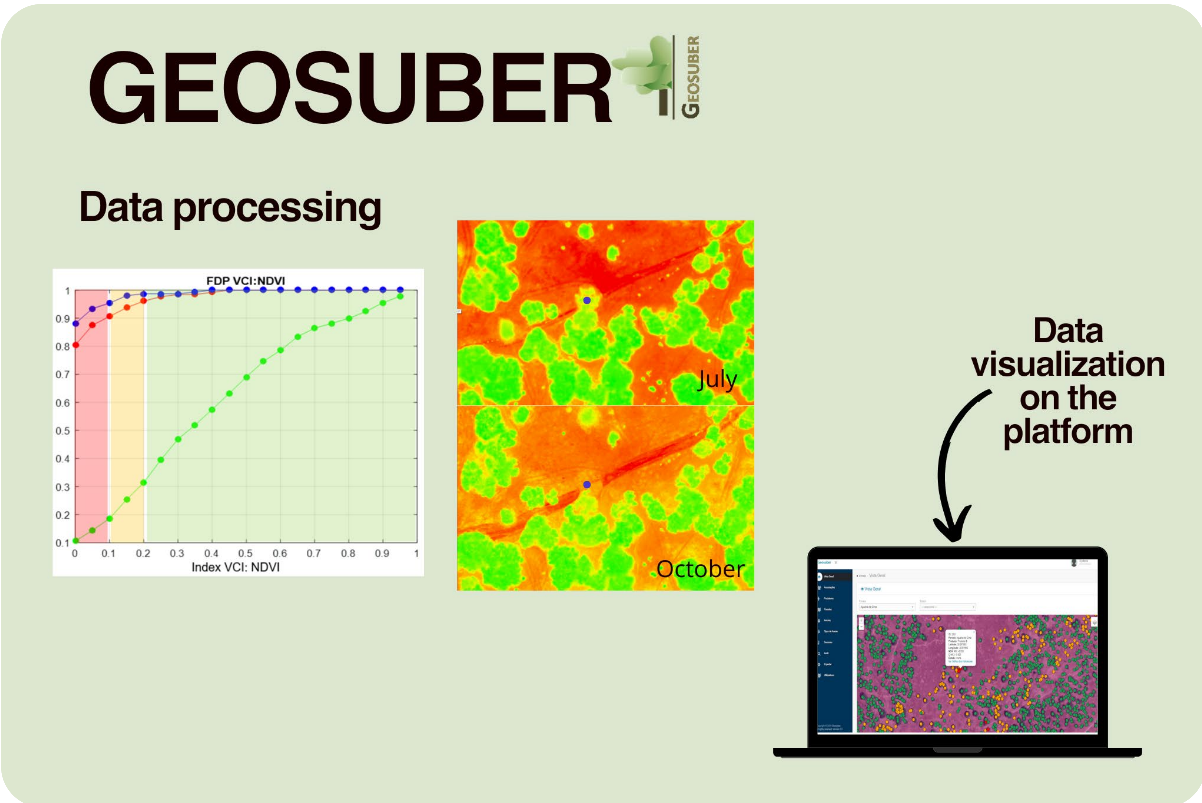
Remote sensing in cork oak

Technology fact sheet

What is satellite-based monitoring of cork oak?

Over the last three decades, cork oak woodlands have shown signs of vitality loss and decline. According to Portuguese legislation, cork oak trees can only be felled if they are dead or severely affected by pests and diseases. Before the landowner can request authorisation to fell, however, the trees must be counted and marked. There are currently no real-time mechanisms for monitoring cork oak vitality, while the National Forest Inventory is carried out only every five years, which is not sufficient for proactive intervention and management.

The Geosuber technology uses remote sensing (open-access satellite images) and spatial analysis to monitor tree vitality and integrate this information into a GIS and a web application. It produces a cork oak vitality map identifying healthy and dead trees, as well as trees with signs of vitality loss, replacing the currently manual, in situ identification that brings high costs. With Geosuber, cork producers have regular access to reliable information for monitoring cork oak woodlands, enabling specific and timely management and more effective interventions to help to reverse vitality loss trends.



