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CORDIS Results Pack on soil health

A thematic collection of innovative EU-funded research results

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Reaping the benefits of healthy soils, for food, people, nature and the climate

Research and Innovation

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Editorial

Reaping the benefits of healthy soils, for food, people, nature and the climate

Soil is the foundation of our lives. Soil services are essential for the provision of food through agriculture, energy and raw materials, carbon sequestration, water purification, nutrient regulation, biodiversity preservation and pest control, to name but a few. This CORDIS Results Pack highlights projects working in the field of soil research that have recently finished or will soon end and also introduces two newer projects that promise to make valued contributions over the coming years.

Life on Earth depends on healthy soil. 95 % of global food production relies on soil. Soil is home to a quarter of all terrestrial species, and it plays a crucial role in nutrient cycling as well as in storing carbon and filtering water, which helps mitigate climate change and prevent flooding and droughts. Yet regardless of soils' fundamental role in the functioning of our planet's ecosystems, soils in Europe (and globally) are being degraded, which is now starting to have far-reaching consequences, for food security and safety, the integrity of ecosystems and the services they provide to humanity. Urgent action is needed, especially as it takes considerable time to (re)generate soils and restore soil health.

EU policy in the field of soil

A number of current and upcoming EU policy initiatives have soil preservation as an important focus. Healthy soils are essential to meeting the ambitious goals of the European Green Deal and the objectives set by its strategies, in particular the Farm to Fork Strategy and the EU Biodiversity Strategy to 2030. The European Commission is also committed to updating the EU Soil Thematic Strategy) in 2021 and setting a common EU framework for action to preserve, protect and restore soil.

Seeding real efforts in soil protection through innovative EU-funded research

Knowledge and tools developed through research and innovation will contribute to preserving healthy soils. For example, recent research has highlighted the function of soils as carbon and nitrogen sinks, thereby supporting the role of agriculture and forestry in the mitigation of greenhouse gas emissions, as well as combating desertification and land degradation.

Under Horizon 2020, several topics were dedicated to advancing research efforts in soil health. These efforts will be carried forward under the EU's new Horizon Europe programme. Horizon Europe will also incorporate new 'EU missions', designed to solve major societal challenges facing our world. Five specific missions have been proposed, with one focusing on Soil health and food: 'Caring for soil is caring for life'. If successfully adopted, this mission will work towards developing real and tangible solutions for restoring soil health and functions, as well as raising general societal awareness of the importance of soils.

Discover the projects making a real difference

The 12 fully featured projects in this Results Pack highlight the synergies between what has already been achieved and how these results can be taken further under Horizon Europe and the proposed EU mission in the area of Soil health and food.

What the food web can teach us about soils

Soil structure is deeply impacted by soil biota and their complex relationships – and the other way around. EU-funded research has delivered new clues for understanding this two-way process.

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Halting soil loss is becoming an urgent necessity. In Europe alone, poor land management practices account for an estimated 970 million tons of soil lost to erosion each year.

To develop efficient strategies for restoring degraded soils, we need to gain a better understanding of the links between soil structure, the communities of organisms living in it and the way they decompose organic matter.

The AGG-REST-WEB (Let's restore our soils: using the soil food web to engineer the soil structure and functioning) project, undertaken with the support of the Marie Skłodowska-Curie Actions programme, has provided new insights into the relationship between soil biodiversity and functioning. The team has been able to demonstrate that soil web consumer-food interactions have a deep impact on the soil's physical properties which, in turn, determine access to food.

"In a nutshell, who eats whom depends on who meets whom in the soil maze," explains Amandine Erktan, Marie Skłodowska-Curie research fellow and the project's lead researcher.

Adding diversity

The soil food web is the network of food chains linking the organisms living in the soil. To examine how these impact soil structure, the team conducted two experiments in which they studied different types of trophic interactions – feeding relationships – and their impact on the soil.

Who eats whom depends on who meets whom in the soil maze.

"So far, the effect of soil organisms on soil physical structure had been mainly studied by looking at each group separately, for instance earthworms or fungi. This approach ignores potential interacting effects in real soils," Erktan says. "We have shown that trophic interactions are important for soil aggregation, suggesting that stimulating the recolonisation of degraded soils by diverse communities from different parts of the food web could help to restore soil habitats."

A feedback loop

While work initially focused on this aspect, Erktan soon came to realise that the relationship between the food web and soil structure might be a two-way street. "Bulk soil characteristics often fail to explain switches in the diet of soil animals. I had the idea that soil structure at the microscale could explain encounter probabilities between food resources and consumers," she comments.

Erktan completed a literature review to gather the available knowledge on this question. The exercise revealed that the soil's physical structure appears to determine how organisms can sense and access food. While more research is required to fully understand these mechanisms, the strategic value of these insights is huge: "They open a new interdisciplinary research path combining soil food web ecology and physics."

Carbon storage

Investigating these aspects further could also contribute to the fight against climate change. "Soil is a vast reservoir of carbon. Small changes in soil carbon content can have large effects on the global climate," Erktan adds.

The amount of carbon stored is not always proportionate to the organic matter added to the soil. While we do not yet have a full understanding of the storage mechanisms, Erktan believes the discrepancy might be linked to the role of soil structure in blocking consumers' access to plant and animal debris. Analysing these patterns could provide us with a roadmap for adjusting them, she says: "It may help us better predict how changes in land management practices influence carbon storage."

PROJECT
AGG-REST-WEB – Let's restore our soils: using the soil food web to engineer the soil structure and functioning

COORDINATED BY
University of Göttingen in Germany

FUNDED UNDER
Horizon 2020-MSCA-IF

CORDIS FACTSHEET
cordis.europa.eu/project/id/750249

Helping farmers to keep their land fertile

Farmers can be soil guardians as they can protect and preserve it. An EU-supported network has worked hard to enable farmers to easily access practical information in their own language on how to boost soil health and why it's in their interests to do so.

Farmers' incomes depend to a large extent on the state of their land, with intensive production systems making soil health a growing concern across Europe. However, information on the specific issues affecting soils and on how to tackle them can be hard to come by.

To bridge this gap, the EU-funded BEST4SOIL (Boosting 4 BEST practices for SOIL health in Europe) project has created a network for sharing know-how on soil health. It focuses on good practice for keeping soils healthy and fertile and for reducing the spread of soil-borne diseases and nematodes, tiny roundworms feeding on the roots of plants.

"An international team of scientists gathered a lot of information for practical use. BEST4SOIL makes this knowledge available through videos, fact sheets, databases and a decision support tool," says Harm Brinks, BEST4SOIL coordinator and project manager at Delphy, the Dutch agriculture and horticulture consultancy hosting the project.

Making the right choices

The decision support tool is a web interface where farmers and advisers can enter information about the location, soil, type of crops and types of pathogens or nematodes to generate an inquiry. Based on this inquiry, the system will search its databases to identify the most promising strategies. "It can be used as a risk analysis tool, to create sound crop rotations and select measures to restore soil health or prevent problems," Brinks explains.

