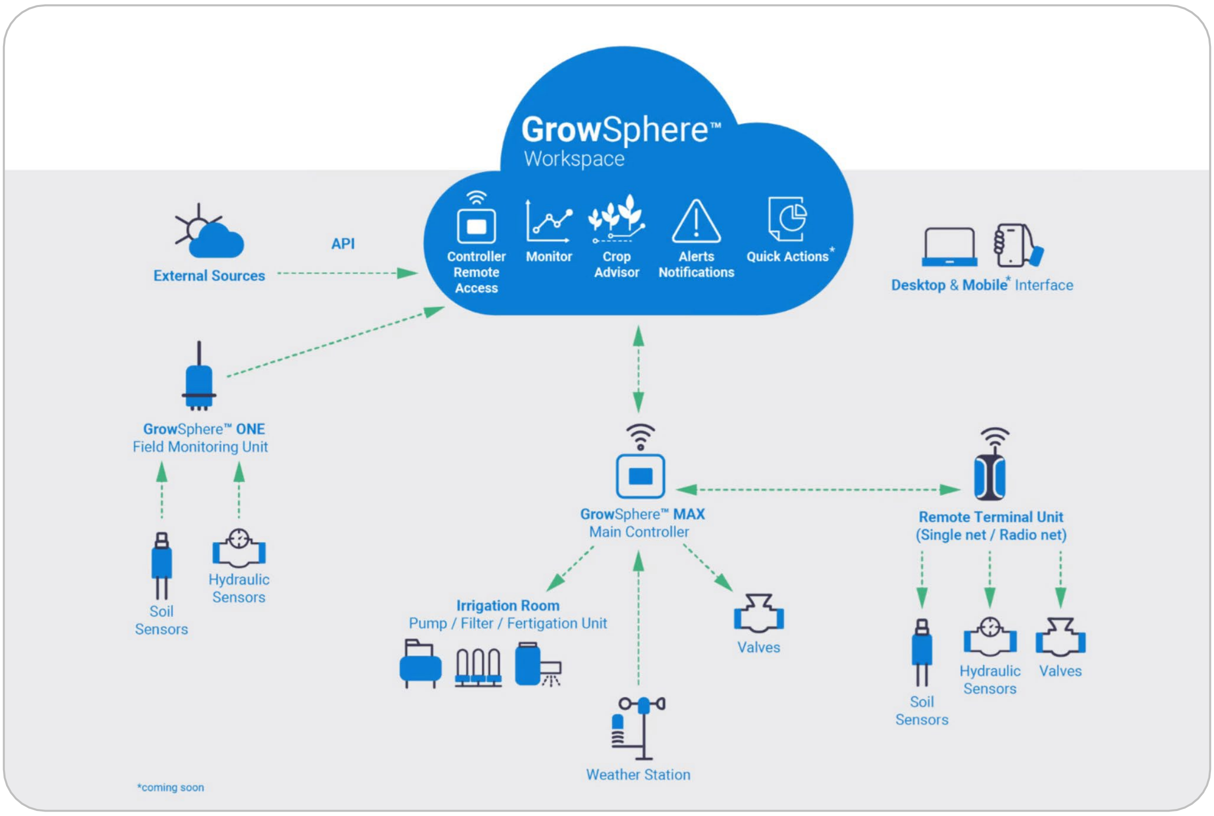
Automated drip irrigation

Technology fact sheet

What is drip irrigation?

Drip irrigation is the most efficient method to deliver water and nutrients directly to plant roots in precise amounts at the ideal time. Initially developed to combat water scarcity and optimise agricultural productivity, the most modern approaches integrate advanced digital tools, such as sensors and cloud-based platforms, to further enhance efficiency and sustainability. While this approach has already proven effective for perennial crops, it is also suitable for annual crops.

Currently, drip irrigation is widely used globally, particularly in regions with water scarcity and intensive farming. Prospective growth is centred on expanding its adoption in digital farming, where real-time data and automated systems help optimise irrigation schedules, improve traceability, and reduce resource waste. Future advancements may focus on integrating AI for even greater precision and adaptability. One example of such a digital tool is the GrowSphere™ operating system developed by Netafim. Using real-time data and advanced algorithms, it can control drip irrigation on multiple diverse plots and potentially improve irrigation and fertigation efficiency.



