Integrated Farming Topic Sheet no 6 / 2015

Precision Agriculture as tool to increase efficiency in Integrated Farming (focus: arable)

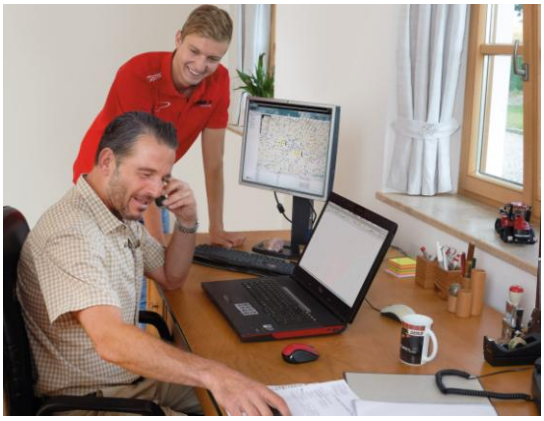
The idea behind Integrated Farming and Precision Agriculture

Integrated Farming (IF)[1] is about continuous development, thus allowing farmers to permanently improve the efficiency and value of all managed resources. It is about attention to detail and adopting innovative practices to deliver sustainable agriculture. And this is exactly where Precision Agriculture comes into play. Ever since the first GPS devices and N-sensors were available for arable farming, engineering has gone a long way in providing farmers with innovative technologies which help saving and protecting resources whilst optimising all kinds of management practices. With detailed planning, precise application, mapping of yields and measures as well as the evaluation of results, Precision Agriculture perfectly matches the holistic Integrated Farming concept.

Various Precision Agriculture tools and systems are available for arable farming. This includes Agricultural Management Solutions (John Deere), Advanced Farming Systems (Case IH), Fuse Technologies (AGCO), S-Tech (STEYR), or Efficient Agriculture Systems (Claas) or to mention just a few examples. Even though guidance tools are one decisive element of Precision Agriculture, systems now go far beyond keeping agricultural equipment “right on track”. Optimisation of individual machines was the main focus for a long time and still is pursued today with integrated sensors and increasing degrees of automation. Precision Agriculture tools and systems that are becoming widely available today also allow interactions between machines in terms of “master and slave systems”, for example.

Documentation in Precision Agriculture: Double benefit

The input used per kg of output, the output achieved per kg of input and the output achieved per hectare of land – as a limited resource – are helpful figures for evaluating and improving the efficiency of agricultural systems. In this context, the documentation of measures offers double benefits to farmers: On the one hand, whilst keeping precise track of all inputs such as fuel, fertilisers, crop protection products and other operating resources, farmers will be able to evaluate and benchmark the efficiency of the whole enterprise as well as individual fields and crops, hence allowing for further improvement and fine-tuning of strategies and measures as required in the EISA Integrated Farming Framework.



Detailed planning and documentation both are decisive elements of Integrated Farming and Precision Agriculture alike (photo: ©Case IH)

On the other hand, documentation can be used in all communication processes with customers, interest groups, authorities, and the general public, thus offering manyfold

[1] http://sustainable-agriculture.org/integrated-farming/

chances to improve understanding, acceptance and trust. Against this background, Precision Agriculture offers excellent opportunities, and sophisticated packages of precision tools are available for farmers nowadays. This includes guidance systems which reduce overlaps or bad spots to almost nil, ISOBUS data transfer between tractors and implements for optimum control of work processes in the field, yield and soil mapping with in-site or sub-area specific digital application charts for fertilisers, telematics for wireless communication between machines and the farm office, as well as software systems including tools for detailed evaluation, planning and documentation.

Exact guidance in the field and on the road

With the latest generation of Real Time Kinematics (RTK) – and depending on the manufacturer or supplier of the system – in-field guidance can be as precise as 2.5cm – from pass to pass and from year to year. Practically eliminating unnecessary overlaps and bad spots, these systems help to reduce the number of passes needed to work or harvest a given field. As a consequence, less fuel is needed, less fertilisers and crop protection products are applied in the field, thus saving time and money – whilst protecting the environment at the same time. By reducing all inputs including seeds, guidance systems markedly improve the efficiency of arable farming.

(Photo: ©Fendt)

Working in straight lines, however, also allows to better preparing fields for mechanical weeding. Straight rows in both directions allow weeding from both directions and the use of new tillage methods – and thus are a valuable contribution to the “tool box” of Integrated Pest Management (IPM).

In addition, reducing the number of passes on a field by making full use of the available working width of implements does not only save inputs but also contributes to soil protection as unnecessary passes on the soil surface are avoided. That is one reason why Controlled Traffic Farming (CTF) receives growing attention: By using compatible working widths of different machines and implements, the same tracks can be re-used again and again throughout the season and in following years, thus reducing the surface area that is used by tracks and tires to about 37-40% of the total field surface. Even though such systems are not widely implemented yet, the reliable availability of precise guidance systems with +/- 2.5cm all over the country will probably lead to an increased uptake in agricultural practice in the years to come.

