



PRECISION FARMING IN SOUTH AFRICA

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1. Introduction

South Africa is a country with an extreme range of topography (plains, lowlands, open and closed hills, low and high mountains and table lands). Rainfall in South Africa varies from less than 100mm annually in the west to an excess of 1200 mm annually in the east. Approximately 35% of South Africa receives less than 300 mm and 7% more than 800 mm annual precipitation. South Africa can be divided in areas with all year, winter and summer (early, mid, late and very late) rainfall areas. The winter rainfall areas is predominantly in the south western part of the country, the all year rainfall in the south eastern part and the summer rainfall in the central, northern and eastern parts of South Africa.

The South African Agricultural market is a free market with no subsidies and limited import tariffs, to protect the market against unfair international competition. The most important limiting factor in agriculture is the availability of water and some parts of the country are prone to drought, having a negative influence on production.

South African have a wide variation in soils although most cultivated soils is low in organic matter and tend to have a below normal pH. Soils have a definite influence on farming practices and crop selection.

South African farmers are challenged by a number of factors including growing production costs and low product prices. Precision farming is one management tool implemented by South African farmers to meet these challenges, reduce risk and ensure sustained farming. Precision farming is seen as managing the variability of soil potential using geo-referenced data and electronic equipment (Nell, Maine & Basson, 2005).

2. History and current status of precision farming

Although yield monitors were imported before 1996 the first 4 yield mapping systems (MicroTrak) were installed by Senwes in 1996 to quantify yield variation and fine tune the Senwes soil potential simulation model, based on soil classification. Variable rate application of phosphorus and lime, based on chemical grid sampling, were done by companies (Nitrophoska and TechniLand) with big machines (teragators) since 1998. The first variable rate controlled (VRC) application (phosphorus), by a farmer, based on soil potential, chemical soil analysis and yield data were done in 1999 (Nell, Maine & Basson, 2005). In 2000 two products (N & P) were applied, by the same farmer, based on the same principals.

The University of the Free State (UFS) did surveys on the status of precision farming in South Africa in 2001 and 2005 and found that precision farming is growing fast (Nell, Maine & Basson, 2005). The following estimates were calculated:

- Yield monitors and mapping: 40 (2001) to more than 600 (2005) farming units with 35% doing just monitoring, not mapping.
- VRC application for lime = 16 (2001) 87.5% done by companies contracting VRC services to farming units to 244 (2005) with 12% farming units doing their own VRC application, with their own converted spreaders.
- Variable rate application of fertilizer = 8 (2001) 87.5% done by companies contracting VRC services to farming units to 251 (2005) with 15% farming units doing their own VRC application, with their own converted applicators and planters.
- Manual Guidance = 200 (2005) farming units.
- Automatic Guidance = 50 (2005) farming units.

3. Role players in precision farming

The farmers (producers) and their farms is probably the most important role player in precision farming. The following were found by the UFS in South Africa:

- Farmers between the age of 25 and 35 are the fastest to adopt new technology but lack the funds. Farmers between 35 and 45 are more ready for new technology than older farmers and where the group which have invested the most in precision farming because they have more funds available than the younger farmers. Farmers older than 45 were the slowest to adopt new technology although they had the most funds available (Matella, 2002).
- There are a positive correlation between education and technology adoption. Most farmers adopting the new technology had college or university qualifications (Matella, 2002).
- Farm size did not have any effect on the adoption rate of precision farming technology (Matella, 2002).
- Farmers adopting the technology tend to have historically higher yields than the average for the farmers in the region (Matella, 2002).

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The companies that play an important role in advancing precision farming in South Africa are:

- Fertilizer companies like Omnia, Kynoch and Nitrophoska for soil classification, grid sampling (chemical), data processing and fertilizer application.
- Cooperatives and former cooperatives (now companies) like Senwes, Suidwes, Afgri (TechniLand), SSK (TechniFarm), North West Co-op and Griqualand Wes Co-op for classification and grid sampling (chemical), data processing and / or precision farming equipment and / or fertilizer application.
- Machinery dealers like John Deere, Case and New Holland for precision farming equipment.
- Private companies like LantekSA and Astrata for classification, grid sampling (chemical), data processing and / or precision farming equipment and / or fertilizer application.

The major suppliers of precision farming equipment to South Africa through one or more of the role players above are.

- KEE Technologies - Open multifunctional systems for a wide range of applications and manufactured equipment.
- GreenStar (AMS). - Focus on the John Deere range of equipment.
- AgLeader & Trimble. - Open system known for yield mapping and Guidance.
- Case & Raven - Focus on the Case range of equipment.
- Omnistar - Correctional signal provider.
- Others - Garmin, Novatel, Farmworks, Fairport, exc.

4. The Process

The process of precision farming is seen as an ongoing process repeating itself each year, while moving towards the optimum.

a. Data Capturing

Different companies and regions use various methods and combinations to gather various types of data to identify management zones and / or points.

- Grid sampling only.
- Grid sampling followed up with smart sampling in the coming years.
- Grid sampling and yield mapping.
- Satellite images and smart sampling.
- Yield mapping and smart sampling.
- Electric conductivity (EC) and smart sampling.

