

How to store, read, sort and evaluate data in precision agriculture



2.3.1



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Dear students, welcome to the first chapter!

In this section, you'll learn how to collect, store, sort, and interpret agricultural data effectively.

- **Focus on understanding where data comes from and how to keep it secure and organized.**
- **Pay attention to tools like CleverFarm or Agdata that help visualize and use data easily.**
- **Practice reading NDVI maps and recognizing patterns in yield data.**
- **Think about how you could apply these techniques on your own farm, even with basic tools.**



Study text

Data-driven agriculture, often referred to as "smart farming", is where farmers make decisions based on information from various data sources (Wolfert et al., 2017). Today, the modern farmer does not have to rely only on intuition or experience from past years. Thanks to data, he can base everyday decisions on concrete information – and thus make work more efficient, reduce costs and increase environmental friendliness (CleverFarm, 2023; Farmonaut, 2024).

It is not just about collecting data, but also understanding it and actively using it. This means that the collected data needs to be used meaningfully. Such an approach leads to improved business results and greater sustainability.



Key types of decisions can be supported by data, such as crop selection, planting dates, irrigation, yield predictions. Collecting, processing and evaluating data helps farmers make better decisions.

The benefits of data analytics for small farmers

1. Saving time and money

 **No more blind experiments. You only apply fertilizer where it really makes sense. You start watering at the right time – and you don't waste it.**

2. Higher yields without more effort

 **Thanks to data, you can better plan sowing, variety selection, and agrotechnology. Data "sees" what the eye misses – such as plant stress or compacted soil.**

3. Greater environmental friendliness

 **Less fertilizers, less spraying, less burden. Data-driven decisions lead to more precise interventions and benefits for the landscape and water resources.**

4. Easy to use

 **Intuitive applications (e.g. CleverFarm, Farmonaut, Agdata) will guide you step by step. No IT team needed – just the desire to get started.**

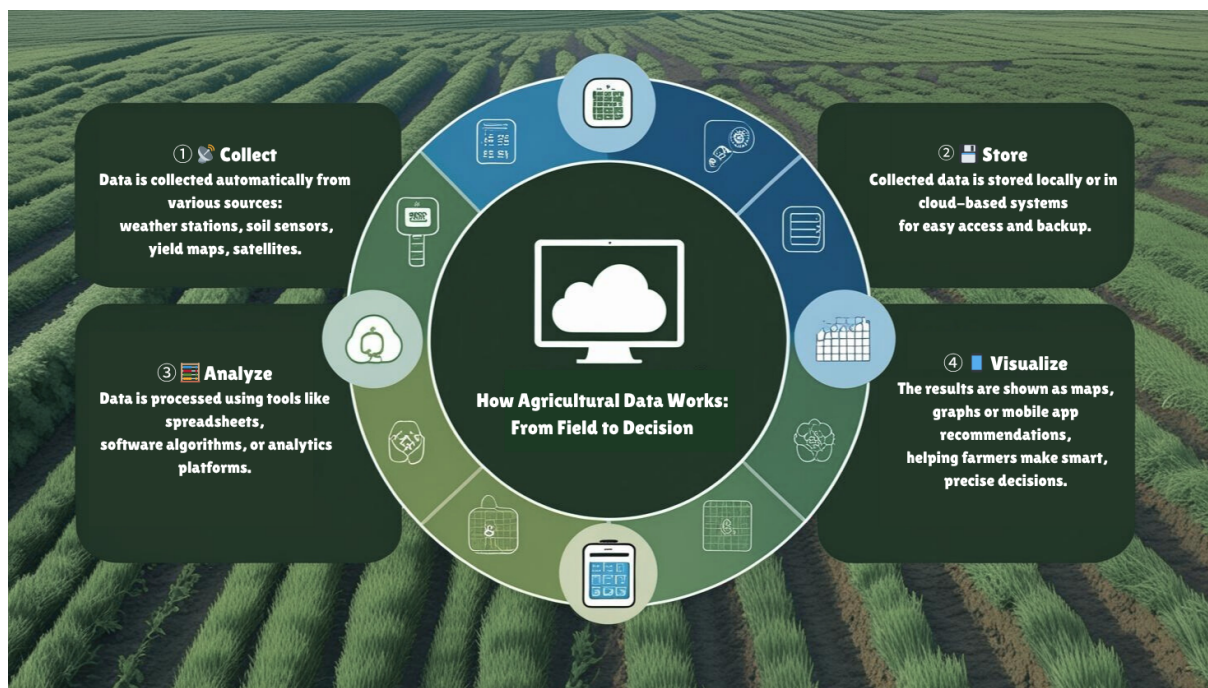
5. Track yields and trends over time – predict yields and crop health

Simple records of yield in different parts of the field help in variety selection, crop planning and assessment of long-term changes. By analyzing historical yields and current drone or satellite images, future yields can be predicted and diseases or pests detected early (Mulla, 2013).



Where does the data come from and where is it stored?

Data comes from a variety of sources – such as weather stations, soil sensors, yield maps, or satellite imagery.



💡 **Example: The [CleverFarm mobile app](#) displays an overview of the moisture status in individual parts of the field. Thanks to this, the farmer knows to start irrigation only in part B1 – not on the entire area (CleverFarm, n.d.).**

- **IoT sensors: soil sensors, weather stations, hygrometers.**
- **Drones and satellite imagery: also as a service (e.g. “drone as a service”).**
- **Mobile application: crop growth measurement, manual data entry.**
- **Free public data: e.g. Sentinel, CHMI, soil map data (e.g. BPEJ).**

1. Where and how to store data – the first step to analysis

 **Local storage (laptop, external drive)** – the advantage is that they are not dependent on the internet. – the disadvantage is the risk of loss (e.g. damaged drive or theft).

