Digitalisation in agriculture.
Tried and tested approaches for successful implementation in the field.
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“Digitalisation makes farmers more competitive.”

“Digitalisation will change the entire value chain and net output ratio – from the farmer to the consumer,” says Prof. Klaus Josef Lutz, Chief Executive Officer of BayWa AG. Not to take advantage of the opportunities digitalisation offers would be negligent considering the global and immediate challenges faced by farmers today.

Prof. Lutz, claims are being made that digitalisation is changing agriculture faster and more profoundly than the technological advances of decades past. How are farmers reacting to this?

The farmers’ reactions are different: Some react very positively to digitalisation. Others are sceptical and think: What will that mean for me? Of course, this is a generational issue as well. What is clear is that in the next few years, more and more IT will be used in agriculture. For example, I went for a walk recently and met my neighbour, who was fertilising his field. I noticed that he was spreading the same amount of fertiliser everywhere, which means wasting money unnecessarily. His response: If he could find a fertiliser optimisation programme that suited his needs, then he could optimise his costs on fertiliser.

Where do you think the greatest benefits of digitalisation are for the farmer?

Farmers are becoming more competitive. This is because digitalisation helps to optimise operating procedures so that farmers can work more cost-effectively.

Resources are no longer used inefficiently, but instead are applied in a targeted manner to where the plants need them most. We can offer even better support to farmers regarding issues such as sustainability and environmental protection, as digitalisation allows us to show a more transparent overview, something that consumers are increasingly demanding. Considering challenges facing farmers today – which are global, but at the same time immediate – it would be negligent not to take advantage of the opportunities digitalisation offers.

Start-ups are driving developments in agriculture with ideas that are sometimes disruptive. What is BayWa doing to keep up?

We aspire to be a driver of innovation and to make these innovations available to our customers. This means we have to be willing to place our business models under scrutiny as often as necessary and adjust them, add to them or develop completely new models, depending on the situation. Start-ups are very important in this process. This is why we work closely with new companies from the agricultural sector. Together with our Austrian subsidiary RWA, we founded the Agro Innovation Lab in 2016 with the goal of discovering innovations in agriculture early, promoting new business ideas and benefitting from them to the advantage of our customers. We are calling for applications for our Acceleration Programme worldwide every year. The winning start-ups have the opportunity to develop their business model with the support of mentors. If an idea fits well into the BayWa portfolio and the start-up wants it, we are also prepared to invest money in it.

Where do you see agriculture in 20 years?

I see three major developments on the horizon. First: Agriculture will consolidate in Germany as it has already done in other countries. Second: Farmers will use more and more high technology in their work. This means that their training and education will have to change to prepare them for the technology. Third: Agriculture is a global business. Ultimately, the goal will be to feed the 10 billion humans on this planet by 2050.

Digitalisation helps optimise operating procedures for more cost-effective work in the agricultural field. With a targeted, plant needs based application of resources, farmers can stop using resources inefficiently. This is a sustainable approach that protects the environment.
Agriculture making its way into the digital age.

Digital technologies have changed the farmer’s working day significantly in the past few years. Whether in the field, the stable or the office, digital solutions are becoming more important in all areas of a farm. Commentators often speak about Agriculture 4.0.

In this paper, three farmers and a workshop manager report on the effect digitalisation is having on their business specifically, how they are benefitting from technological advances and why personal consultation is still indispensable to them.

Martin Gilch describes how he uses digital sowing maps in his arable farm to optimally take advantage of the yield potential of his fields. In high-yield zones, the seed count is automatically increased during drilling, while less seed is used in areas with lower yield potentials. (Page 6)

Stefan Hollfelder from Upper Franconian Litzendorf talks about the challenge he faces in finding the best way to take care of his 170 dairy cows. With the smart feeding software fodjan, he can optimise both his cows’ feed and their milk yield. (Page 8)

Rudolf Paukert, a farmer from Upper Palatinate, talks about the advantages modern technologies offer him in running his entire business – from his field card index to his payroll accounting. (Page 10)

Daniel Sander explains what makes a good workshop in the digital age and how farmers can save time with repairs. As manager of a BayWa workshop for agricultural equipment and machines, he offers not only a 24-hour service for the machine, but also often steadies the farmers’ nerves with the help of his colleagues. Thanks to new technologies and a more effective data transfer, replacement parts turn up much more quickly than they did just a few years ago. (Page 13)

