# UAV-based crop spraying

Technology fact sheet

## What is UAV-based spraying?

Unmanned aerial vehicles (UAVs), also known as drones, have been used in agriculture since the early 2000s, becoming more common in the 2010s. Spraying drones for vineyards refer to unmanned aerial vehicles capable of applying agrochemicals at a desired rate close to the crop (usually from a height below 5 metres). The flight paths of the drones can be plotted in advance together with all the relevant application parameters, after which the drone executes the plan as a set of sequential 'commands'. The adoption of unmanned aerial vehicle sprayers is associated with several potential benefits, including protecting human health and the environment, as well as reduced chemical and water use. Such sprayers are useful in situations where a crop is difficult to spray by traditional means due to the terrain being too dangerous or inaccessible for land vehicles, or when distance from spraying is required for human safety. This is particularly relevant to vineyards, which are often located on steep slopes. In addition, spraying drones allow for a precisely targeted, fast and high-volume application of pesticides. However, despite being commercially available, agricultural legislation currently prohibits most applications of drone spraying in the EU.

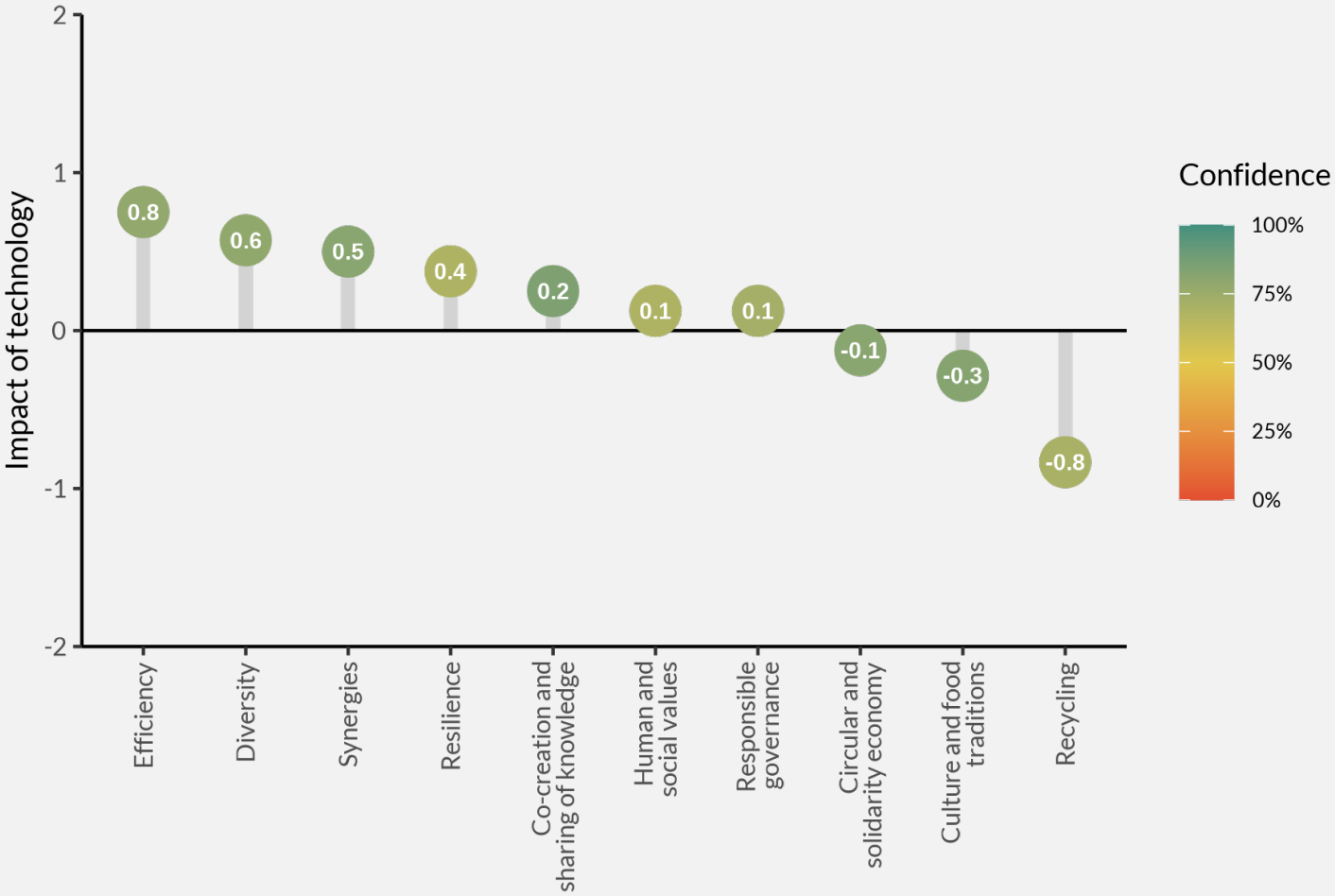
**Aerial spraying drone for vineyards.** The T16 drone flies over vineyard rows and can help to improve efficiency and yield through precise spraying. Photo credit: Konstantinos Grivakis.

