TAB OFFICE OF TECHNOLOGY ASSESSMENT AT THE GERMAN BUNDESTAG

Digitisation of agriculture: societal preconditions, frameworks and effects

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Summary

- In agriculture, digitisation opens up new opportunities for data-based control of production processes.
- This is linked to the vision of systemically interlinking and integrating agricultural machinery and processes – not only at farm level, but across the entire upstream and downstream value-added chain.
- The digital transformation has an impact on business models and business relations in the agricultural sector.
- In view of the ongoing agri-structural change in Germany, it is considered to be important to remove obstacles especially for small and medium-sized farms, so that they can sufficiently participate in digitisation.

What is involved

The technical state of development of digital agricultural technologies is already at an advanced stage (see TAB-Fokus no. 31). Milking and feeding robots are widely used in livestock farming. In crop cultivation, certain sensor systems for site-specific management and automatic steering systems are already state of the art. However, all these systems are still individual applications that are largely used as stand-alone solutions. The greatest potential for optimising agricultural processes is seen in the systematic data-based interlinking and integration of these individual technologies at farm level (and beyond).

With regard to the feasibility as well as the implications of this vision of systematic integration towards a comprehensive digital network, many questions still remain unanswered. Thus, new service providers – some of them even from outside the sector – are entering the market with data-based business models. This might lead to a fundamental restructuring regarding the conditions of competition and the market. On the one hand, the issue of data sovereignty will play an important role for future development. So far, there is often legal ambiguity about who is allowed to dispose of data collected on farms. On the other hand, the smaller farms in particular are facing major challenges. Due to economies of scale and economic viability thresholds, the acquisition of digital equipment often only makes sense for farms of a certain size. As a consequence, it is much more difficult for smaller and medium-sized farms to benefit from the potential economic advantages of digitisation.

Digital transformation in agriculture

In addition to agriculture, the agricultural sector generally includes upstream and downstream sectors of the value-added chain such as e. g. seed producers, agrochemical companies, the agricultural machinery industry, food industry and food trade. Since the 1980s, all of these sectors have been characterised by continuing processes of concentration, which have led to a few global players dominating a major part of the market.

In the course of digitisation, a large number of new companies with innovative digital products and services have been entering the market for some time already. The development is significantly characterised by the fact that more and more data are collected directly at the agricultural machinery and on the farm. These data are transmitted and shared between various actors, e. g. consultants, contractors and other service providers, suppliers of production equipment. The so-called farm management systems play a key role in the processing of farm and machine data at farm level. These systems are software solutions with a wide range of functions that are intended to support e. g. documentation and operational planning.

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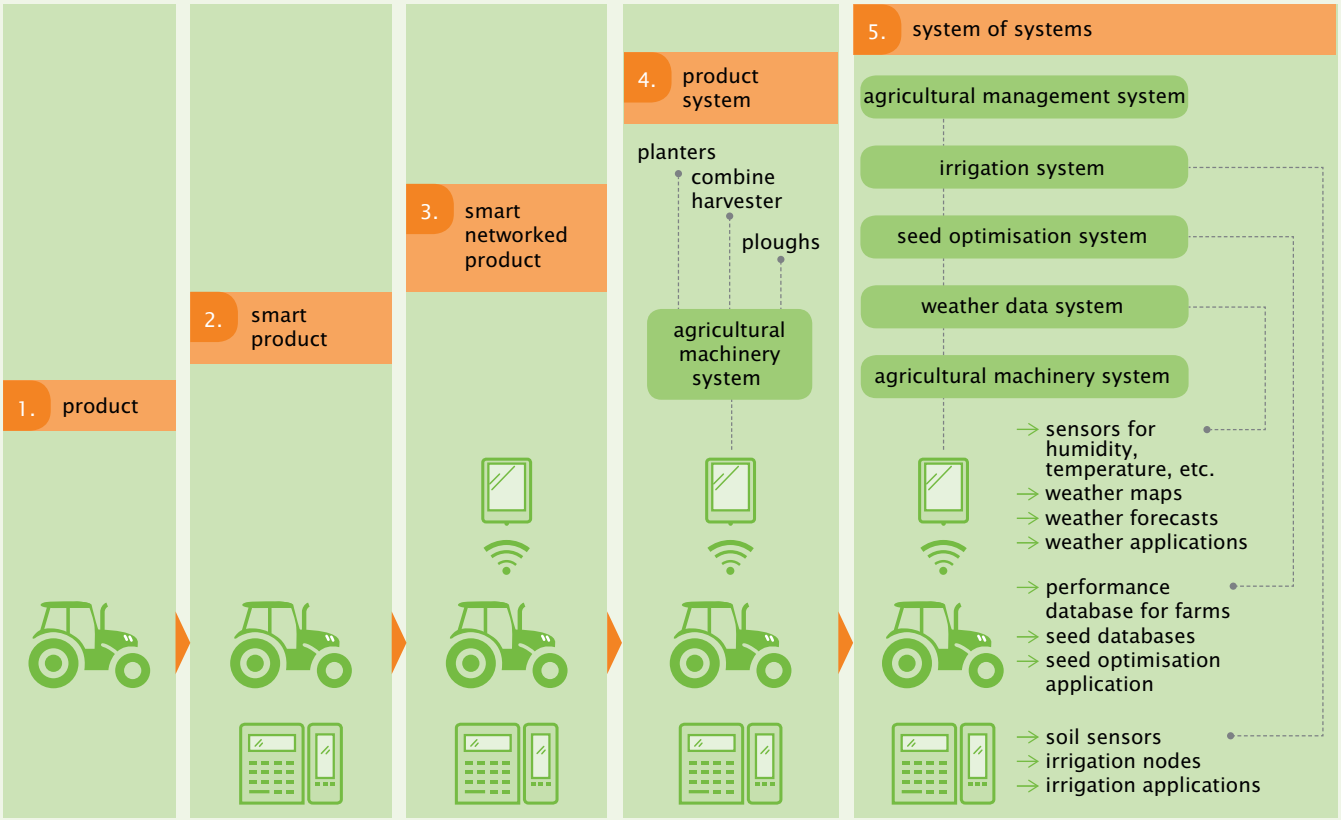
Development stages of digitisation in agriculture