Grid sampling with yield monitoring is used the most to identify management zones (Zeilinga, Nell, & Le Roux, 2005).

• Soil classification

It is the annotation of the physical characteristics of the soil (depth, clay & slit, Submissive layer, aspect, slope, ex.), used to simulate soil potential for a specific crop in a specific region. Soil classification started before the 1980's and where mainly used for sub-dividing fields into so called homogeneous fields. Approximately 25% of all arable land is classified (Nell, Maine & Basson, 2005).

o Moisture availability

It is the annotation of available (gathered) moisture in the soil before the crop is planted and the best estimate of the rainfall for the coming season. Different soils react differently in dry and wet seasons and when planning the application levels of fertilizer in these zones the expected rainfall should be taken into consideration (Zeilinga, 2004).

• Soil nutritional status

It is the sampling and analysis of the status of the available soil nutrients in the soil and the balances of the nutrients towards each other. Most of the time the level of variation and geographical spread of the different chemical elements in the soil differ in such a way that one area will not be consistently low or high for all elements.

• Yield monitoring

It is the result of the interaction between the soil, available nutrients and balances, climatic conditions and management.

• Management

The cultivation, fertilization, weed & pest control, cultivar selection, exc. for the specific season.



b. Data Processing

Looking at each point individually, taking the captured data into account and staying with good agronomical principals:

- Cut the low yielding / potential points to size.
- Balance and restore the nutrient levels in the soil, start with the most limiting factor.
- Challenge the high potential points.

c. Application

- Plan ahead and try to ease the pressure during planting by doing the VRC fertilizing upfront.
- Use liming as a quick win to get your investment back.
- Keep control strips to weigh your VRC decisions against.

d. Evaluation

Evaluation is best done with a yield monitor to quantify the results of the season and measure the progress made, also as a net result. The UFS confirmed through a survey that yield monitoring should be considered as a control / evaluation instrument in precision farming (Nell, Maine & Zeilinga, 2005).

5. Results

- The approach of companies and services companies offered had a definite influence on the precision farming phase the farmers in that region get involved in first (Matella, 2001).
 - In the Western Cape Province (winter rainfall area) companies focused on smart sampling for chemical analysis of management areas identified through satellite images and offered VRC application services. The farmers started with smart sampling for chemical analysis of soil and contracted the companies to do VRC application of phosphorus, lime and gypsum.
 - In the Free State and North West provinces (summer rainfall) the companies offered grid sampling, focussed on soil potential, chemical status and yield variation, did not contract services for fertilizer, lime and gypsum application but, focussed on helping farmers to convert existing implements of the farmers to do VRC application themselves. The farmers started with grid sampling for soil potential and chemical status of the soil and yield mapping. Identify management zones. Do VRC application themselves.
- The availability of contracting companies to do VRC application had a negative influence on farmers buying their own equipment.
- Technologies that give back a direct incentive (save inputs or yield increase) was more easily adopted (Matella, 2002).
- Precision Farming help to reduce risk (Nell, Maine & Zeilinga, 2005).
- Farmers claimed to have increased their management capacity (Matella, 2002). Precision farming stimulated and benefited management on more levels than expected.
- Manpower where reduced or used more effectively (Matella, 2002).
- Farmers claimed that precision farming helped them identifying problems in areas in their fields they did not know where present (Matella, 2002).
- Guidance saves the cost of marking swaths.
- Automatic steering showed less driver fatigue, enhanced productivity and enable in-between-row rotation.
- Farmers claimed over spraying where broad down from 12% to 4% on row crops and 22% to 6% on broad-acre crops.
- Farmers experienced lower production costs and higher yields with higher profits as a result. (Matella, 2002).
- Farm records show a yield increase averaging 20% confirmed by a survey of the UFS who found farmers had a yield increase of 15.4 - 30.8% after starting with VRC application (Zeilinga, 2004).
- The use of fertilizer per ton product yield where lower after the 2nd year of VRC application indicating more effective use of fertilizer, although the fertilizer per ha has been higher than with conventional production (Zeilinga, 2004). This can be contributed to the higher yield per ha over the 4 years where VRC application where done.
- Farm records show a reduction of up to 12% in fertilizer cost, however the UFS found during a survey that most farming units had a higher fertilization cost per ha, average 37.9% (Zeilinga, 2004).
- Farm records show lime savings up to 50%, however the UFS found during a survey most farming units lime savings, average 19.2% (Zeilinga, 2004).
- Most farming units had a better gross margin on fertilizer cost, average 21% (Zeilinga, 2004).



6. Looking ahead

- Good practical mechanisation planning is needed to phase precision farming into the business in an economic responsible way.
- Agronomic and economic planning and estimates don't take the advantages and cost of precision farming into consideration (Zeilinga, Nell, & Le Roux, 2005). Agricultural and financial organisations should take in consideration the benefits and cost aspects of precision farming to promote and stimulate the growth of precision farming to the benefit of both.
- Precision farming will grow strong in the next years to come (20% of all farmers). The growth will be influenced by:
 - The strength of the ZAR currency affecting the cost of precision farming equipment.
 - Product prices.
 - Production costs (fuel, fertilizer, labour).

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