SEEDS OF GROWTH

A RECENT SURVEY OF DUTCH FARMERS SHOWS THAT ALTHOUGH SIZE DOES MATTER, SMALLER FARMS CAN BENEFIT FROM THE UPTAKE OF GNSS, REPORT TAMME VAN DER WAL AND BERT KLEIN

Global navigation satellite systems (GNSS) are a key enabler for precision agriculture. Driving on perfect parallel lines, avoiding overlaps and gaps in cultivation activities, and reducing driver fatigue through autopilot applications have been the main incentives for farmers to invest in GNSS systems.

A survey in the Netherlands last year showed that 65 per cent of the country's arable farms are now using GNSS in their operation. The Netherlands is known for its small fields and high yields compared to other agricultural areas. Farmers know every corner of their fields. A tough job to get precision farming adopted, you might say, as the usual benefits are not so obvious. This is perhaps the reason why yield monitors never became very popular here, as they only confirm what farmers know already.

Instead, the main technology to boost precision agriculture in the Netherlands has been GNSS and applications like parallel driving and auto-steering. In the past 10 years, the use of GNSS tools has grown rapidly, from 10 per cent of arable farms in 2007 to 65 per cent in 2013. Besides a growth in the number of farms using GNSS, the number of GNSS systems per farm has also increased, from one to two or three GNSS-equipped tractors.

Nowadays, the majority of replacements for tractors and implements have factory-installed GNSS. In other agricultural sectors, such as horticulture and animal husbandry, the adoption rates are much lower. The most obvious reasons for this are the smaller scale operations that less easily provide return on investment.

The survey

In Europe, the advent of the Galileo GNSS provided a need to monitor the adoption levels of GNSS systems and the benefits and barriers experienced by different user groups.

Several other surveys were conducted recently. A first survey of 48 representative, selected farms concluded that 55 per cent of Dutch farmers use some sort of precision-farming technology, including but not necessarily GNSS systems. A Dutch market leader in farm management software also conducted a survey. It concluded that 60 per cent of its customers were using GNSS systems.

These surveys did not ask about motives and barriers to uptake. Therefore, we prepared a questionnaire dedicated to GNSS-use in the agricultural sector in the Netherlands. It was distributed electronically to 17,000 members of the regional Southern Agriculture and Horticulture Organisation (ZLTO, and 242 completed surveys were returned, mainly by farms in two provinces: Noord-Brabant (55 per cent of respondents), which has a distribution of farm types similar to the whole country's;

and Zeeland (38 per cent of respondents), which has more arable and less animal husbandry farms compared to the national average.

Pros and cons of on-farm GNSS-use

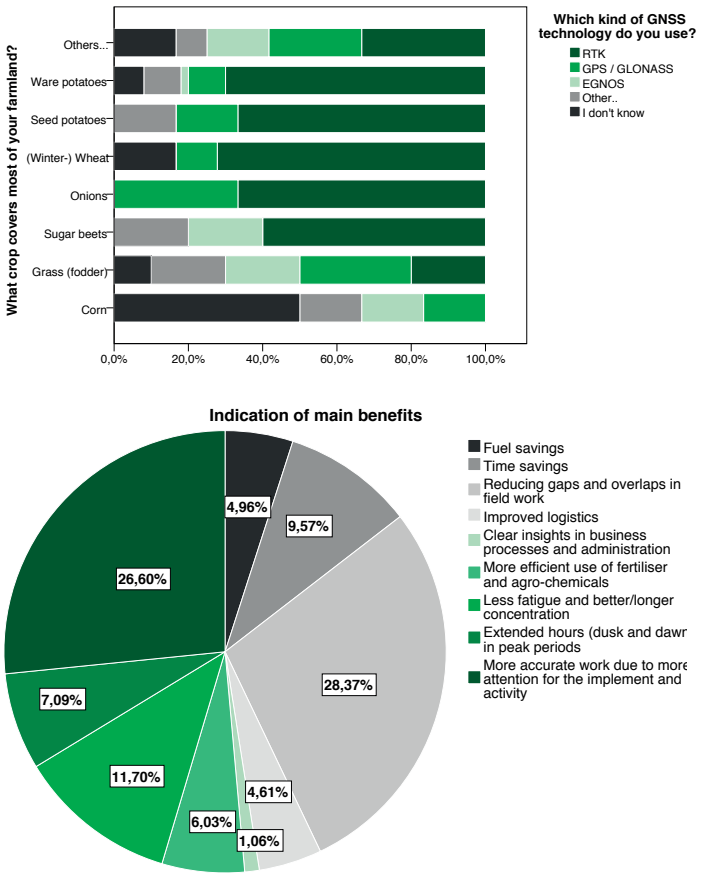
Although the satellite signals are free, applications that use GNSS require substantial investments in receiver equipment, additional correction signals (such as DGPS and RTK) and changes to the machinery. Farmers indicate that the main benefits from these investments are the reduction of gaps and overlaps in their fieldwork. Another important benefit is that farmers can concentrate on the tools and farming activity, rather than on steering the tractor.