But although innovations and technological advances can have an impact on agriculture, the farmers’ knowledge and experience, as well as their instincts with animals and plants, remain indispensable. This is still true in the digital age – and might be truer than ever.
39 % of farmers name the costs of digitalisation as the current greatest challenge for their farm.¹

88 % of farmers think resource efficiency in agriculture is increased by digital technologies.¹

75 % of farmers think digital technologies will help them to reduce their long-term costs.¹

52 % of farmers name digitalisation as the current greatest challenge for their farm.¹

86 % of farmers think that digital technologies will help them make environmentally friendly changes to their agriculture production.¹

28 % of farmers invest in training and continuing education on digital competencies for their farms.²

¹ Bitkom Research, commissioned by DBV | n = 521 farms | Some respondents may have given more than one answer
² Product + market commissioned by Bitkom and DBV | n = 850
Working with digital precision: sowing in focus.

Increased rental costs, stricter regulations on fertiliser, consumers that demand more ecological production: Only by using operating resources efficiently can an agricultural business meet these requirements and stay competitive. One possible determining factor is site-specific farm management.

Martin Gilch operates a 90-hectare arable farm in his native Lower Bavaria. It is important to him to always look for ways to further optimise his operating results. Site-specific sowing is very helpful to him in this regard. How it works: Software generates a digital sowing map for each field section using satellite data. This map shows precisely how many seeds are needed per hectare for each field site to best utilise the yield potential. The seeder implements this recommendation, which is based on satellite data. In high-yield zones, the seed count is increased, while less seed is used in zones with lower yield potentials.

Thanks to satellite-controlled track guidance, meanwhile, the tractor itself drives autonomously, so to speak, over the field, as Martin Gilch explains: “My margin of error with the tractor is just two centimetres. The main advantage being that I can sow very precisely.” No area is sown twice and no area is missed.

As well as being supported by modern technologies, Gilch has his personal contact to rely on – a plant cultivation expert who advises him on the correct choice of seed variety and keeps him up to date on digital developments in agriculture. “One of the biggest changes I noticed is the shifting of my workplace,” says Martin Gilch. Instead of sitting on a tractor all day as he once did, he now has more free time for other activities, such as keeping on top of office work. Another advantage of digital technologies: in his case, they make his work easier and save him time.
“Digitalisation leads to better decisions in plant cultivation.”

Josef Bauer is Head of the agronomists at BayWa AG. He was agronomic supervisor of the two-year series of tests on site-specific corn sowing and managed the process up to ready for market maturity.

What is the difference between traditional and site-specific sowing?

In traditional sowing, the farmer uses an average seed rate based on his or her experience. This then applies to the entire field section. The disadvantage is that differences in the field section, such as different yield zones or soil types, cannot be taken into account. With site-specific sowing farmers can react to this by using varying seed rates. The challenge is determining the optimal desired crop densities for each zone. This determination is influenced not only by differences in the soil, but also by the characteristics of each variety of corn, because the varieties of corn react differently to different densities, both in their yield and in their quality. The plant cultivation requirements are better satisfied this way than if the farmer uses a calculation based on averages. This is also reflected by our two-year series of tests on corn, in which we were able to increase yield in the high-yield zones by around 5 percent.

BayWa offers its customers a complete package for site-specific corn sowing. What does it include?

The complete package means that the farmer no longer just buys a unit of corn, but one or ten hectares of site-specific corn sowing. In addition to the seed as a central resource, this includes a prescription map that shows the different seeding rates. Sowing is done by regional contractors if the farmer choose this service. Without having to invest in the required technology themselves, the farmers profit from the benefits of Smart Farming. This is especially of interest for small and medium-sized farms.

“Without having to invest in the required technology themselves, the farmer benefits from the advantages of Smart Farming.”

What experiences are there with site-specific sowing with other plant cultures?

We also tested site-specific sowing with cereals and sugar beet. The effects were negligible with cereals. Cereals tiller and balance thereby the different seed rates. However, with sugar beet, our observation in the first year was very promising. For clear results, however, we will need to carry out practical tests to complement the results we already have.