Crop rotation is one of the most efficient techniques for controlling soil-borne diseases and pests. To maximise its impact, farmers need to carefully adjust the system to local conditions. BEST4SOIL can help them assess which crops to grow in which order, and how best to combine rotation with other management practices.

Best practice in the field

The project focuses on four practices which are key to soil health: green manure, compost, anaerobic soil disinfestation (ASD) and (bio)solarisation.

"Compost and green manure crops deliver organic matter to the soil: they are an important source of micronutrients, which are necessary for soil fertility and biodiversity," Brinks adds.

ASD and (bio)solarisation, on the other hand, help to fight diseases and parasites: "Many soils are contaminated with nematodes and pathogens which damage crop yield and quality. Biological control measures help to restore soil health by getting rid of infestations."

Biological control measures help to restore soil health.

Information and advice on how to use these practices are shared on the website through videos and fact sheets. All online resources, including database content, are made available in 22 EU languages.

Connecting practitioners

The web platform is just one of the channels through which the BEST4SOIL network is reaching out to farmers. Facilitators across 19 EU countries and the United Kingdom organise local activities such as meetings, conferences and workshops offering training opportunities and enabling participants to connect and exchange experiences. Ultimately, the project aims to build a community of practice connecting growers, advisers, educators and researchers across Europe.

The team hopes to keep the network active after the project draws to a close. "The project partners guarantee that all the information will remain available for at least 5 years. But we are working on a plan to keep it online for much longer," Brinks notes. With his colleagues, he is exploring different options, including the integration of some of the tools into an agricultural knowledge database currently being developed with Horizon 2020 support.

PROJECT
BEST4SOIL – Boosting 4 BEST practices for SOIL health in Europe

COORDINATED BY
Delphy in the Netherlands

FUNDED UNDER
Horizon 2020-FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/817696

PROJECT WEBSITE
best4soil.eu

A precision agriculture tool that lets farmers measure soil's biological activity

New technology lets farmers see the type of microorganisms that are present in a particular soil type and tailor their resources accordingly.

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The world population is forecasted to reach 9.8 billion people by 2050 – a 25 % increase on today's numbers. Feeding this population will require society to double its current level of food production. For this, there is precision agriculture.

"Precision agriculture uses new technologies to observe, measure and respond to crop variability," says Jorge Blanco, R&D director at Greenfield Technologies, a Spanish agritech company. "The goal is to increase crop yields and profitability while lowering the level of resources needed to grow crops."

Despite precision agriculture's potential, Blanco says its widespread use is hampered by general ignorance of the importance of accurate soil variability. "Soil texture, water content, pH level and biological properties all impact the irrigation, seeds and fertilisers used," he explains. "As current sampling is subjective-based and analysis techniques require large soil samples, they are grossly inefficient."

To fill this gap, Greenfield Technologies has developed BIOMAP2SOIL (Biological analysis of soils and advanced data

analytics for precision agriculture maps), a new method that measures physical, chemical and biological variability based on objective soil sampling. "Using these measurements, our solution produces soil maps and provides the farmer with practical recommendations for efficient irrigation and crop management," adds Blanco.

With the support of EU funding, Greenfield Technologies has been able to develop, test and bring to market its innovative BIOMAP2SOIL solution.

Examining biological activity in soil

BIOMAP2SOIL builds on the company's MAP2SOIL solution. The solution uses a sensor capable of measuring apparent electrical conductivity at different soil depths. The sensor is attached to a tractor and is driven through an entire farm to gather data. This data is then analysed and used to create maps showing the different parameters of the various soil types found within the same plot.

"Even though a farm is comprised of very different soil types, the entire farm is typically treated the same," remarks Blanco. "Precision agriculture solutions like MAP2SOIL allow one to manage different soil types in a tailored and more efficient way."

BIOMAP2SOIL takes this process one step further, measuring not only the physical and chemical characteristics of soil, but also its biological activity. "We believe that knowing the health of a soil and its variability within the same farm is just as important as knowing its composition," adds Blanco.

To do this, BIOMAP2SOIL essentially looks inside the soil to see what biological activity is happening. "Soil is full of microorganisms, some of which are pathogenic, while others are beneficial to crop growth," he explains.

Our solution produces soil maps and provides the farmer with practical recommendations for efficient irrigation and crop management.

The BIOMAP2SOIL solution focuses on the presence of plant growth-promoting rhizobacteria (PGPR), bacteria that can increase plant growth and stimulate its immune system. "By analysing the existence of pathogens or PGPRs before a crop is planted, BIOMAP2SOIL helps farmers make the most efficient use of their resources," says Blanco.

A step in the right direction

With the support of EU funding, Greenfield Technologies has successfully validated BIOMAP2SOIL's use in real-world settings. It also conducted an in-depth competitive analysis, secured the necessary patents, and developed a comprehensive strategy for launching BIOMAP2SOIL onto the international market.

"There's still a long way to go in terms of increasing global food production to a level capable of meeting the demand of a growing population," concludes Blanco. "Precision agriculture solutions like BIOMAP2SOIL represent a big step in the right direction."

PROJECT
BIOMAP2SOIL – Biological analysis of soils and advanced data analytics for precision agriculture maps

COORDINATED BY
Greenfield Technologies in Spain

FUNDED UNDER
Horizon 2020-Societal Challenges, Horizon 2020-SME and Horizon 2020-LEIT

CORDIS FACTSHEET
cordis.europa.eu/project/id/884251

PROJECT WEBSITE
greenfield.farm/proyectos

Sharing expertise to increase soil carbon sequestration and healthy soil practices

Soils are key for global carbon balance – benefiting climate change adaptation and mitigation, food security, biodiversity and efforts against desertification. To maximise these benefits, CIRCASA prepared the groundwork for an international research consortium on soil carbon.

Soils form the largest terrestrial carbon pool: estimated at 2 300 gigatons, two to three times more than atmospheric carbon. Healthy soils store large quantities of carbon as soil organic carbon (SOC). This has tremendous potential in the fight against man-made climate change, as stabilisation mechanisms in organic matter stores carbon over decades to millennia.

Whilst there is considerable interest in the benefits of soil carbon, adoption of soil-enhancing agricultural practices remains slow. Working with farmers around the world, the EU-supported CIRCASA (Coordination of International Research Cooperation on soil CArbon Sequestration in Agriculture) project found that socio-economic factors were the main impediment. Concerns included: additional costs (with little support for access to technology), a lack of soil carbon monitoring options and insufficient overall best practice knowledge.

"Although barriers vary with national circumstances, views were similar," explains project coordinator Jean-François Soussana from the National Research Institute for Agriculture, Food and Environment (INRAE), the project host. "We need more knowledge and advisory services, increased availability of indicators and tools, improved public awareness, as well as financial support for agricultural transition to more sustainable practices."