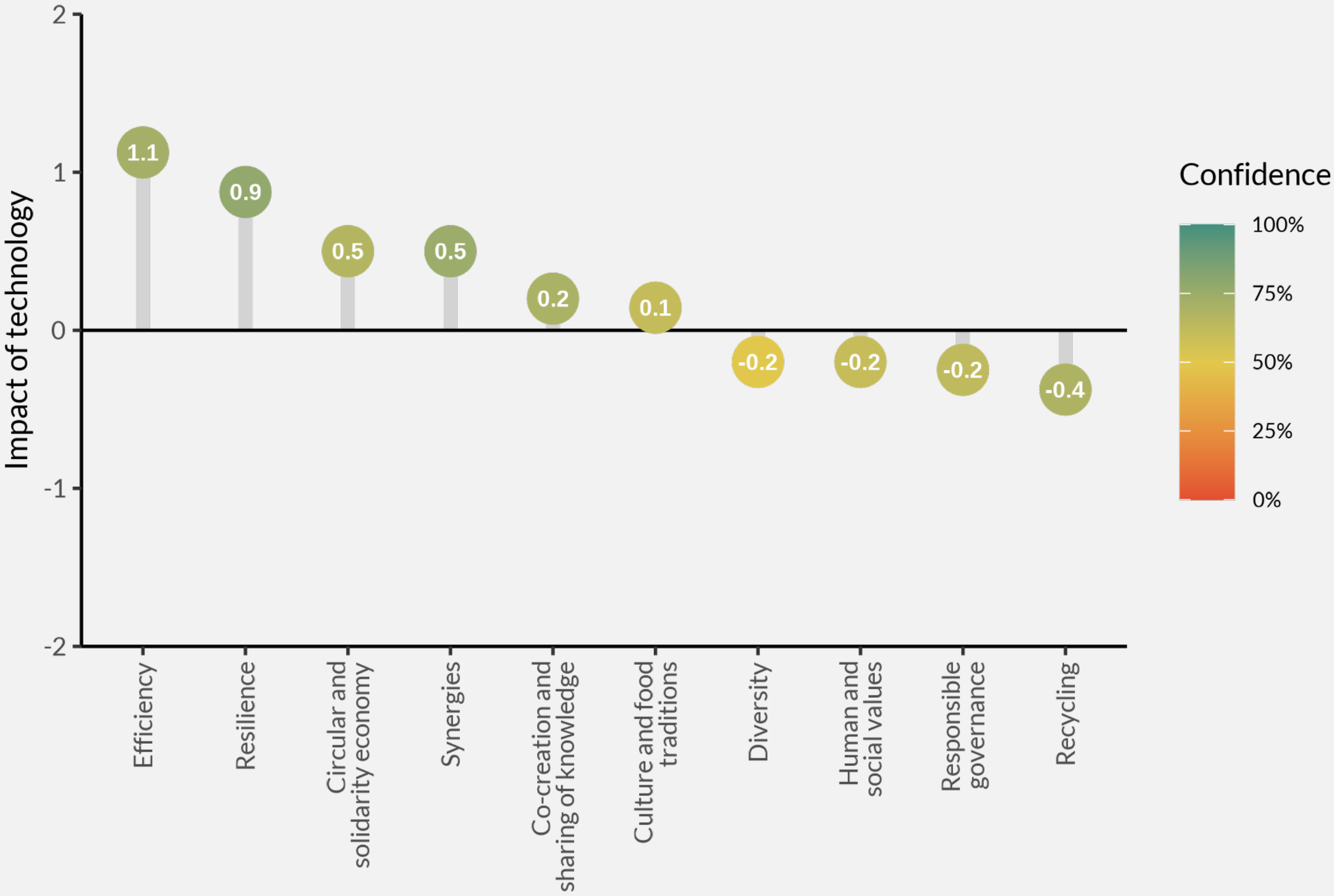
The GrowSphere™ workspace. The system uses real-time data and advanced algorithms to deliver water and nutrients directly to plant roots in precise amounts. Figure credit: NETAFIM Deutschland GmbH Innovative Bewässerung.