Digital sowing map: The optimal use of yield potentials

The basis for calculating a digital sowing map is the TalkingFields (TF) Base map. It is a result of the geostatistic analysis of satellite data over several years and shows the statistics-based relative biomass differences and therefore the long-term yield differences of the field section.* The above can be seen in the following corn field example:

The darker a site, the higher its yield. If 9 seeds/m² are sown in a site of the sample field, the amount in the high- and low-yield zones will be adjusted using the yield potential to 11 seeds/m² (red) and 7 seeds/m² (dark green).*
Stefan Hollfelder manages his fourth generation family business in the Upper Franconian town of Litzendorf, calling himself a “passionate farmer”. The young farmer faces great challenges in taking care of his 170 dairy cows: What basic components are the right ones and how can these be put together to create the best possible feed ration? “There is a very fine line we tread in both making sure the animals are in the best health and farming efficiently.”

To cope with this balancing act, ration calculation programmes such as fodjan smart feeding are here to help. In addition to milk yield, the internet-based software takes into account costs such as the effect of the feed on the health of the animals. With one mouse click, Stefan Hollfelder can get an overview on his computer of all the relevant data, the feed rations in the right composition and a detailed overview of his stock. This helps the young farmer to find the ideal balance between efficiency on his farm and the health of the animals. The interface with the feed mixer allows him to balance target quantities and actual feed quantities. “Before, my parents had to take thousands of notes by hand. Now, farmers are high-tech managers that can call up lots of important information from electronic datasets. Our life and work have been made significantly easier thanks to digitalisation.”

If so desired, Stefan Hollfelder can also give authorised third parties access to his data. This is how, in the digital age, he stays in direct contact with his BayWa consultant who is there for him if he has any questions about feed. The young farmer is completely convinced: “The feeling a farmer has for nature, for the field and for the animal can never be captured by technology. A farmer’s intuition and experience are irreplaceable.”

Smart Feeding: working towards optimal feeding.

Optimal feeding is an absolute requirement in livestock farming, both for the well-being of the herd and to ensure the quantitative and qualitative best possible milk and meat yield. New software offers solutions to this challenge.

“Our life and work have been made significantly easier by digitalisation.”

Stefan Hollfelder, farmer
Save costs and improve nutrient balance with optimised feeding.

Better feed efficiency and less nitrate and phosphorus in the soil – optimised feeding also helps farmers comply with the German Fertiliser Ordinance (DüV). The animals are fed optimally and their nutrient excretions are reduced. The farmer cuts costs at the same time.

Save costs and improve nutrient balance with optimised feeding.

With 100 cows the farmer saves the feed costs for every tenth cow.

Using feed management software fodjan, farmers can achieve an average saving in feed costs of more than 10 percent** – while maintaining perfect animal health and the same milk yield.

Operating principle: All the relevant data at a glance.

fodjan allows simple interfaces to other platforms and programmes, so all the relevant data, from the feed to the milk yield, are bundled together and can be viewed at a single glance. If desired, other farm employees, or a vet, can see the data to check the rations and their quality and to warn of any health risks with regard to animal welfare. Feed certificates from laboratories can be uploaded to fodjan directly using the interface, which provides a better overview. The network connection with the feed mixer means target quantities and actual feed quantities can be balanced. Constant expansion of the interface to further technologies and devices means the farmer gets more accurate information all the time. Finally, the farmers’ feed dealer and consultant can see all the data and give the farmer important information on rationing or quality – but only if the farmer wants this to happen. This is because with fodjan, the farmer is the sole master of his data and decides with whom and how much information to share.
Rudolf Paukert manages two arable farms in Bavaria and Thuringia. It is important for him to have access to reliable and secure software for the planning of production processes and for farm management purposes. By providing comprehensive and largely automated data collection, farm management systems help overcome the strict documentation requirements associated with the German Fertiliser Ordinance (DüV). “Compared to before, this has made documentation much more easier and quicker to create,” Rudolf Paukert says. In the past, his father would usually take notes by hand. Today, data is partly saved and analysed automatically using software solutions such as NEXT Farming from the BayWa subsidiary FarmFacts.

NEXT Farming has special applications for fertilising that for example give economically and ecologically optimal recommendation for fertiliser requirements. For every field section, the programme calculates how the regulated amount of fertiliser should optimally be used under the relevant regulations. Amongst other things, natural nutrient supply from the soil, regulation of fertiliser and crop rotation is taken into account in order to achieve the best possible yield and protect the environment. Farmers can additionally create a prescription map on the basis of these results and spread fertiliser on a site-specific basis.

Data security has the highest priority in FarmFacts’ farm management system: Rudolf Paukert is always the sole master of his own data. If data is transferred to make the best use of the software modules, he will always be asked and must actively agree.