Almost all farm management systems no longer store data locally on the farm PC, but on a remote network server. This enables cross-user data aggregation and analysis and, based on this, the intelligent networking of individual digital technologies into machine systems – right up to machine systems that communicate with each other (see figure for a system of systems). Thus, farm management systems are increasingly acting as data platforms and are becoming a hub for digital value creation in the agricultural sector. In this context, the question of who owns the operational data and who is allowed to use them commercially is becoming ever more urgent (box).

Typically, the platform economy is characterised by network effects. The more data and the more market participants come together on a platform, the greater the potential added value for the users and thus ultimately also for the operator of this platform. This is one of the reasons why the market dynamics are particularly pronounced in newly emerging platform markets and why the long-term tendency towards market concentration and even monopolisation is particularly strong. As a result, the agricultural sector is undergoing a fundamental transformation process that is calling established market structures into question. In order to keep up with the changes involved, most traditional players are now building up their own digital divisions or have already done so.

New digital business models and data sovereignty

With the increasing spread of farm management systems, the question of who may dispose of the data stored on the platforms and profit from their commercial exploitation is becoming ever more urgent. This aspect is negotiated under the concept of data sovereignty. It is to be understood as the right of individuals to have self-determination over the data generated by themselves or concerning themselves, i. e. to decide on the type, extent and purposes of their use and to be able to exclude others from the use of these data. According to surveys, there is great concern among farmers about a loss of data sovereignty.

However, there is currently no legal regulation – neither at national nor at the European level – stating according to which standards data are to be assigned to a certain legal subject. In literature, various legal approaches have been controversially discussed for some time on how such a property-like right to data could be justified – but so far without finding a satisfactory solution. To date, regulation is only possible via contractual agreements between the parties involved (e. g. within the framework of general terms and conditions). According to the current legal situation, providers of farm management

Figure: Porter/Heppelmann 2014, p.12 f., adapted by BMEL 2016, p. 9

Effects for farms and agricultural structures

The prospect of increasing efficiency and possible savings is one of the big promises of digital agricultural technologies and makes them economically attractive for farms. At the same time, however, their acquisition is partly associated with high costs. Whether a corresponding investment is economically viable depends essentially on whether the realisable efficiency and productivity gains outweigh the additional costs incurring over the useful life.

In this context, i. a. the farm size is a decisive factor. For larger farms, a higher machine utilisation can be assumed, so that they are more likely to be able to amortise the costs incurred. On the other hand, especially family farms often do not reach the minimum farm size required for an economic use. Against this background, it is assumed that in the course of automation and digitisation, the economic pressure on smaller and medium-sized farms might grow, thus exacerbating the continuous structural change that agriculture has been undergoing for decades. A central feature of structural change in agriculture is the decrease in the number of farms – with average farm sizes increasing at the same time.

Various causes – some of which are closely interwoven – are held responsible for this ongoing agristructural change. One of the key drivers are the high productivity gains which are due to technological progress and result in falling prices on agricultural markets because of an oversupply of agricultural products. This in turn increases the pressure on farm incomes. Altogether, it is widely agreed that digitisation tends to continue to drive this development. On the one hand, this is due to the required need for investment, which will further increase the capital employed in agriculture. On the other hand, specialised and expert knowledge is needed, which is less available in smaller farms or more difficult to obtain due to the limited opportunities for specialisation of the few workers.