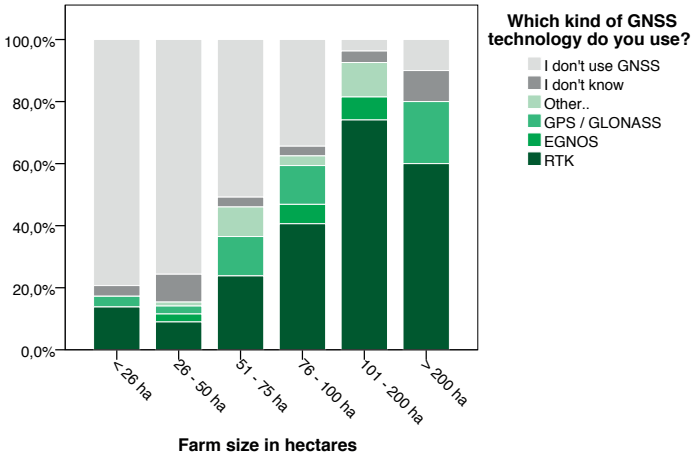
However, the full list of benefits is much longer, showing that the business case for investment in GNSS is quite clear. In order of importance indicated by the farmers, these were:

- Reducing gaps and overlaps in field work and optimised traffic in the field.
- More accurate work due to being able to pay more attention to the tools and farming activity.
- Less fatigue and better or longer ability to concentrate.
- Extended hours (dusk and dawn) in peak periods.
- More efficient use of fertiliser and agro-chemicals.
- Time savings due to more efficient work.
- Fuel savings due to more efficient work.
- Improved logistics (for example, supply of inputs during field work).

The relative importance of these benefits for the individual farmer is related to the farm type and how the work is organised, with each farmer having his or her own motives for investing in GNSS, based on these benefits.

However, farmers indicate they find it difficult to start working with GNSS, as the investment up front is substantial. One reason for their hesitation is the poor communication and interoperability between different brands of GNSS tools and between GNSS tools and farm management software. This implies that the choice of a brand has implications beyond just the technology and this is difficult to oversee.





Good independent advice is hardly available. Related to this, farmers acknowledge that benefitting from GNSS-use requires an investment in knowledge. Although manufacturers provide user courses, a lack of general training and education in GNSS technology causes suboptimal use and reduces farmers' ability to benefit from all the options that the technology offers. Vocational agricultural schools only recently started to include precision farming and GNSS in their curricula.

Outlook

The good news is that farmers are optimistic about the future. More than 50 per cent of the survey's respondents expect that manufacturers will solve the interoperability problems in five years' time. Farmers' confidence in these manufacturers originates from the hopes that all will benefit from such actions. Manufacturers of agricultural machinery are already working together in the worldwide operating Agricultural Industry Electronics Foundation, a platform of companies that focus on standardisation and interoperability.

Another expectation is an increased used of autonomous robots, working unsupervised in the field, with 15 per cent of respondents expecting to introduce them on their farms within five years.

Discussion

While we have talked of GNSS in general, GPS dominated the survey responses, with the Russian Glonass system little reported, despite being standard on different commercial receivers. In addition to the GPS and Glonass signals, farmers use RTK (57 per cent of all respondents), EGNOS (six per cent) and other differential GPS corrections (10 per cent).

In the Netherlands, GNSS applications to precision agriculture start with parallel driving and auto-steering. Adoption at arable farms is already substantial, despite the investment in equipment and knowledge. Two major trends will help this continue: increasing farm sizes make it easier to make returns on investment; and the next generation of farmers will be better educated and IT-literate, which will increase the benefits of GNSS.

There are also the first signs of farmers using GIS to optimise their field traffic patterns based on machine width, field geometry and working times, leading to so-called drive-maps or traffic-plans for the fields.

In the slipstream of GNSS adoption, other precision farming technologies are finding their way onto farms. Now that farmers know exactly where they are, they are interested in making their fieldwork location-specific. This requires integration with all kinds of GIS data, such as soil maps, groundwater data and remote sensing maps of crops. There is an explosion of possibilities, from scanners, sensors and cameras to sampling strategies and more.

The link between sensor and activity is the 'taskmap', a machine-readable map that indicates different rates of the particular cultivation measure. Applications that are already demonstrated in practice and have created high expectations are, for example, variable sowing densities based on soil heterogeneity and variable fertilising based on satellite imagery. To avoid cloud problems with satellites, services use unmanned aerial systems (UASs) to perform the scanning, although this is subject to regulations that still need to be formalised in many countries. But when those are settled, a swarm of UASs monitoring the crops and fields can be expected.

At the other end of the spectrum, tractor-mounted multispectral cameras control the flow rate of fertiliser or other crop chemicals to provide the right dose in the right spot. For many farmers, this is an ideal solution, as there is no human intervention needed to translate sensor readings into a taskmap. This increases significantly the usability of the tools. However, these black-box solutions have limited 'knowledge' of the causes of different sensor readings, so are not easy to interpret.

The use of yield monitors is very low in the Netherlands compared to North America, for example. However, with more GIS tools on farm, information on spatially varying yields becomes more relevant. Linking the final yield to all the operations done in the season provides an excellent benchmark to improve the farm performance. Having said this, precision agriculture is not only about doing the right thing at the right place and moment, but also documenting these activities for analysis. This will be a growing area now that geospatial technologies have become part of common practice.

The Netherlands is internationally characterised as a country with small farms with small fields. However, Dutch farmers show that although size does matter, smaller farms can benefit from the uptake of GNSS. As a farmer once put it, GNSS technology allows him to do 'large scale agriculture in a small scale landscape'.

ACKNOWLEDGEMENTS

The authors wish to express great gratitude to Peter Paree of farmers organisation ZLTO, which kindly distributed the survey to its members. Agro-GNSS expert Jan Nammen Jukema of AgroMetius gave first feedback on the findings. Corné Kempenaar and Corné Kocks of CAH Vilentum University of Applied Sciences approved the work of Bert in our company. The whole survey is done under the framework of the European-funded project UNIFARM (www.project-unifarm.eu).

GNSS TECHNOLOGY ALLOWS HIM TO DO 'LARGE SCALE AGRICULTURE IN A SMALL SCALE LANDSCAPE'

Tamme van der Wal is a partner and Bert Klein is a junior consultant at AeroVision (www.aerovision.nl)