CIRCASA identified priority research and technologies, alongside knowledge gaps, to create the scientific basis for a Strategic Research Agenda (SRA) on agricultural SOC sequestration.

The approach rests on four pillars. Firstly, research on key soil carbon processes. Secondly, design of an international standard for monitoring SOC balance supported by soil data, remote sensing and modelling. Thirdly, support for agroecological innovations (e.g. deep-rooted crops, improved machinery and organic fertilisers) to store soil carbon. Lastly, the creation of an enabling environment, which includes farmers' expertise.

Interdisciplinary and state-of-the-art research

Covered soil becomes rich in organic matter and also therefore in carbon. As such, it's important to avoid bare soils that also lead to erosion.

Agroecology, regenerative agriculture, agroforestry, conservation agriculture and landscape management are just some locally adaptable practices that are key to soil health and carbon sequestration. Techniques include: using cover crops; nourishing soils with manure and compost; and restoring crops, pastures and degraded forests, etc.

"Our project created a knowledge bridge across continents, involving soil carbon stakeholders and researchers from Australia, Brazil, China, Russia and the United States, and also Colombia, Costa Rica, Kenya, Madagascar, South Africa and Tanzania," adds Soussana.

The team established a Knowledge Information System, on an Open Collaborative Platform, as an online library of soil carbon knowledge, which also serves as a social network for members.

An International Research Consortium comprised of the European Commission, funding bodies, research organisations, public agencies and the private sector was prepared by CIRCASA to coordinate projects and programmes.

Sustainable soil management

CIRCASA's research synergies contribute to important initiatives. Sharing agricultural soil carbon sequestration techniques benefits nationally determined contributions, supporting the Paris Agreement on climate change. Achieving sustainable soil management is crucial for the European Green Deal and the EU's proposed 'Caring for soil is caring for life' mission aiming to ensure that 75 % of soils are healthy by 2030. Target 2.1 seeks to reverse carbon losses on cultivated land. Soils also play a central role in the United Nations Sustainable Development Goals, such as target 15.3 on land degradation neutrality.

Technical momentum is already building through the CIRCASA network, with mapping of soil carbon and the development of cost-effective monitoring, reporting and verification systems.

"Ultimately, practices must be adopted by millions of farmers. One of the results of COVID-19 has been the high participation in online meetings, which many individuals have found that they actually prefer. The appetite for change is clearly there!" says Soussana.

Our project created a knowledge bridge across continents, involving soil carbon stakeholders and researchers from Australia, Brazil, China, Russia and the United States, and also Colombia, Costa Rica, Kenya, Madagascar, South Africa and Tanzania.

PROJECT
CIRCASA – Coordination of International Research Cooperation on soil CArbon Sequestration in Agriculture

COORDINATED BY
National Research Institute for Agriculture, Food and Environment in France

FUNDED UNDER
Horizon 2020-FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/774378

PROJECT WEBSITE
circasa-project.eu

Revealing the metabolic survival strategies of soil microbes

Food, water and shelter – these are the priorities for humans in survival situations. The DormantMicrobes project explored how microorganisms adapt similarly, generating energy (food), fortifying their cells for protection (shelter) and utilising limited, short pulses of water.

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Soil microorganisms often face harsh, changing conditions – in temperate soils and deserts. Much of the soil microbial diversity is contained in a 'microbial seed bank'. Here, it has been assumed the majority remain dormant at any given time, with different members resuscitated if environmental conditions change.

The DormantMicrobes (Revealing the function of dormant soil microorganisms and the cues for their awakening) project, supported by the European Research Council, was set up to explore how soil microorganisms are equipped for dormancy in desert soil crusts and temperate soils, and investigated some of the environmental cues that can lead to resuscitation.

We constructed almost complete genomes, uncovering a large diversity of previously unknown soil microorganisms. These data also revealed a large variety of strategies microbes use to survive unfavourable conditions.

"Previously, there was little information about the ratio of active to dormant cells in soil, let alone the actual strategies used to cope with harsh conditions," explains project coordinator Dagmar Woebken from the University of Vienna.

A range of survival strategies

Woebken's team has been working with microorganisms that inhabit soil crusts in the Negev Desert using two state-of-the-art methods: NanoSIMS and meta-omics. Lack of water limits activity in desert soil crusts, so the project explored microbial reactivation in the lab by mimicking rain.

Stable isotope probing was applied by using 'heavy water' – water containing the rare isotope deuterium instead of hydrogen. Cells that incorporated deuterium, functioning as a marker, were tracked to follow reactivation over time at the single-cell level using NanoSIMS. "Our data confirmed that some of the cells do indeed remain dormant, probably as an insurance policy for the community," says Woebken.

To uncover potential genes and pathways essential for dormancy and resuscitation, a meta-omics approach was also applied to sequence the DNA and mRNA of the soil crust-inhabiting microorganisms.

"We constructed almost complete genomes, uncovering a large diversity of previously unknown soil microorganisms. These data also revealed a large variety of strategies microbes use to survive unfavourable conditions," Woebken adds.

These survival mechanisms included the 'feast-and-famine' strategy, where microbes react to sudden pulses of water by using organic nutrients as energy sources, or by generating resting stages. Furthermore, the production of reactive oxygen that otherwise damages DNA and proteins can be reduced. Cells contain enzymes that protect or repair these important cell components.

A particularly interesting strategy is the generation of energy by scavenging atmospheric gases such as hydrogen. Expanding on this finding, the team also found atmospheric gas scavenging across temperate soils and have identified some novel and ubiquitous taxa exhibiting this potential.

"We discovered this metabolic capacity in very successful soil microbes called acidobacteria," says Woebken. "This capacity also occurs widely in other soil microbes, in completely different soil environments and with different stressors, illustrating its prominence as a survival strategy."

The researchers are now devoting their efforts to investigating whether or not this is the case. Their findings will also enable them to determine if microorganisms in less arid soils are as equipped to sustain droughts as their desert cousins are.

Ensuring biodiversity

The increased prevalence of droughts and desertification are just two hallmarks of the impact that man-made climate change is exerting on many of the Earth's ecosystems.

"Better understanding the mechanisms that microorganisms have adapted to survive a lack of water and to quickly reactivate when it becomes available again, helps us appreciate how biodiversity can exist in these ecosystems. This knowledge could help future climate change mitigation efforts," concludes Woebken.

PROJECT
DormantMicrobes – Revealing the function of dormant soil microorganisms and the cues for their awakening

HOSTED BY
University of Vienna in Austria

FUNDED UNDER
Horizon 2020-ERC

CORDIS FACTSHEET
cordis.europa.eu/project/id/636928

PROJECT WEBSITE
bit.ly/DormantMicrobes

Agricultural drainage changes soil more profoundly and faster than previously assumed

The cycling of organic matter, nutrients and pollutants in soil is affected by minerals. IDESoWa's exploration of agricultural drainage challenges the assumed stability of these minerals, suggesting that cycling changes can potentially happen faster than previously thought.