What is agroecology?

Agroecology is broadly defined as a way of managing food systems more sustainably by following different environmental, economic and social principles. The assessment here is based on the **Food and Agriculture Organization's 10 elements of agroecology**, one of the most important recent frameworks for agroecology.

Agroecological performance

The figure below shows how automated drip irrigation affects the FAO's 10 elements of agroecology, based on discussions between farmers, academics and digitalisation experts during our workshop. The height of each bubble represents the average impact ranging from strongly negative (-2) to strongly positive (+2), with the exact score inside the bubble. The bubble colours reflect how confident participants were in their evaluations on average (0% - not confident at all, 100% - highly confident). Note that the figure only shows averages and does not reflect variation in individual assessments.



Examples of potential effects on agroecology

The potential effects of automated drip irrigation on agroecology vary from positive to somewhat negative. By reducing water consumption, lowering moisture levels (and thereby also disease pressure) in crops, and reducing nutrient leaching, the technology can help to improve **efficiency**. Meanwhile, irrigation pipes also limit mechanical weed control, and installing and maintaining the system is currently expensive and labour-intensive. There is likely to be a positive effect on **resilience** through reduced disease risk and stabilised yields, even though birds and rodents can still damage crops. **Circular and solidarity economy** can be supported through regional yield stability and increased product diversity, both of which can benefit small producers and lead to better prices. Saving water can also reduce competition for water resources, even when overall water consumption may remain high. The likely impacts on **co-creation and sharing of knowledge** are more mixed. While the automated drip irrigation collects vast amounts of data about the soil, climate and crops, the quality of these data varies, and making them accessible for wider use can be a challenge. Similarly, while the technology could increase **diversity** by promoting habitat creation and avoiding flooding, it could also restrict the growth of other plants as the water is almost exclusively absorbed by the main crop. While the tool can provide flexibility and bring time savings via remote monitoring of crops, its overall impact on **human and social values** is likely to be mixed due to high labour requirements associated with its installation and maintenance. Finally, while the irrigation hoses can be reused after cleaning and the technology can help to save water, these benefits are likely to be realised mostly in permanent crops, and so the overall impacts on **recycling** are still expected to be somewhat negative.

Why does digitalisation matter?

Agriculture in Europe and globally is digitalising rapidly. While digital tools often aim to enhance farming efficiency, they bring a variety of environmental, economic and social effects ranging from changes to fertiliser use to data privacy. Digitalising agriculture can therefore enable a sustainable transition and boost the resilience of food systems, but it also introduces new challenges and risks.

OPPORTUNITIES 🚀

- Automated drip irrigation can reduce water consumption, lower moisture levels in plants, and optimise fertiliser use
- Optimised management of crops has the potential to increase yield stability (reduced losses) as well as improve the quality of produce
- Digitalising irrigation can provide flexibility for farmers, improving adaptability and independence in farming operations

CHALLENGES 🧩

- Currently, the installation and maintenance costs are relatively high and can considerably increase manual labour requirements during the installation of the technology (which will later decrease again)
- The technology requires equipment, which hinders mechanical weed control and has limitations (for example, no site-specific fertilisation)
- The system is relatively complicated and may therefore require specialised knowledge

Workshop context

Importantly, the results in this fact sheet reflect the regional context of our assessment. The workshop to assess automated drip irrigation was organised by the German Agricultural Society (DLG) on 2 December 2024. DLG is a non-profit organisation focussed on promoting science and education in agriculture and connecting different stakeholders involved in food production. The workshop was organised online with the help of Netafim, who presented their GrowSphere™ drip irrigation system. The agricultural systems discussed during the workshop included arable farms, horticulture, vineyards and permanent crops. Workshop participants included stakeholders from various fields, such as digitalisation, agriculture and environmental science. Notably, all participants were male.

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