Digital data drives better soil management

September 20 2021, by Cecilie Jensen

Credit: Andrea Piacquadio from Pexels

When we think about limited resources in agriculture, water is normally the first that springs to mind. The bad news is that just like water, soil is a finite resource that is fast deteriorating as a result of human activity. The good news: Research is providing farmers, landowners and policymakers with new tools to turn the tide.

Digitalisation is a game changer in many sectors—and agriculture is no exception. For years, technological innovations have been helping farmers work more efficiently and sustainably. Now data-driven insights can also guide them to improve the health of soil—the most critical part of successful agriculture.

Making sure farmers and landowners have the tools and the knowhow to understand how their soil is performing is important. So is information about which actions they can take to improve the health of their soils, and which they should avoid. Data is also needed by policymakers to formulate policies that promote soil health across the board.

Where's the data?

For years, countries across the globe have been collecting data on their soils and found strategies to optimize farming. In Austria, for example, there is a wealth of research on conservation agriculture, a farming system that causes minimal disturbance to the soil (i.e., no plowing), and boosts the natural biological processes below ground. This leads to healthier soil and more efficient crop production. Long-term experiments are also being carried out in Murcia, Spain, where researchers study the effects of deficit irrigation in vines as a way to make the best use of a limited water supply.

The data from these local experiments can play an important role in the global quest for improving our soils by providing important insights into the farming strategies that work—or don't work—in specific geographic and climatic contexts.

The problem is that a lot of this data is not readily available for others to use or harmonized at the EU level. "There are many reasons for this," said Dr. Jose Alfonso Gómez of the Institute for Sustainable Agriculture (IAS) in Spain. "It's not that people hide their data, it's simply that they

don't have an incentive to share it."

Dr. Gómez is speaking from the perspective of the research community when he says this. Making the scientific data we already have available for other researchers to use and build on is the first step to gaining an overview of the status of the world's soils and what can be done to reverse negative trends.

An EU-China collaboration on sustainable soil-water resources management led by Dr. Gómez, is now working on doing just that. Headed by the University of Natural Resources and Life Sciences, in Vienna, the SHui project is building a database where the results of long-term experiments will be uploaded and visualized on a map.

This is a highly useful tool for researchers studying soil. Say, for example, you're an agronomist studying vine crops in a water scarce area, such as Greece, and would like some data from a region with similar climatic conditions to benchmark your own results against. The three experiments on deficit irrigation in Murcia could be helpful, suggested Dr. Gómez. "If you go to the location of these experiments on the map, you can download the data on the type of soil, the climate, and the yield that they found when applying deficit irrigation and full irrigation techniques."

A second data challenge is now also apparent: it is unlikely that the average farmer and landowner, upon finding the data from all these research projects, will be able to understand it and put it to use on their own land. This is a challenge Dr. Gómez is well aware of. "To improve soil health and water scarcity, the work of academics is not the most important thing that is missing. We need to put the data and knowledge in the hands of the people who are going to use it: farmers, policy makers and companies," he said.

This is a key point that is also raised by Dr. Luuk Fleskens of Wageningen University & Research in the Netherlands. While there is a wealth of data and information being produced on sustainable soil management, he explained that 'it's often fragmented and rarely tailored to land users and land managers."

Not to mention that sustainable soil management involves looking at a complex set of factors that differ based on climate, geographic location, type of soil, and many other parameters. "On top of that, and maybe more importantly, there is a need to address soil quality issues holistically," said Dr. Fleskens. "Maybe a farmer is not aware that in addition to a specific issue they experience, there are other soil parameters or soil threats that can explain why their soil performs poorly."

Enter the SQAPP, an app tailored for farmers that Dr. Fleskens and colleagues of the iSQAPER project have developed. "It brings together digital soil information in a handy location and format for end users to learn more about soils and options for sustainable soil management," explained Dr. Fleskens.

The data for the app has been gathered by the project's researchers. They compared soils that are farmed in similar ways in similar climates and found that some management techniques made the soil healthier than others.

To use the app farmers simply need to insert the location of the land they would like to know the soil quality of. The app then provides a list of the soil's properties, such as its salinity, organic matter content, and any threats affecting the land, and recommends measures to improve the soil quality, ranging from new farming methods to irrigation techniques.

Weeding out the complexities

The SQAPP app helps farmers improve the quality of their soil and identify emerging risks, ultimately supporting them in making their farms more efficient without adding further stress on the environment. This is important in the grand scheme of improving the globe's soils since it promotes awareness and action among the actors that manage our land.

For Dr. Gómez, building trust with the farmers and establishing a system for incorporating their feedback on what works and what doesn't in practice, is another crucial way for research and innovation actions to have a concrete impact on the agricultural sector.

While agriculture often gets all the attention in discussions on soil management, food production is in fact just one of several "functions" that we rely on our soils to perform: they also regulate and purify our water, store carbon which contributes to mitigating the effects of climate change, provide a home for a wide range of animals and plants, and allow for the sustainable cycling of nutrients. In order to truly ensure that we are making the most of our land, all of these essential soil functions need to be considered.

In Europe, the EU Common Agricultural Policy (CAP) has in fact tried to do just that. It aims to target both the management of land for food production as well as supporting soil's essential environmental functions. However, there is still room to improve the consistency of policies, especially in line with new emerging priorities.

Researchers of the LANDMARK project wanted to figure out how the policy landscape could be simplified and tailored to the specific interests and conditions of different countries. By looking at how countries actually use their land, the project discovered big variations across Europe. For example, in Portugal, the highest demand on soil is placed on its ability to regulate water, while in Ireland, they're more interested

in soil's capacity to store carbon. Many of these differences have to do with the farming system, type of soil, population size, and other factors specific to each country. This raises the question of whether all soils can be expected to perform the same functions to an equal extent, or whether a more targeted approach is needed.

Based on data from 94 sites in 13 countries across Europe, the LANDMARK researchers discovered that while soil at a single site can deliver multiple functions, synergies and trade-offs between focusing on one soil function over another are often non-linear as they are influenced by local conditions such as the type of soil and climate. "For example, a synergistic relationship existed between biodiversity and climate regulation in some European regions, such as Pannonia, whereas in Atlantic conditions this relationship is negative in grassland systems," said Dr. Rachel Creamer from Wageningen University and coordinator of the LANDMARK project. This finding supports the need for tailor-made approaches to sustainable land management dependent on local conditions.

Luckily for Europe's farmers, the new CAP period of 2023-27 will give countries more flexibility to decide how they want to manage their land. Going forward, each Member State will develop its own national CAP strategic plan explaining how it will contribute to the environmental, climate, and biodiversity protection commitments of the European Green Deal. This "new way of working" will give countries the freedom to prioritize the soil and land management combinations that are most relevant for how they use their land. The LANDMARK project's findings indicate that this is likely a very good approach and can be a step on the way to meeting the goals of the EU mission on soil.

Provided by Horizon: The EU Research & Innovation Magazine