As well as storing carbon, soils also work as filtration systems, keeping surface water and groundwater clean. Soil mineral particles (such as clay) are crucial for the sorption and stabilisation of organic matter and nutrients (like phosphates) and can also reduce the toxicity of pesticides.

A 2008 study found significant loss of mineral particles close to drains, only 16 years after installation. Previously it was assumed that such changes would take centuries to millennia.

Despite these findings, the study was not replicated until the EU-funded IDESoWa (Increased drainage effects on soil properties and water quality) project set out to investigate, for the first time, how changes in the mineral composition of soils affect organic matter and nutrient cycling.

Similarly to the 2008 study, the IDESoWa project found loss of clay particles close to drains. "The assumption that soil mineral conditions remain quite static during a human lifetime needs re-evaluation," explains Antra Boča, the Marie Skłodowska-Curie fellow from the Latvia University of Life Sciences and Technologies, the project host.

Agricultural drainage and soil evolution

Soil water management techniques such as subsurface drainage systems can alter soil processes. Yet, there have been surprisingly few studies into the effect of human activities on soil mineral composition.

To learn more about the effect of agricultural drainage on soil processes, the IDESoWa team dug pits perpendicular to tile drains in three different land use scenarios. These were: clay loam under tilled agriculture and pasture formed on glacial till sediments, and silt loam under no-till agriculture formed on glacial lake sediments.

The researchers collected soil samples at various distances from the drain. The soil furthest away experiences water saturation conditions most similar to that prior to drain installation, allowing a comparison between unaltered and altered soils.

The soil was sampled up to the depth of the drains, approximately 1 metre, to determine its mineral composition, as well as phosphorus sorption capacity, organic carbon stability and nitrogen cycling.

"While the pandemic has delayed some data, we already have interesting results. We found that 40 years of subsurface drainage can change the mineral composition of soils so substantially that it is even evident on such heterogeneous materials as glacial till," says Boča.

We found that 40 years of subsurface drainage can change the mineral composition of soils so substantially that it is even evident on such heterogeneous materials as glacial till.

Somewhat confusingly the team found that the concentration of total iron did not change with distance to the drain, as it had for clay. "As iron is closely associated with clay particles, a loss similar to that for clay would be expected. Additionally, the different redox conditions in the soil at varying distances from the drain, should also impact iron mobility. Soil closer to the drain typically experiences less oxygen depletion as water drains away quickly, whilst soil further away will experience oxygen depletion because there is more chance of water saturation," Boča continues.

To follow this up, the team intends to study different iron forms as the current finding seems illogical. "Given how important iron is for the cycling of nutrients and organic matter, we need to understand what is happening," adds Boča.

Sustainable soil management

Minerals are the backbone of soils, affecting many biological and chemical processes. Understanding changes caused by subsurface drainage installations will help incorporate ecosystem services, such as soil organic matter storage and nutrient/pesticide filtration, into agricultural practices.

"When all the data have been analysed, the results could help improve soil management practices for artificially drained soils, prevalent in many European countries," notes Boča.

Future work will investigate how changes in soil mineralogy affect the toxicity of pesticides. This will be undertaken in fields with both controlled (where water is left in soil for longer) and uncontrolled drainage systems. Both systems create different reduction-oxidation conditions for mineral weathering and transformations, which likely also affects soil mineral-pesticide interactions.

PROJECT
IDESoWa – Increased drainage effects on soil properties and water quality

COORDINATED BY
Latvia University of Life Sciences and Technologies in Latvia

FUNDED UNDER
Horizon 2020-Spreading excellence; widening participation

CORDIS FACTSHEET
cordis.europa.eu/project/id/867423

Novel management approaches, treatment concepts and decision-support tools for sustainable agriculture

The INSPIRATION project has characterised the key behaviours of agriculture-derived carbon, nitrogen and organic pollutants, devising solutions to mitigate their environmental impact and improve soil quality.

To feed growing populations, intensive farming methods are widespread, including the wide use of fertilisers and pesticides. Some of the adverse effects are: increased greenhouse gases (GHGs), such as nitrous oxide, carbon dioxide and methane; the pollution of water bodies by agrochemicals and nutrients; and degraded soils through lost organic matter and diminished biodiversity.

The EU-funded INSPIRATION (Managing soil and groundwater impacts from agriculture for sustainable intensification) project has made some important scientific advances to address these impacts. "We now better understand how, at the catchment scale, GHG concentrations in groundwater are influenced by the interplay between hydrogeological, hydrogeochemical and land use processes,"

says project coordinator Steven Thornton from the University of Sheffield, the project host.

INSPIRATION identified specific conditions in aquifers under which these nutrients can be transformed into nitrous oxide, methane and carbon dioxide, and enter the atmosphere. This is valuable for quantifying and managing regional GHG emissions.

Treatment concepts

As a Marie Skłodowska-Curie Innovative Training Network, the project comprised 15 multidisciplinary early-stage researchers who employed laboratory, field and modelling studies to experiment, sample, monitor and evaluate technological solutions, at both farm and catchment scales.

As farm drainage pollutes surface water and groundwater with nitrogen and phosphorous compounds, INSPIRATION developed treatment concepts using various natural materials (such as zeolite, woodchip, compost) to capture this nutrient run-off.

Different mixtures of nutrients and the previously described natural materials were tested in laboratory batch and column experiments to find the best combination for permeability, adsorption and operational lifetime. The team then designed a solution for a dairy farm drainage scenario. Waste media were also investigated for use in land drainage systems to capture phosphorous for recycling back to land as a fertiliser, offering a sustainable solution to mitigate nutrient impacts on water, while reducing mineral fertiliser use.

Additionally, a biosensor was developed to monitor the restoration of land degraded by heavy metal contamination. "This innovation measures the bioavailability of metals in soil, a more appropriate soil health indicator than total chemical concentrations. By identifying metal concentrations toxic to soil microorganisms, landowners can take remedial actions," notes Thornton.

Soils containing heavy metals were mixed with biochar, which adsorbs these compounds, reducing their bioavailability to microorganisms and so improving soil functions. Tests corroborated the biosensor's performance in monitoring soil restoration.

Decision-making support

To assist with the selection of locally sourced material to treat nutrient surpluses in dairy farm drainage water, an open access decision-support tool, FarMit, was developed. FarMit includes a database of 75 materials assessed against performance and cost criteria. It was successfully tested in Belgium, Ireland and the United States, with different agricultural practices and nutrient scenarios.

The new framework also works at different scales. It can evaluate agricultural productivity, soil quality and environmental protection Europe-wide, for different crop-soil-climate combinations.

"The tool improves pollution mitigation at source, reusing locally available material and so reducing transport and operational costs," adds Thornton.

A modelling and decision-support framework was also created to quantify the impacts of different management techniques against indicators, such as crop yield, soil organic carbon content and nitrogen losses. The tool assesses management trade-offs to maximise sustainable production, while minimising environmental impacts.