“Compared to before, documentation is much more easier and simpler to create.”
Rudolf Paukert, farmer
It costs farmers money to make their business fit for the digital age. Do smaller farms lose out through digitalisation?

Farmers who started precision farming in the past 15 years have actually had to invest in expensive equipment and software. Since 2015, however, the importance of online systems has grown and provides two crucial advantages.

First of all: While the farmer must make an investment at the outset in order to be able to use a programme, online system costs only arise with actual use – this is comparable to sending an MMS with a mobile phone. Secondly: Associated costs depend on the extent of use; for example, the number of hectares, as opposed to a lump-sum fee. This reduces the barrier to entry considerably, especially for smaller farms.

"The barrier to entry is reduced, especially for smaller farms."

Dr Josef Bosch is Head of FarmFacts Academy and is a farmer himself. This means that he knows where the real problems lie. With the FarmFacts Academy, he gets his colleagues in the business ready for digitalisation.

How can digitalisation specifically support farmers?

In the German Fertiliser Ordinance (DüV), for example, the state specifies fixed limits for nitrogen and phosphorus output. If the farmer carries out the nutrient requirement calculation for N and P using digital solutions, they can reduce the efforts involved in ensuring compliance with the German Fertiliser Ordinance (DüV) to a minimum – and can even achieve better results than those required by legislation. The crucial factor is that the solution is not an isolated application but is instead incorporated into a farm management system. This means the farmer can continue to digitally evaluate the data entered in the field card index when creating a nutrient mass balance, for example.

Who does the collected data belong to and who has access to it?

With FarmFacts’ software solutions, the farmer is always the owner of his data. If data is transferred to provide optimal use of software features, the farmer must always actively consent.

In contrast to FarmFacts’ farm management systems, there is software available that is free of charge. Why do you advise against using this?

Free products in this sector should cause the customer to question how the vendor makes their money and whether they have a business model that involves processing the farmers’ data. With FarmFacts’ farm management systems, farmers can be absolutely sure that their data will always be theirs.

"Digital solutions keep the efforts associated with complying with the German Fertiliser Ordinance to a minimum."

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Fertiliser requirements at the press of a button.

When determining the amount of fertiliser required by the NEXT Farming software, the legally permitted quantity of nitrogen and phosphorous (along with potash) is calculated at the press of a button. The farmer is led step by step through the menu, chooses the relevant field section from the overview and gives the system the following parameters: Federal state, type of crop, target yield, result of soil tests, information on crop residue, catch crops and organic methods of fertilisation. The result of the fertiliser calculation can be output as a PDF file. The farmer can download this file, print it and file it for case of inspection.
“Without expertise in plant cultivation, a data platform has no added value.”

Despite its advantages, many farmers shy away from investing in digital farming. One of the main reasons is the lack of compatibility between agricultural machinery and software – closely followed by insufficient broadband coverage. Chief Digital Officer Jörg Migende explains what BayWa is doing to eliminate this obstacle.

Why is a lack of machine compatibility a problem in agriculture?

In the past, agricultural equipment manufacturers developed their own data formats, expecting to thus be able to bind customers to their brand. But farmers want to be able to freely choose which machines they buy. This has made the machinery found on farms very diverse.

The smooth data transfer between machines is only half the battle if the data that is collected is of no use on the farm.

Six leading agricultural equipment manufacturers see this problem and are having a cross-manufacturer machine data management system developed by BayWa subsidiary FarmFacts. The system for example documents what happens on the fields, the quantity of operating resources to be used, how much work has been done on the field and where the machines are currently located. The data collected has even more uses for the farmers if they use other applications within the NEXT Farming software, which is designed to be modular.

“With a manufacturer-independent machine data management system, it no longer matters which manufacturer the farmer prefers – it just works.”

For example?

Imagine a farmer is planning his fertilisation activities. They include satellite data because the farmer would like to work site-specifically. He sends the prescription map directly from his PC to the machine. The machine, in turn, reports back how much fertiliser was used after fertilisation has been completed. The documentation which the farmer would previously have had to create by hand in the evening, at the weekend or on holidays, is produced almost autonomously. This process has worked well until now with individual brands. With FarmFacts’ machine data management system, it doesn’t matter which manufacturer the farmer prefers – it just works.

And how does the agricultural equipment manufacturer benefit? They are always in competition.