## 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 UAV-based crop spraying 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

As shown in the figure above, spraying drones in vineyards are likely to have mixed effects on agroecology. The greatest overall benefits of aerial spraying are likely to be seen in **efficiency**, where reduced costs and improved crop quality have already been demonstrated, even though there are challenges related to the lack of established spraying protocols. By making it easier to reach more inaccessible areas and improving farmer safety, and by being able to provide new job opportunities and facilitate the cultivation of new crop varieties, the drones could improve **diversity** in agriculture. **Resilience** could be bolstered as the drones can offer crop protection, insights into frost prediction, and income stability for farmers. However, challenges related to long-term research and income planning remain. Cautious adoption of the technology and diversification strategies can help to mitigate these risks. The effects on the **co-creation and sharing of knowledge** are also likely to be mixed, as the drones enable quick information sharing among farmers but also bring the risk of data breaches. While the potential for reduced physical labour needs and improved safety contribute positively to **human and social values**, the technology could also promote the loss of some traditional jobs and farming practices. Similarly, the use of drones could weaken farmers' sense of identity, negatively affecting **culture and food traditions**. Nevertheless, the technology can also help to preserve local crop varieties by making their cultivation easier, while cultural preservation initiatives can counteract the potential negative impacts. Regarding **recycling**, the overall impacts are likely to be negative due to challenges with repairing the drones. Overall, spraying drones can often contribute to agroecological principles but require cautious use to maximise the benefits and mitigate any potential risks.

## 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 🚀

- Drones can streamline tasks, optimise resource use, and offer targeted spraying, which could improve farming efficiency and reduce costs
- Predicting frosts and ensuring accurate pesticide application can help to protect crops, stabilising farmer income from year to year
- Using drones could attract young people to farming, empower farmers by providing access to more data, and create new job opportunities

### CHALLENGES 🧩

- Overreliance on the technology can undermine resilience benefits if the technology is not adopted cautiously or other diversification strategies are ignored
- Sustainable practices should be promoted while preserving farmers' cultural identity and knowledge of traditional practices
- Potential for data breaches poses a significant risk

## Workshop context

Importantly, the results in this fact sheet reflect the regional context of our assessment. The workshop to evaluate UAV-based spraying in vineyards was organised at the Agricultural University of Athens on 4 April 2024. The Smart Farming Technology Group of the Farm Machine Systems laboratory at the university is mainly investigating the use and efficiency of spraying drones for agricultural purposes in perennial and annual crops. Workshop participants included agricultural experts, vineyard and perennial fruit producers, researchers, and representatives from agricultural organisations. While the technology can be used in all kinds of crops and in both organic and conventional farming, the workshop discussions mainly focused on vineyards.


ΓΕΩΠΟΝΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ
AGRICULTURAL UNIVERSITY OF ATHENS

BOKU UNIVERSITY

D4AgEcol
DIGITALISATION FOR AGROECOLOGY

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101060759. The project is co-funded by UK Research and Innovation (UKRI Reference No. 10037994). The views and opinions expressed here, however, are those of the authors only and do not necessarily reflect those of the European Union, the Research Executive Agency or UK Research and Innovation. The European Union, the Research Executive Agency or UK Research and Innovation cannot be held responsible for them. The authors of this fact sheet may not be held liable for any consequences arising from the use of the information contained in the fact sheet.

Funded by the European Union