One guidance option which is particularly helpful for staff of contractors who are not familiar with the location of individual fields of a customer is quite similar to the GPS systems used in private cars: Systems provide guidance on how a given site can be reached best without exceeding any road limits such as weight or width restrictions.

Implements “talking to” and effectively controlling the tractor

Whilst ISOBUS Class I and Class II systems are quite common in modern agricultural machinery such as tractors, combines and all kinds of implements already, the latest

(Graph: ©Poettinger)

generation ISOBUS Class III is just on the starting grid. Offering a common base for data exchange between agricultural machinery, ISOBUS is used to control implements via the tractor's ECU – the Electronic Control Unit. In addition to this one-way communication, ISOBUS Class III enables implements via their own ECU to control functions of the tractor such as lowering and lifting the rear hitch, increasing or reducing Power Take-Off (PTO) speed, increasing or reducing forward speed of the tractor and opening or closing remote valves.

Again, such technological achievements of Precision Agriculture increase the efficiency of arable farming even far beyond the capabilities of experienced and well-trained operators. Never tiring, ISOBUS Class III balers for example automatically optimise the baling process, thus saving fuel and time whilst producing evenly dense and uniform bales which will preserve the harvested produce effectively.

Precise mapping – precise application: On the spot and according to the demand

By means of GPS-based guidance systems, yield mapping is one element to improve land use efficiency. Quite often, in-site specific differences in soil type and texture, water supply or nutrient availability will have far-reaching effects on growth conditions and yields in different parts of one field. By mapping yields 'on the go' with modern combines, precise yield maps of individual fields become available.

Yield mapping (yield levels indicated by different colours) and adapting seeding rates as well as fertilisation rates, are very effective tools to increase the resource use efficiency of arable farming.
(Graph: ©Claas)

Digitalised results of soil testing and according nutrient maps offer further insights in and explanations for yield differences and underlying causes. Combined with yield maps and other tools such as remote reconnaissance satellite images etc., this information will help farmers to set up site-specific or sub-site-specific application charts for fertilisers. The same is true for N-sensors which can be used in the growing crop to measure light reflectance properties of crop canopies and thus identify the "sub-site-specific" nitrogen supply status. By adapting fertiliser rates to available nutrients in the soil and the demand of a given crop, a targeted application can be ensured, thus increasing efficiency and protecting the environment at the same time.

'Matching' top performance with telematics

Operators need a lot of training and experience to effectively use the potential of modern machines such as combines with 12m headers for example. Adjusting the

speeds of intake auger, threshing drum or rotor, sieves and other grain cleaning devices as well as choppers and spreaders for straw can be the source of multiple mistakes which in sum reduce the efficiency of the whole harvesting process.

(Graph: ©Case IH)

That is where wireless telematics offer some of their far-reaching possibilities: Experienced operators can check – and submit suggestions for improvements – from the desk in the farm office to operators and machines in the field.

By comparing parameters of different drivers and / or machines, telematics thus offer opportunities to increase the performance of equipment in the field whilst reducing time and fuel needed to work a given area at the same time.

In addition, telematics enable machines to exchange information on where they are, what their status is (e.g. grain tank is full) and thus allow further optimisation of the farm management. Telematics allow to increase the efficiency of logistics chains, to improve the performance of machines, to detect possible malfunctions even before they occur, and to give guidance on how to best handle possible problems right on the spot.

Holistic approach – in Integrated Farming and Precision Agriculture alike

This Topic Sheet focuses on Precision Agriculture tools and systems in arable farming. However, modern Precision Agriculture also provides a growing number of tools, strategies and solutions for livestock systems. That is true for milking robots with all options to measure milk quality as well as health status of each cow. That is true for transponders which allow the automatic identification of animals, and that is also true for pedometers which collect data on movements and behavioural patterns of individual animals, to mention just a few examples of technologies which are increasingly taken up and used in animal husbandry.

Similar as the EISA Integrated Farming Framework, modern Precision Farming systems follow a holistic and systematic approach to agriculture – to arable and livestock systems alike – thus giving one clear reason why Precision Agriculture increasingly becomes an important element in the “Integrated Farming tool box”.

Precision Agriculture systems often comprise the whole package, outlined above for arable farming, including computer software to edit, evaluate and document all relevant data. These so-called “big data” become increasingly important in modern agriculture. By including weather forecasts, pest prognoses and various other features used by farmers today, these systems can effectively help to further developing businesses on the path of sustainable agriculture.

Whilst cross-linking more and more data from more and more on- and off-farm sources, however, there is a growing challenge to identify, interconnect and evaluate the relevant information from the pool of “big data” and then implement according measures on a given field or farm. It must also be ensured, however, that all data generated on a farm, whether stored at the farm office, in a cloud or in an advisor’s data processing system, solely belong to the respective farmer: data security and privacy must be maintained at all times.