"As indicators are traditionally evaluated separately, this is unique," he explains. "The new framework also works at different scales. It can evaluate agricultural productivity, soil quality and environmental protection Europe-wide, for different crop-soil-climate combinations."

INSPIRATION's research, techniques and tools support key EU legislation and policies, notably the Water Framework Directive and others on nitrates, groundwater, the sustainable use of pesticides, the European Green Deal and the Soil Thematic Strategy. These require Member States to adopt measures which protect, restore and ensure the long-term sustainable use of natural resources.

PROJECT
INSPIRATION – Managing soil and groundwater impacts from agriculture for sustainable intensification

COORDINATED BY
University of Sheffield in the United Kingdom

FUNDED UNDER
Horizon 2020-MSCA-ITN

CORDIS FACTSHEET
cordis.europa.eu/project/id/675120

PROJECT WEBSITE
inspirationitn.co.uk

New app assesses soil quality and enables more sustainable agriculture

The iSQAPER project has created an app for all stakeholders involved in agriculture and wanting to preserve soils for future generations. It provides valuable data and recommendations on best agricultural practices, based on the local pedo-climatic conditions and farming system.

Agriculture is unarguably the foundation of organised and settled society. But it's also a constant reminder of how unsustainable our current production models are. According to the Food and Agriculture Organization (FAO), the world's topsoil – which we need to grow 95 % of our food – could be gone within 60 years. If that were to happen, nature would take 1 000 years to rebuild it.

As if that wasn't alarming enough, many questions related to the creation of a more sustainable land management model still go unanswered. We don't know, for instance, which soil properties can be used as reliable markers of improvement in soil quality. And when researchers identify something that works, often policy fails to follow course and stakeholder support is missing due to a lack of involvement of the entire value chain from the get-go.

"A French city mayor told us the only thing he needed to protect soils was more information," Luuk Fleskens, associate professor in Sustainable Land Management at Wageningen University, notes. "That's why we decided to launch the iSQAPER (Interactive Soil Quality Assessment in Europe and China for Agricultural Productivity and Environmental Resilience) project, which aims to provide science-based, easy-to-apply and cost-effective tools to assess soil quality and function."

Reliable recommendations in the palm of your hand

With the reliable knowledge and data provided by iSQAPER, land users can assess the quality of their soils and make well-informed decisions about its use. They can do so by downloading SQAPP, an iOS and Android soil quality app. It has been developed, tested, evaluated and improved by farmers, scientists, practitioners, agricultural service providers and policymakers.

"SQAPP grants free access to soil maps and data for any location of choice. It assesses the most likely threats to soil quality status and provides targeted advice on how to improve it. Users can also interact with the databases and upload local data to refine our analysis and recommendations," Fleskens explains.

The project team fed its app with valuable data thanks to 14 study sites across Europe and China. In Europe, they could benefit from very diverse pedo-climatic conditions within a common EU context to address the issue of soil quality decline and its mitigation. Access to China, on the other hand, was enabled by the EU-China Task Force on Food, Agriculture and Biotechnology (FAB), first established in 2013. "Our four study sites there are situated in quite different pedo-climatic zones than those that we could find in Europe. Yet they face similar soil quality and management issues," says Fleskens.

SQAPP grants free access to soil maps and data for any location of choice. It assesses the most likely threats to soil quality status and provides targeted advice on how to improve it.

In total, the project identified 138 different agricultural management practices and tested their effect on soil quality across eight different climatic zones and 32 potential farming systems. There is precious advice for all stakeholders, no matter the context and location.

In Crete for instance, Fleskens and his team focused on comparisons between conventional tillage, no tillage and pesticides, and no tillage and no pesticides. The impact of each combination on soil erosion and loss of organic content – the main threats faced by farmers on the island – was analysed and compared with alternatives.

Besides SQAPP, the project team has also developed a toolkit for policymakers, researchers and land managers wanting to monitor and assess soils at the local, regional or continental scale.

In the long run, the team expects an important uptake of suitable farming and agricultural management practices. In Portugal for instance, farmers sharing their experience with a multidisciplinary audience have already enabled major discussions about agricultural practices in the country.

PROJECT
iSQAPER – Interactive Soil Quality Assessment in Europe and China for Agricultural Productivity and Environmental Resilience

COORDINATED BY
Wageningen University in the Netherlands

FUNDED UNDER
Horizon 2020-FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/635750

PROJECT WEBSITE
isqaper-project.eu

A soil management framework for sustainable food production

Guided by the multiple, complex and sometimes conflicting demands placed on land, LANDMARK worked with stakeholders – from farmers to policymakers – to develop sustainable land management tools.

The EU-supported LANDMARK (LAND Management: Assessment, Research, Knowledge base) project comprised a pan-European consortium of leading academic and applied research institutes, chambers of agriculture and policymakers tasked with developing a framework for soil management to support sustainable European food production.

"Our functions approach treats soils as a farmer-managed resource that delivers not only food, but also ecosystem services for humankind," says LANDMARK project coordinator Rachel Creamer from Wageningen University, the project host.

The Soil Navigator

After literature reviews, stakeholder consultations and data analyses, project experts developed scientific soil function models to better understand how soils respond to different management practices, under different climatic conditions.

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This led to the development of the 'Soil Navigator' – a tool used to assess cost-effective, practical measures for more sustainable, context-specific soil management.

Users input soil data, collected from field sampling and analysis, then the system assesses current capacity against key soil functions: primary productivity; water filtering and purification; carbon management and climate regulation; provision of biodiversity habitats; and nutrient provision and cycling. Each function is assigned a score of high, medium or low based on the data. Users then select the capacities they wish to improve and the system subsequently recommends solutions.

The monitoring blueprint

The team used the Soil Navigator to develop a monitoring blueprint. The tool was applied to 94 participating sites, across 13 European countries covering two types of land use (arable and grassland) and five climatic zones: Alpine South, Atlantic, Continental, Mediterranean North and Pannonian. "Many sites scored high for two to three soil functions, demonstrating that managing for multifunctionality is not only possible, but already quite common," explains Creamer. "While all functions performing optimally would be rare, achieving three out of five at field level would mean all functions are covered on a larger scale."

Discussions with farmers about the management practices being applied to their land allowed for the identification of the best functions relevant to them that would allow for a successful delivery. Using these sites, the team also identified synergies and trade-offs.

"We found that synergies and trade-offs varied according to both the climatic region of these management systems and their land use," adds Creamer. "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."

Policies based on supply and demand

Using pan-European data sets, LANDMARK modelled the supply of soil functions across the EU alongside the societal demands for them. When ranking demands, marked differences were found between countries.

"As it is difficult to fulfil all societal demands everywhere at once, our analyses offer guidance for more targeted interventions to bridge the gaps between supply and demand," notes Creamer.