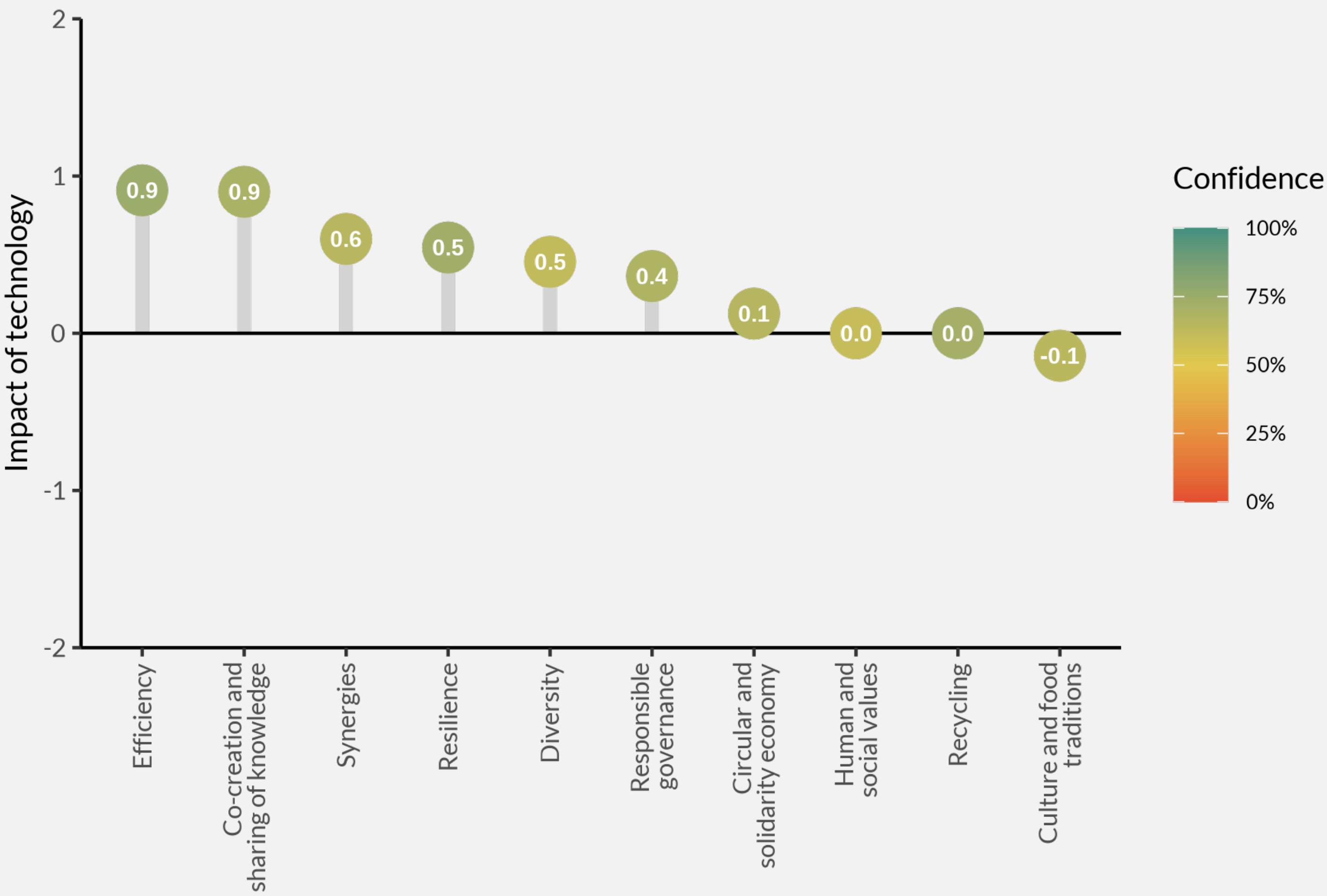
Remote sensing for cork oak vitality and mortality mapping in agroforestry systems. Using satellite images, Geosuber creates a map to identify dead cork oak trees and areas with vitality loss. Figure credit: UNAC – União da Floresta Mediterrânica.

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 remote sensing in cork oak 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 expected impacts of the Geosuber tool on agroecology range from positive to somewhat negative. By reducing the cost of identifying dead trees, the tool could increase the **efficiency** of cork oak management. While its accuracy could be improved, the technology would allow cork producers to act promptly and thereby better comply with guidance on forest protection. Easy access to data through the platform can contribute to the **co-creation and sharing of knowledge** and allow forest associations to work more closely with producers. The tool could also speed up bureaucracy related to felling permits, although there is room for improvement regarding the criteria that define tree mortality, while data validation is also still needed. Not all producers may have the technical skills to process the data, which could limit these benefits. The ability to interpret data could be a more critical issue than access to data. Geosuber has the potential to be compatible with non-digital technologies (such as molecular markers of tree diseases) and could be adjusted for other purposes, which would support **synergies**. By enabling consistent woodland monitoring, the tool could be useful in issuing management recommendations that reduce tree mortality, thereby helping to increase **resilience**. Regarding **diversity**, the tool could be used to identify landscape heterogeneity, but it does not enable species identification for more specific purposes. Unlike many other digital tools, Geosuber could also directly contribute to **responsible governance** by providing frequent localised information that can support policies and regulations. The impacts on **human and social values** are likely to be more mixed. On the one hand, the tool may create specialised jobs and attract young people. However, data sharing and exchange may also create conflicts over data protection.

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 🚀

- Efficient and up-to-date monitoring that significantly reduces the costs compared with manual monitoring, as well as the amount of bureaucracy faced by cork producers
- Potential for the creation of specialised jobs, particularly those attractive to young people
- The tool could be compatible with other non-digital technologies and could be adapted for purposes beyond monitoring the vitality of cork oak

CHALLENGES 🧩

- The accuracy of the tool still needs to be improved, and there are limitations to the results (for example, the tool does not determine the cause of vitality loss in trees)
- Potential data sharing and exchange conflicts, although the platform guarantees data confidentiality
- Interpreting the data collected by the tool can be challenging for producers

Workshop context

Importantly, the results in this fact sheet reflect the regional context of our assessment. The workshop on the Geosuber tool was organised by UNAC (União da Floresta Mediterrânica), an organization representing forestry producers in the Portuguese Mediterranean region, advocating for their interests before national and European institutions. The workshop took place at the Observatório do Sobreiro e da Cortiça in Coruche, Santarém—known as the 'cork capital' of Portugal—on 23 October 2024. The participants had backgrounds in farming, digitalisation, and academia, specifically forest sciences. The farming systems discussed in the workshop were agroforestry and agro-silvopastoral systems where the dominant tree species is cork oak, *Quercus suber*.

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