

Digital technologies in agriculture and their use

2.1.2



Dear students,

in this part of the course, we will look at what specific digital tools and technologies even a small farmer can use to improve their production, save water, land and labour. Some of the terms may seem new or technical to you – but don't worry, we will explain everything simply and with practical examples. While reading, I recommend you pay attention to:

- **what each technology is used for (e.g. sensors, drones, GPS),**
- **how they complement each other (e.g. sensor → application → recommendation),**
- **what benefits they bring to smaller farms.**

As you study, try to imagine what you could use in your environment – even on a small scale. Focus on what makes sense to you. There's no need to implement everything at once – the key is to start with one small change that makes your daily work easier or saves you money.





Study text

Precision agriculture uses several main types of tools that complement each other and create a functional system.

Sensors, also known as **IoT sensors**, are placed in the soil, environment, storage areas or directly on animals. These sensors record values such as humidity, soil and air temperature or nutrient content, providing important information for decisions on irrigation or fertilization.

In the case of sensors on animals, the health and activity of individual animals can be monitored. All this data is usually transmitted wirelessly to a central system, where the farmer can monitor it in real time and react to any deviations (IoTPort, n.d.). Sensors placed in the soil, greenhouses or on animals collect information on humidity, temperature, pH or movement. This data is transmitted in real time to a computer or mobile application. The advantage is that the farmer can react quickly and accurately – for example, based on a warning that the plants are suffering from drought (European Commission, 2020).



GPS technology and satellite navigation ensure the precise location of agricultural machinery and land. Tractors equipped with these systems can maintain an optimal route when working in the field with a deviation of only a few centimetres, which minimizes overlapping or missing areas when applying fertilizers, sowing or spraying. Farmers can also use GPS to create digital maps of their land and record their production characteristics. Satellite images from programs such as Sentinel provide an overview of the state of vegetation and help with targeted interventions (ZD Sloupnice, n.d.; IoTPort, n.d.).

Drones, or unmanned aerial vehicles, offer the possibility of rapid and detailed survey of large areas of agricultural land. They are equipped with cameras or sensors that can scan vegetation in various spectra – including infrared – and thus detect, for example, areas affected by diseases, pests or areas of stress with a lack of moisture.

More advanced models allow the application of preparations or fertilizers with high precision directly to endangered areas. Although drones can be financially demanding for small farmers, there are “drone as a service” services that allow their short-term rental (Farmy Stejskal, n.d.).

Automation and robotics are increasingly being used in precision agriculture. Self-driving machines, robotic seeding systems or electric weeders work independently based on instructions from digital maps and sensors. In the field of livestock production, automatic milking systems are common, which themselves recognize the appropriate time to milk each cow. Even smaller farms are already using small electric robots for vegetable production, thus saving labour and increasing the accuracy of interventions (Agromanual, n.d.; Farmy Stejskal, n.d.; Geopard, n.d.).

Satellite and drone data

Thanks to satellite images or drone footage, it is possible to monitor the development of vegetation, soil moisture or temperature differences between individual parts of the field. The output is so-called yield maps, which show where crops are doing better and where they need help. Based on these maps, it is possible to target fertilization or irrigate only the weaker areas (ESA, 2023). Data processing and smart applications then enable the collected information to be transformed into specific recommendations.



Farm management software

Digital farm management tools allow you to record interventions, track costs, compare yields, plan crop rotations, and other activities. Some of them (e.g. Agdata, CleverFarm) work without the Internet or have offline modes (CleverFarm, 2023). For a small farmer, the advantage is the ability to have an overview of the entire farm in your pocket. Specialized software platforms such as Agdata or CleverFarm provide farmers with a comprehensive overview of field conditions, weather forecasts, and vegetation development. Users can create maps for targeted fertilization, receive alerts, or recommendations based on sensor data.

Many of these tools work directly in mobile applications, which allows for flexible and easy use even in the field (IoTPort, n.d.; Geopard, n.d.).

Artificial Intelligence and Modeling

AI can analyse large amounts of data and use it to predict risks – for example, the occurrence of pests, diseases or drought. In combination with cameras, it can recognize weeds and replace the use of herbicides. In animal production, AI evaluates animal movement, feed intake or body temperature (FAO, 2022).

Variable input applications

Using field condition data, fertilizers, sprays, or irrigation can be precisely dosed to suit a specific location. Instead of blanket application, inputs are adjusted to current needs – reducing chemical consumption and costs (UNDESA, 2021).





Summary

Agriculture 4.0 means not only modernizing technology, but also changing thinking. Precision farming allows you to better understand nature and adapt to its changes. For small farms, it can be the path to competitiveness, self-sufficiency and ecological balance. The key is to choose the right combination of technologies, start gradually and learn as you go. To make the most of technology, you need: a good internet connection – for collecting and sharing data, access to information and advice – so you know what makes sense for you, and sometimes financial assistance – for example through subsidies or projects.

A smart countryside is no longer a dream. In some villages you can already commonly find:

- **sensors in the fields,**
- **automatic irrigation,**
- **robots in stables,**
- **drones for vegetation control,**
- **satellite monitoring of crop development,**
- **and smart mobile applications.**



All of this can help you do things faster, cheaper, more environmentally friendly – and you still have everything under control.