LANDMARK developed 11 formal policy options, including measures that could be adopted in the Common Agricultural Policy, with an emphasis on the need for National Strategic Plans. The project also suggested prioritisation of those soil functions furthest away from meeting their functional and societal demands. Lighthouse Farms, those ready for tomorrow's sustainability challenges, were highlighted as inspirational approaches.

Findings were presented to the European Commission and stakeholders at the LANDMARK Final Conference, held in Brussels, as well as at the Wageningen Soils Conference in September 2019. The results were valuable inputs for the development of an EU mission in the area of soil health and food.

Work on the Soil Navigator continues in a number of countries and the outcomes of the soil monitoring schema have already fed into discussions about future updates of the LUCAS Topsoil Survey.

Our functions approach treats soils as a farmer-managed resource that delivers not only food, but also ecosystem services for humankind.

PROJECT
LANDMARK – LAND Management: Assessment, Research, Knowledge base

COORDINATED BY
Wageningen University in the Netherlands

FUNDED UNDER
Horizon 2020-FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/635201

PROJECT WEBSITE
landmark2020.eu

Free, easy access to information on novel biofertiliser technologies and products

Farmers will need support with how to comply with the new EU Fertilising Products Regulation on replacing unsustainable fertilisers beyond 2022. The NUTRIMAN project helps by offering an online Farmer Platform presenting novel technologies and solutions to facilitate the switch from chemical-processed mineral fertilisers to safe biofertilisers at lower cost.

The majority of Europe's agricultural land is fertilised using chemically processed nitrogen and phosphorus. The problem however is that they cause algae to grow faster than ecosystems can handle, pollute water, release greenhouse gases, are made from non-renewable resources and are produced using fossil energy and water-intensive processes.

Mineral phosphorus – which originates from rock phosphate with cadmium and uranium toxic metal content – is also on the EU's list of highly important Critical Raw Materials (as per COM 2020/474) risking supply shortage. It is almost exclusively imported and has a very low recycling rate, if any at all.

The conclusion is clear. To keep agri businesses afloat, improve food safety, ensure continued soil quality and preserve our environment, farmers will need to switch to bio-based fertilisers. But there are many obstacles ahead. The availability of highly concentrated and pure biofertilisers is limited, and a new EU regulation significantly reducing the amount of cadmium allowed in all fertilisers – including bio-based ones – will enter into force in July 2022. Meanwhile, farmers' knowledge of and confidence in bio-based fertilisers are still low.

"We need more trust and knowledge across the entire value chain. Farmers should understand the real benefits of bio-based fertilisers and how to practically use them in their farming processes," says Edward Someus, Recycling and Upcycling engineer at 3R-BioPhosphate Ltd. So far, basic research programmes have failed to truly grab farmers' attention. Farmers are more interested in innovations that are 'ready for practice' and already proven and demonstrated under real field conditions with market competitive performance.

Our platform lists and presents 'ready for use' and 'close to market' novel recovery technologies and products focusing on the most urgent needs of farmers.

A web platform for all farmers

This is where the NUTRIMAN (Nutrient Management and Nutrient Recovery Thematic Network) project kicks in. Since October 2018, 3R-BioPhosphate and other actors from across the value chain have been working on a free-of-charge web platform where new, user-driven innovations are showcased to farmers. The platform specifically focuses on innovative nitrogen/phosphorus nutrient recovery solutions, which are key to a sustainable farming model using safe bio-based fertilisers.

"Our platform lists and presents 'ready for use' and 'close to market' novel recovery technologies and products focusing on the most urgent needs of farmers. The database is continuously expanded and will continue to be until 2031," Someus explains. "It presents all innovative solutions with a status just before they are introduced to the market or slightly after."

As they looked for such innovative solutions, the team was surprised by the low number of new innovations, competitive and market-driven technologies and products above TRL 6. From the over 1 000 projects/developments invited to join, only 80 have made it to the NUTRIMAN Farmer Platform so far. Someus expects this number to reach 100 by September 2021.

NUTRIMAN has already contributed to a large-scale take-up of innovative, recovered nitrogen and phosphorus fertilisers. These include, for instance, a zero-emission pyrolysis technology (3R Recycle-Recover-Reuse) enabling phosphorus recovery from food grade animal bone grist at industrial scale. "The resulting biophosphate does not contain any chemicals or contaminants and boasts a P_2O_5 nutrient density as high as 35 % while being safe and efficient at low cost," Someus notes. On the nitrogen front, another example is the Poul-AR® technology which enables the production of ammonia sulfate/nitrate from poultry manure.

The full training documents for products, technologies and best practices are available for farmers in English. Over 40 solutions are already translated into seven other languages. The NUTRIMAN partners are also in the process of organising more than 50 workshops across Europe to disseminate their results. The project team hopes to reach over 1.5 million farmers by the end of the project and many more within the following 10 years.

As they keep updating their platform's database, Someus and his colleagues can undoubtedly provide significant support to farmers with solutions delivering high economic, environmental, climate and improved safety impacts, most importantly in compliance with actions under the new EU Fertilising Products Regulation beyond 2022.

PROJECT
NUTRIMAN – Nutrient Management and Nutrient Recovery Thematic Network

COORDINATED BY
3R-BioPhosphate Ltd in Hungary

FUNDED UNDER
Horizon 2020-FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/818470

PROJECT WEBSITE
nutriman.net

Tailored solutions for soil-preserving agriculture across Europe

Changing consumer habits and climate change call for more sustainable agricultural practices. But there is no such thing as a one-size-fits-all solution. The SOILCARE consortium has developed a novel methodology to identify the best possible crop and land use combinations for each climate and socio-economic system in Europe.

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One of the main predictions of the EU's Agricultural Outlook for 2019-2030 report is that the total agricultural land area will decline over the next 10 years. This is all due to increasing productivity, but it also begs a question. As we keep asking more from less land, don't we irremediably risk exhausting soils to a point of no return?

To prevent this from happening, the SOILCARE (Soil Care for profitable and sustainable crop production in Europe) project has been considering options to keep European agriculture competitive while reducing its environmental impact. "Europeans increasingly want good quality food that doesn't negatively impact the environment, and climate change reinforces this need. It's all about creating sustainable products preserving soils while maintaining profitability," says Rudi Hessel, researcher at Wageningen Environmental Research specialising in soil erosion and coordinator of the project.

The project team strikes this delicate balance with a new concept of soil-improving cropping systems (SICS). The concept is new not only because it considers both sustainability and profitability, but also because of how it considers each of these aspects.

Here, profitability is about more than just production volumes, as Hessel notes. "We see profitability as balance of costs and revenues. So, if costs can be reduced, for instance by using fewer fertilisers and chemicals, profitability can remain positive even as production levels somewhat decline." This is crucial, as past attempts to switch to more sustainable production methods have often resulted in lower productivity. Whilst Europe can afford a slight drop in agricultural output, this can't be done at the expense of farmers who need to fetch a better price for products of better quality.