 **Mobile device** – ideal for collecting data in the field (e.g. Farmonaut, Agdata applications). – limited space and greater risk of loss.

 **Cloud storage** (e.g. Google Drive, Dropbox, OneDrive) – data is accessible from anywhere and can be easily shared. – automatic synchronization, usually free in the basic version. – a strong password and two-step verification are important for security.

 **Recommendation: Combine cloud (for accessibility) and local backup (for security).**

 **Why is it important to sort and organize data?**

If a farmer records yields, crop photos, weather station records, or fertilization history, a system is essential. Without it, the data will be lost or impossible to analyze later.

Examples of organization:

- **folders by year / crop / plot**
- **filenames with date and data type (e.g. NDVI_2024_05_Svahy.png)**
- **notes for each record (e.g. in Excel or an application)**

 **Thanks to clarity, the farmer can:**

- **to track development over time,**
- **reveal patterns in fertility or the need for fertilization,**
- **argue when dealing with authorities or customers.**

 **Backup and security**

- **Backup is essential. Every record should be saved in at least two places (e.g. on a laptop and in the cloud).**

Safety principles:

- use strong passwords (a combination of letters, numbers and symbols),
- back up data regularly (e.g. once a week),
- Use two-step verification where possible.

! Warning: Data loss can mean losing an entire year's worth of revenue records, making bad decisions, or even causing a problem during an audit.

Tool demonstrations with intuitive controls even without professional training

- All tools can also be used on mobile – an advantage for small farms without IT facilities.
- You don't need expensive computers or complicated installations.
- Many applications have a national interface and offer technical support.
- Most basic functions can be handled by a user without previous experience.

→ 1. [CleverFarm](#) – sensor monitoring, graphs, notifications.

- monitors data from sensors (humidity, temperature, precipitation),
- offers clear graphs and automatic notifications (e.g. "it's time to water"),
- allows you to plan fertilization or plant protection based on real conditions.

 **Advantage: Works on mobile, clear interface in Czech.**

2. [Agdata.cz](#) – records of land, yields, weather.

- helps to record land, yields, fertilizer applications, but also weather,
- allows planning of activities (e.g. sowing, spraying) and keeping records for ecology, clear calendars and map views.

 **Advantage: The user interface is adapted to Czech conditions and smaller farms.**

3. Farmonaut – free satellite images and NDVI map.

- provides free satellite images – including the NDVI index for monitoring vegetation vitality,
- warns of problems in the field (e.g. dry or infected areas),
- it doesn't require any devices – just the internet and a mobile phone.

 **Advantage: Free basic version, suitable for starting without investment.** 
farmonaut.com

4. GeoPard – zoning, yield maps, historical data.

- can create historical yield maps, divide fields into zones and show their development over time,
- combines data from different seasons – helps to find weak and strong points of the field,
- enables targeted fertilization planning or variety selection.

 **Advantage: Combination of visual maps and analytical outputs.**



Visual tools: colorful maps and graphs

Modern tools for working with agricultural data often use colored maps and simple graphs. They may look complicated at first glance, but in reality they work like a colored traffic light – green = all is well, red = attention, problem.

What is an NDVI map?

NDVI (Normalized Difference Vegetation Index) is a vegetation index that shows how healthy and actively growing the vegetation is.

What do the colors mean:

Dark green – healthy and dense growth.

Light green/yellow – average condition, may need intervention.

Red – weak growth, drought, diseases or pests.

Gray – no vegetation (e.g. post-harvest or unplowed fields).

✓ From practical experience: On a Czech organic farm near Nymburk, the NDVI map from Farmonaut helped reveal that the left edge of the field was suffering from drought. Thanks to this, drip irrigation was added to this area. (Farmonaut, 2024)

What is a zone map?

A zone map divides a field into sections based on yield or crop health. These zones can be: permanently profitable (dark green), fluctuating (yellow), problematic (red).

📌 This information helps you decide where to invest more (e.g. fertilization) and where to save.

 Practical example from Bavaria: A small farmer used the Geopard zone map for barley sowing. In the lower yield zone, he reduced the seeding density and adjusted the fertilization. The result was a 15% increase in yield at lower costs (DLG, 2023).



How to understand graphs?

- **Charts in tools like Agdata or CleverFarm tend to be simple:**
- **The columns show the yield in tons or soil moisture.**
- **Lines show temperature or precipitation.**

 **Example: If humidity dropped below 20% in June and yield decreased at the same time, it may be a result of drought – the graph visualizes this.**

Tips for reading visualizations:

- **Start with colors – green = good, red = problem.**
- **Monitor changes over time – is the situation getting worse?**
- **Focus on the extremes – significant jumps are a signal for action.**
- **Don't focus on "accuracy", but on the direction of development – it is a decision-making tool, not an absolute truth.**



Summary

This chapter introduces the basics of data management in smart farming, focusing on how small farmers can collect, store, interpret, and use data for better decision-making. It explains that data is automatically gathered from sources like weather stations, soil sensors, yield maps, and satellites, then stored locally or in the cloud, analyzed using tools or apps, and visualized as maps and graphs. The document emphasizes the benefits of data-driven farming: higher yields, lower costs, better environmental outcomes, and ease of use through mobile-friendly applications. It also provides practical tips on data organization, security, and interpretation of NDVI maps and yield trends, with tools like CleverFarm, Agdata, Farmonaut, and GeoPard.

