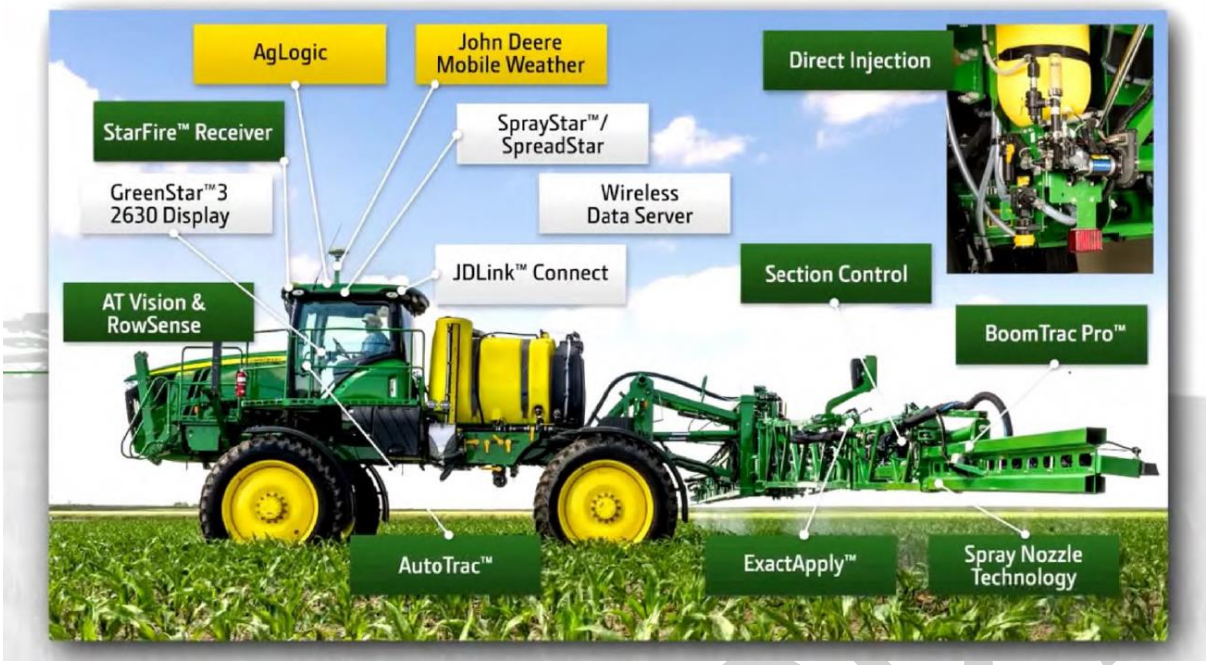

Figure 2: Technology – the Future of Agriculture

There is a very good Nature Journal overview on technology: future of Agriculture which needs incorporation (http://www.nature.com/nature/journal/v544/n7651_supp/full/-544S21a.html).

2. Application Examples and Case Studies

The Nature article offers some nice applications which can be shown. This section also overlaps with the sensor discussion on, i.e. FarmTrak.

The Goldman Sachs report outlines:

- Precision fertiliser application
- Precision planting
- Compaction reduction with smaller tractors (autonomous)
- Precision spraying
- Precision irrigation
- Field monitoring
- Data management
- Precision weeding (i.e. flame throwers, steam, chemicals).

3. Technology or Application Life Cycle: Current Status and Expected Development in 2020 and 2025

Considering that precision agriculture is a culmination of technologies, it is proposed that this should be done in the final review (using the input reviews) for the building blocks – also refer to the Business ecosystem view for reference to the building blocks.

With regards to this in literature there seems to be a difference between precision agriculture, which is a term in use for many years (late majority, mature phase?), vs smart farming which is a more modern term pulling in IOT and robotics (with their respective phases of maturity/adoption as in other reviews).

Table 1: Sub-technologies as in business ecosystem view?