"We also wanted to avoid restricting our analysis of costs to factors that can be monetised. We extend these to the whole of society as production methods have multiple effects on various ecosystem services. These can be found not only on-site, but also off-site," Hessel explains.

When it comes to sustainability, SOILCARE also uses what the team calls a "truly integral approach". The latter considers biophysical sustainability of course, but also economic, social and policy factors.

SICS for all

As each country has its own climate-related and socio-economic specificities, the project team selected a total of 16 study sites across Europe to identify promising SICS. These SICS consider available methods such as soil-improving crops, fertilisation, tillage management and solutions preventing soil compaction. In Norway, for instance, the team has been trialling biological compaction release, plant mixes for cover crops, and precision agriculture.

Work on the 16 sites is still ongoing, but a methodology to monitor and evaluate the adopted SICS has already been developed. The consortium also conducted a thorough analysis of the impact of policies on SICS adoption and implementation.

By the time SOILCARE ends in August 2021, an interactive tool allowing stakeholders to identify the best possible SICS for their needs will be made available. "The tool will combine a land use model with a biophysical model. Users can also simulate the effects of policies. For each category of SICS, we are currently developing maps showing where it is suitable and relevant. We will use these maps as input for the model, which will then, based on local conditions, provide advice on which categories of SICS would be promising," Hessel adds.

It's all about creating sustainable products preserving soils while maintaining profitability.

To come full circle, the project team is also working on a 'Report on the selection of good policy alternatives' at EU and study site level. Three policy briefs have already been published, and Hessel hopes that the project's policy recommendations will assist in the development of policies stimulating the adoption of SICS, as well as contribute to the success of other EU initiatives on soil.

PROJECT
SOILCARE – Soil Care for profitable and sustainable crop production in Europe

COORDINATED BY
Wageningen University in the Netherlands

FUNDED UNDER
Horizon 2020-FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/677407

PROJECT WEBSITE
soilcare-project.eu/en

Better informed farmers for higher freshwater quality

Farmers play a key role in ensuring the safety of drinking water, but they can hardly play their part if they are unaware of their role or the measures they can take. The WATERPROTECT project has set up action labs in seven European regions to raise farmers' awareness and encourage new practices.

We all want water that is crystal clear, safe to drink and devoid of pollutants that may harm valuable ecosystems. For the most part, we can breathe a huge sigh of relief: in the EU, water now is cleaner than it was 25 years ago, and this is largely thanks to the Water Framework Directive which aims to protect and improve it.

But while it is not all doom and gloom, the threats posed by some agricultural practices to Europe's freshwater resources are not to be taken lightly. Pesticides are still a major problem, and so are the nutrient surpluses causing abnormally high concentrations of nitrates and pesticides in water. To this day, half of European waters are considered to be of 'poor ecological status', and this calls for better management practices and effective mitigation measures.

The WATERPROTECT (Innovative tools enabling drinking WATER PROTECTion in rural and urban environments) consortium was tasked with this mission in June 2017. As Ingeborg Joris, researcher at VITO and coordinator of the project, explains: "The project's approach was essentially to sit down and talk with farmers and other stakeholders, inform them about various water quality issues that they may not have been aware of before, and the positive role they can play and solutions they could put in place."

The project's approach was essentially to sit down and talk with farmers and other stakeholders.

An educational approach was essential, as many farmers often hear about the impact of agriculture on the environment only in general terms. Some farmers are not as aware about the environmental issues in their fields' surroundings as others, and neither are they conscious of how some agricultural practices amount to a potential threat to drinking water.

Seven action labs

WATERPROTECT essentially revolved around its seven so-called 'action labs' – local coalitions in agricultural areas with water quality issues linked to drinking water production. "We looked for cases with differences in agricultural practice, climate, levels of farmer awareness, and scale of farms and the drinking water facilities. We ended up with our seven action labs, ranging from small farms in Ireland with an impact on private groundwater wells to farms with large surface areas potentially threatening the drinking water supply of a major city. Other examples include farmers with low environmental awareness farming for their own produce, and well-informed farmers considering an optimal layout for land use in the drinking water capture zone", Joris says.

The action labs were an opportunity not only to raise awareness and promote best management practices, but also to collect valuable data with participation of local actors. The project team developed collaborative management tools bringing information to the local coalitions and feeding discussions. Joris is confident that all this work will, ultimately, contribute to more actions at the local level.

The project's beneficial impact does not have to be limited to the seven selected regions either. Joris and other project partners produced written guidelines on the use of the project's multi-actor approach so that it can be applied in other regions. In the meantime, the action labs have already started bearing fruit. In Belgium for instance, work continues with the local drinking water company providing financial support for the implementation of WATERPROTECT measures by farmers. In Romania, partners have set out to develop an ecotourism destination. In Ireland and Spain, new regional and national projects have been kicked off. Meanwhile, best practice demonstrations continue in Ireland and Italy, in other catchments on the initiative of farmers organisations and advisory organisations.

The project ended in September 2020, but the WATERPROTECT community lives on at the EU level too, with a forum dedicated to sharing experiences and contributing to future actions and research.

PROJECT
WATERPROTECT – Innovative tools enabling drinking WATER PROTECTion in rural and urban environments

COORDINATED BY
VITO in Belgium

FUNDED UNDER
Horizon 2020-FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/727450

PROJECT WEBSITE
water-protect.eu

Introducing the EJP SOIL, a major international initiative to build an integrated research community for climate-smart agricultural soil management

The EU-funded EJP SOIL programme was launched with the mission of bringing together researchers to work on climate-smart and sustainable solutions for agricultural soils.

Launched in February 2020 and lasting 5 years, the European Joint Programme on Soil – or EJP SOIL for short – is bringing together 26 partners from 24 European countries with a total budget of nearly EUR 80 million (with EUR 40 million provided directly by the EU). Its purpose? To create an enabling environment to enhance the contribution of agricultural soils to key societal challenges such as climate change adaptation and mitigation and sustainable agricultural production.

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Whilst officially launched as a Horizon 2020 project, the EJP SOIL will closely align and link with future work to be developed under the EU's newest research and innovation programme, Horizon Europe, including the proposed EU mission in the area of Soil health and food: Caring for soil is caring for life. The project's work is also expected to contribute to the ambitious climate targets outlined in the European Green Deal and its strategies including the Biodiversity Strategy, the Farm to Fork Strategy, the Adaptation Strategy and the European Climate Pact.

The research team, coordinated by the French National Research Institute for Agriculture, Food and Environment (INRAE), have some extremely busy years ahead of them.

A bursting inbox of goals, ambitions and objectives

One of their key targets is the strengthening of the European research community addressing agricultural soil management. This will be achieved through an alignment and implementation of research, education, training and capacity building, as well as developing harmonised agricultural soil information systems and promoting their adoption to achieve global consistency and applicability of agricultural soil information. This would include the crucial issues surrounding soil carbon (essential for climate change mitigation efforts).