Limited knowledge on the distribution of digital agricultural technologies

There are still large gaps in knowledge regarding the actual distribution and use of digital agricultural technologies. In recent years, surveys have been conducted among German farms with regard to the extent to which digital agricultural technologies are used. However, since the representativeness of the survey results cannot be verified or guaranteed, the validity of these surveys is limited.

Nevertheless, some cautious conclusions can be drawn from the available studies and survey results. Thus, there are indications that some digital agricultural technologies are already being used on a larger scale. In the field of crop cultivation, this includes applications of precision farming such as e. g. satellite-based navigation and assistance systems and, in the field of livestock farming, sensor systems for monitoring animal health and behaviour as well as automation technologies such as automatic milking, feeding and cleaning machines. On the other hand, particularly innovative applications or those that require a high level of operating and data competence – e. g. methods for site-specific management, agricultural robotics, drone applications, farm management systems – are not yet very widespread in agricultural practice, although there are indications of an increasing use (especially with regard to farm management systems and drones).

It is still widely unclear which digital agricultural technologies are used to what extent in which farm types. This deficit is one of the reasons why it is hardly possible to make a valid assessment of the impact of digitisation on the competitiveness of smaller farms or on structural change in agriculture. However, representative historical data on the spread of digitisation applications are of major importance not only for the analysis of such research issues, but also for the planning and subsequent evaluation of agricultural policy measures. It would therefore be desirable for the

systems thus have almost unlimited possibilities of how they want to deal with data sovereignty contractually.

In order to strengthen farmers‹ confidence in digitisation, it would therefore be desirable to clarify quickly whether and how data ownership can and should be handled in the future. In this context, either the creation of a legal regulation on data sovereignty could be considered – although the sense and purpose of a legal solution are disputed among experts. Or, if the allocation of rights to data is to be reserved by contractual agreement solely for the parties involved, consideration should be given to amending the law on general terms and conditions in order to better cover data-specific problems and strengthen the rights of users. The promotion of open data platforms could also be a means to strengthen operational data sovereignty.cases not suitable, to address some major environmental and animal welfare issues in agricultural production, e. g. overfertilisation as a consequence of intensive livestock farming.

government to implement statistical surveys on the use of digital technologies in agriculture – as is already being done in other countries.

Ensuring access to digital technologies

There is no question that the digital transformation of agriculture requires forward-looking approaches. This is by no means only a question of technological innovation in the narrow sense. Rather, digitisation has an impact on workflows and processes on farms and the entire agricultural value-added chain – which raises manifold questions. In addition to future-proof infrastructures (broadband coverage, free availability of geodata) and clarifying the question of data sovereignty (see box), ensuring access to digital technologies in particular is a major political task.

In view of the ongoing structural change in agriculture, it is considered to be of particular importance to remove obstacles especially for small and medium-sized farms, so that they can sufficiently participate in digitisation. Here, the focus is particularly on regions with a predominance of small farm structures (southern and south-western Germany). One solution is the shared use of technologies, i. e. the partially or completely coordinated use of machines and machine capacities by several farms, with the primary objective of distributing the fixed costs incurred among several farms and achieving a better degree of utilisation. This practice is already widespread in the form of machinery rings as well as machinery co-operatives, but a stronger orientation towards digital services (Machinery Ring 4.0) would be necessary. It should be noted that collaborative work is not equally suited for all digital technologies and is also associated with restrictions on farmers' internal decision-making autonomy.

Moreover, it is important to strengthen training and consulting. In view of the challenges of digitisation, many family farms have an increased need for advice before, during and after the digital transformation. In times of digitisation, agricultural consulting is more than ever confronted with the task of developing individual solutions that are tailored to the specific needs of the farms. So far, there is still a lack of practical experience as to how the benefits of digitisation can also be tapped by small and medium-sized farms. In this regard, it would make sense to establish and maintain demonstration farms, such as those already successfully operated and used at colleges and universities. By highlighting examples of best practice, such demonstrations could serve as platforms for education and training as well as for targeted advice to farms.

Finally, a proven instrument to support the modernisation of agricultural production and promote the deployment of new technologies is government investment subsidies. By granting subsidies for the acquisition of certain technologies, their investment costs decrease. Thus, there is a chance that the technologies will become profitable for a larger number of smaller farms, since with lower fixed costs, the economic viability threshold will also be lower. In principle, however, the granting of investment subsidies is only recommended for those agricultural technologies that have a proven operational benefit and offer positive environmental or animal welfare effects.

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Digitalisierung der Landwirtschaft: gesellschaftliche Voraussetzungen, Rahmenbedingungen und Effekte

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www.tab-beim-bundestag.de/english/projects_digitisation-of-agriculture.php

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