Technology Area	Current application in agriculture	Expected applications in agriculture by 2020	Expected applications in agriculture by 2025
Sub technologies as in business eco system view?			

Business Eco-System View

Figure 3 presents an eco-system overview of precision agriculture and smart farming.

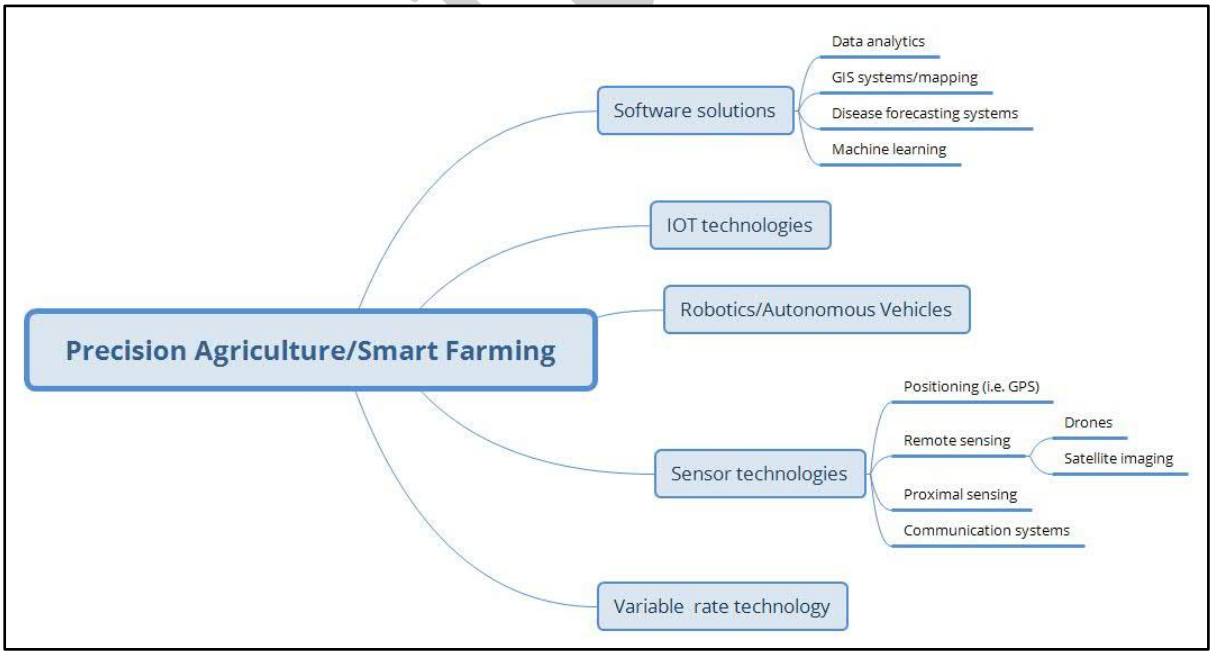

Figure 3: Some key components of precision agriculture/smart farming

Benefits and Risks

Potential Economic, Social, Ecological and Political Developments and Impacts

Evaluation Matrices

Synthesis, Conclusions and Key Trends from the Literature

Write up the key trends and overall conclusions.

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[1]De Wilde, S. 2016. *The Future of Technology in Agriculture*. [Online] Available: https://stt.nl/stt/wp-content/uploads/2016/05/ENG-Toekomstverkenning-agri-food-Web.pdf [Accessed: 22 October 2017].
[2]Guerrini, F. 2015. The Future Of Agriculture? *Smart Farming*. [Online] Available: https://www.forbes.com/sites/federicoguerrini/2015/02/18/the-future-of-agriculture-smart-farming/#1d56905e3c42 [Accessed: 15 October 2017].
[3]Macaskill, C. 2017. Precision farming. *Agrihandbook - Services and Technologies section*. [Online] Available: http://www.agrihandbook.co.za/index.php/book/services-technologies/precision-farming [Accessed: 22 October 2017].