From a scientific perspective, new insights are hoped to be gained on climate-smart agricultural soil management and to quantify trade-offs and synergies between sustainable agricultural production, climate change adaption and mitigation, soil degradation, soil quality and other ecosystem services, such as soil control. Through these insights, new knowledge will be developed of carbon sequestration in agricultural soils under different conditions across Europe and its contribution to climate change mitigation.

Of course, all of this new knowledge will also be used as the bedrock for detailed and evidence-based recommendations and advice for policy at EU, national, regional and local level.

Finally, alongside these policy ambitions, the EJP SOIL aims to raise people's awareness on key issues surrounding soil health and foster improved societal understanding of agricultural soil management and its contribution to sustainable agriculture, the fight against climate change and the wider aspects of environmental protection.

PROJECT
EJP SOIL – Towards climate-smart sustainable management of agricultural soils

COORDINATED BY
National Research Institute for Agriculture, Food and Environment in France

FUNDED UNDER
Horizon 2020-FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/862695

PROJECT WEBSITE
projects.au.dk/ejpsoil

Introducing Soil Mission Support, a recently launched initiative to comprehensively map the needs for research and innovation in soil and land management

The Soil Mission Support coordination and support action, launched in November 2020, will bring major research and innovation stakeholders in soil health and management together and promises to be a good supporting initiative for the proposed EU mission in the area of soil health and food.

One of the novelties introduced by Horizon Europe is the concept of 'EU missions'. These are major tools aimed at overcoming some of the greatest challenges facing our world. Missions will operate as a portfolio of actions including research projects,

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policy measures and even legislative initiatives designed to meet a common goal. Five missions areas have been identified, including one mission in the area of soil health and food, titled 'Caring for soil is caring for life', which aims to have 75 % of soils healthy in the EU by 2030.

The SMS (Soil Mission Support: Towards a European research and innovation roadmap on soils and land management) project will very much support the mission's development and implementation during its first years of operation. Over its 2-year lifespan, the project seeks to provide a comprehensive analysis on the needs for research and innovation (R&I) in soil and land management. It will identify gaps, priorities and the type of actions needed for intervention, such as the creation of 'living labs' and 'lighthouses'. The project will also facilitate coordination of existing activities both in Europe and across the world, thereby increasing the visibility and effectiveness of R&I funding.

PROJECT
SMS – Soil Mission Support: Towards a European research and innovation roadmap on soils and land management

COORDINATED BY
Federal Office for Agriculture and Food in Germany

FUNDED UNDER
Horizon 2020-FOOD

CORDIS FACTSHEET
cordis.europa.eu/project/id/101000258

PROJECT WEBSITE
soilmissionsupport.eu

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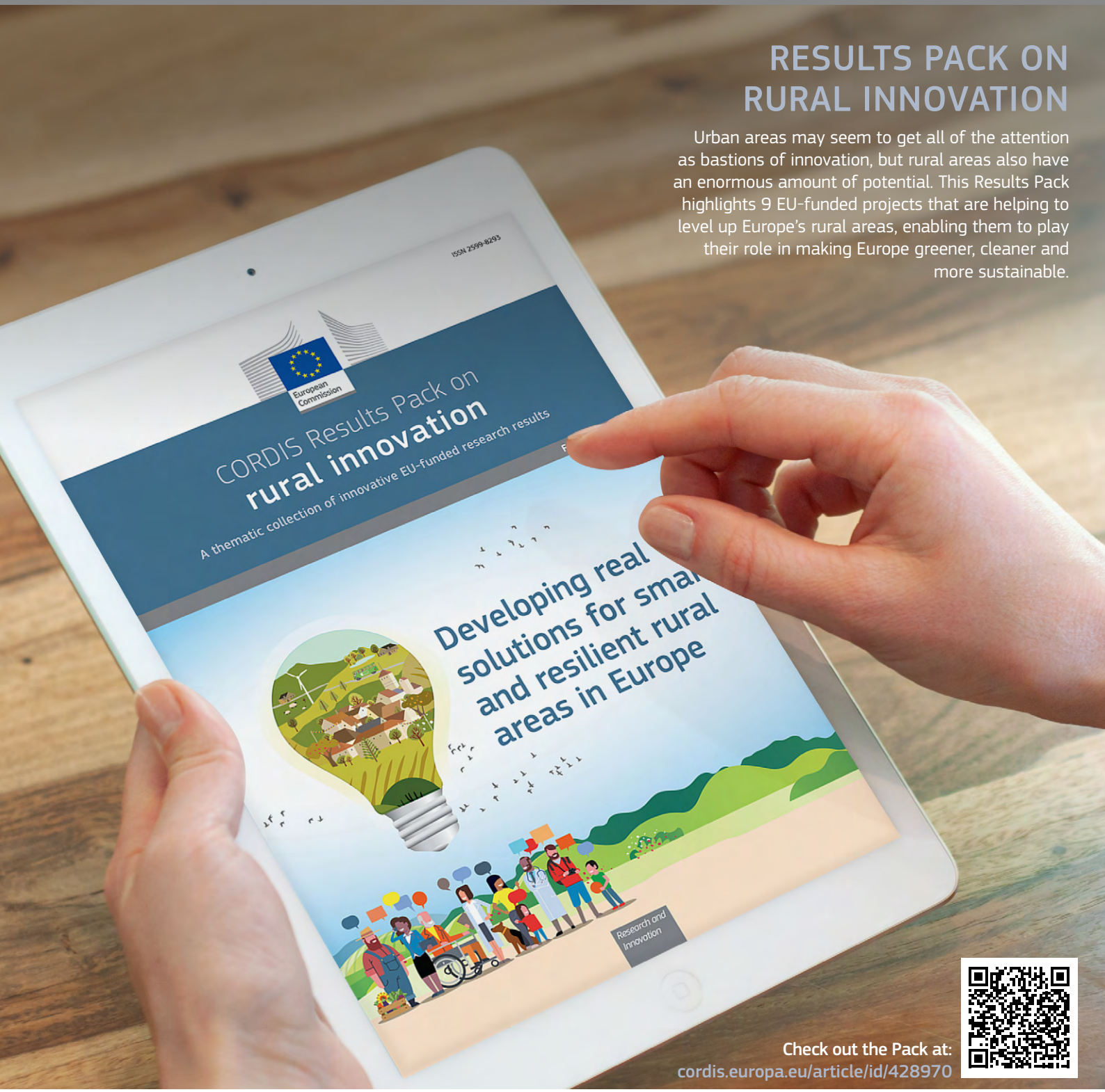
RESULTS PACK ON RURAL INNOVATION

Urban areas may seem to get all of the attention as bastions of innovation, but rural areas also have an enormous amount of potential. This Results Pack highlights 9 EU-funded projects that are helping to level up Europe's rural areas, enabling them to play their role in making Europe greener, cleaner and more sustainable.



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