The agricultural equipment manufacturers will have to bravely acknowledge that it is very difficult nowadays to bind farmers to a brand, at least in Western Europe. They have also acknowledged that a pure data platform without any expertise in plant cultivation and customised applications offers no added value for farmers. The agricultural machinery is part of a process chain in a farm and, as with Industry 4.0, the chief task is to save processing costs.

Will the consumer accept a farm that is automated like this?

There was similar scepticism with milking robots. The fact is that it is mostly family farms that use these technologies because they can scale their costs better. To increase acceptance with consumers, we will have to emphasise the results much more. Digitalisation in animal farming can help, for example, to recognise illnesses early and minimise the use of antibiotics. In plant cultivation, field weeding robots could contribute to reducing operating resource use.

Top 3 barriers to investment in digital farming:

- High costs of acquiring the technology: 76%
- Uncertainty of return on investment: 54%
- Poor compatibility of agricultural machinery and software, as well as a lack of technical standards: 50%

Source: pwc | n = 100 farms | Some respondents may have given more than one answer
When every minute counts: workshop service in the digital age.

The time factor is becoming more and more important in agriculture. Faulty equipment and machines delay processes and can lead to significant financial losses if they are out of operation for longer periods. This means easily accessible round-the-clock service from a nearby workshop that can offer quick and simple help on-location day and night is becoming more and more important.

Georg Gruber knows the problems that a fault with equipment and machines can bring only too well. Last summer, his tractor unexpectedly failed, and of course, it happened just at the wrong time. "When you want to make the best use of three or four days of sunshine to mow the meadow, mechanical problems like this aren’t just a nuisance," says the west-Munich farmer. "A failure like this costs money, and the longer the machine is out of operation, the more it costs."

In these situations, it is all the more important for farmers to have a workshop they can trust and that can be reached around the clock – with a repair service whose employees can not only be at the farm quickly and with the latest technology, but who are also specialists with the right instincts and the right vocabulary. This is why, as manager of a BayWa workshop for agricultural equipment and machines, Daniel Sander not only offers a 24-hour service for the machine, but also often calms the farmers’ nerves with the help of his colleagues. “People in our line of work have to be computer specialists nowadays. It’s important that we can react to problems rapidly on-site.”

Thanks to new technologies and more effective data transfer, replacement parts turn up much more quickly than they did just a few years ago. "In the past, we sometimes would have had to wait for a very long time," says Daniel Sander, "but now it happens overnight." The BayWa location in Franconian Röthelein can accept orders until 8 p.m. during the harvest, and not only from workshop managers like him, but from farmers as well. The part requested is delivered the next morning at 7 a.m.

Digitalisation will continue to pose challenges for farmers and workshops alike. Personal contact between farmers and mechanics will remain indispensable, along with easily accessible service and quick repairs. From person to person.

"People in our line of work have to be computer specialists nowadays. It’s important that we can react to problems rapidly on-site."
Daniel Sander, workshop manager
Digitalisation is changing the way we communicate, the way we obtain information and the way we shop – even in the agricultural world, this is increasingly happening online. Despite this, BayWa continues to invest in its resources on-site at its locations. Is this a contradiction?

BayWa has its roots in various regions. Even in the digital age, it is important for us that we maintain personal contact with farmers, which we achieve through our comprehensive service network and the modernisation of our locations. However, there are more and more farmers who want to get in contact with us or get advice outside of business hours, for reasons to do with their own time management. The younger generation especially takes care of the majority of its tasks online, gets its information online and places orders on the internet. With the BayWa Online World, in the future we will offer a digital closeness in addition to the personal closeness that is already our focus. The crucial point is that BayWa can respond whenever farmers need something – whether in person or via an online chat.

What use is the BayWa Online World to farmers?

The BayWa Online World will be the farmers’ personal control centre. The customer can see their receipts, invoices, contracts and personal information, and of course, they can buy products and services as well. They can also get important information to manage their business: from current weather and stock market data to the fill level of their heating oil and feed silos.

Who benefits from that – traders or farmers?

Digitalisation allows us, as agricultural traders, to meet farmers’ changing needs on an individual basis. But we can only do that with the right mix of digital and personal closeness. Agriculture is a global business. We always start our thought processes with the customer and ask ourselves what farmers need to be able to do business successfully on the international stage, and how we can support them in optimising their production processes and use of operating resources. That means that when our customers succeed, so do we.

What part will humans play in the future if agriculture is increasingly digitalised?

The human factor will always play a role in a sector in which we work together with nature. Digital solutions will never replace humans, but will support them in drawing better conclusions from the wealth of information that is available.
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