



CORDIS Results Pack on fertilisers

A thematic collection of innovative EU-funded research results

April 2023

Innovative research for sustainable nutrient management



Research and
Innovation

Contents

3

Bioleaching eco-mining
benefits agricultural
sustainability

6

Circular agronomics
techniques benefit diverse
farming scenarios

9

Nitrogen-fixing microalgae
produce quality organic
fertiliser

11

Identifying microbes that
can boost plant growth
in saline soils

13

Mobile technology
turns organic waste
into fertiliser

15

Towards a more carbon- and
nutrient-efficient
agriculture sector

17

Absorbing phosphate
fertilisers from agriculture
waste water

19

Creating more productive
soils with fewer fertilisers

21

Creating fertiliser
from air – and manure

23

Helping Europe secure water
and nutrients

25

Bringing sustainable
fertilisers to the market

27

New treatment for better
recycling of animal manure

29

A circular economy approach
for waste water treatment

Editorial

Innovative research for sustainable nutrient management

Fertilisers play a fundamental role in food security. Their production and cost is largely dependent on the availability of natural gas, and following Russia's invasion of Ukraine, the world faces a fertiliser crisis that is driving up food prices. This Results Pack on Fertilisers highlights 13 EU-funded research projects that can help alleviate the pressures placed on farmers and consumers, through the innovative synthesis, use and recapture of fertilisers and improved nutrient management.

While humans have been practising agriculture for more than 10 000 years, it was revolutionised a century ago by the innovation of synthetic chemical fertilisers. Today, those transformative inputs are under threat, demanding a new agricultural revolution.

In November 2022, the European Commission presented a [Communication on ensuring availability and affordability of fertilisers](#), highlighting the need to reinforce the overall resilience and sustainability of our food systems.

Research and innovation carried out through Horizon 2020 and its successor Horizon Europe are key drivers in reducing the dependency on fertiliser imports, improving the efficiency of fertiliser use and reducing nutrient losses, thereby ensuring soil fertility and food affordability.

By creating healthy soils rich in organic matter and biodiversity, optimising the efficiency of fertiliser use and enhancing the recovery of nutrients from nutrient-rich side streams such as from manure, food waste or sewage sludge, European farmers can produce healthier crops and higher yields while reducing impact and increasing resilience to climate change.

In addition, crop-livestock integration, more environmentally friendly methods of fertiliser production (including the use of green hydrogen), crop diversification and agroecological plant breeds are helping to reduce the EU's dependency on mineral and fossil fertilisers. Market-based solutions are also crucial to a more sustainable agricultural system, such as the 2019 [EU fertilising products regulation](#) that introduced a single market in organic fertiliser, facilitating trade between EU Member States.

A cleaner, greener Europe

Yet improved nutrient management is about more than defending our agricultural system. In step with the [European Green Deal](#), the [new common agricultural policy](#) includes activities to reduce emissions from fertiliser use as part of overall action on climate change. Reducing fertiliser use also ties into the [Communication on safeguarding food security](#) adopted in March 2022, the [Farm to Fork strategy](#), the [REPowerEU](#) initiative on energy independence, and the goals of the EU Action Plan: '[Towards Zero Pollution for Air, Water and Soil](#)'.

Research and innovation for transition towards healthy soils and sustainable soil management is supported by the EU Mission '[A Soil Deal for Europe](#)'. The [European Innovation Partnership for agricultural sustainability](#) (EIP-AGRI) promotes innovation, knowledge exchange, education and training to ensure farm resilience and competitiveness.

EU-funded research and innovation is accelerating Europe's transition towards sustainable, resilient, circular and competitive farming systems.

Bioleaching eco-mining benefits agricultural sustainability

BioRevolution's bacteria-driven bioleaching process not only mines minerals in an eco-friendlier way, it can produce biostimulants that benefit plant health.

Mining and farming both have significant sustainability challenges.

Mining often uses hazardous chemicals when extracting metals, causing environmental pollution. Furthermore, underinvestment in innovations to better mine local primary and secondary resources, result in a European dependency on imports.

Meanwhile, the widespread use of chemical pesticides and herbicides in agriculture destroys soil microbiomes, reducing the nutrients available to plants. Farmers typically compensate using chemical fertilisers which leach into groundwater, contaminating food and drinking water.



"With a [third of global farmland severely degraded](#), this is a vicious circle. We urgently need viable alternatives," notes Darina Štyriaková, the project coordinator of BioRevolution (Biosolution for global mineral crisis and increased food production without chemicals) and CEO of [ekolive](#), the project host.

The EU-supported project addresses both challenges with a patented biotechnology (InnoBioTech®) which co-opts the natural process of microbial weathering of minerals.

The technology – the most comprehensive of its kind available – has been [ETV-certified](#) and also won the [WUR](#) sustainability award. Two biostimulant products, ekofertile and microfertile, are already in the organic agriculture marketplace.

"Our natural mining innovation gives industrial residue a second life as biostimulants – great for sustainable agriculture and the circular economy!" remarks Štyriaková.

Giving nature a boost

After identifying and collecting the best bacteria for accelerated mineral weathering, the team has developed a patented technique to rapidly multiply them. The bacteria dissolve minerals from raw materials, creating leachates which are then treated to form liquid nutrients.



Our natural mining innovation gives industrial residue a second life as biostimulants – great for sustainable agriculture and the circular economy!

When applied to waste silica sand, probiotic bacteria dissolve minerals, leaving behind pure resistant silica – useful for glass or ceramics for example. The dissolved minerals (such as iron, manganese silicon, cobalt and magnesium), alongside organic acids and proteins, provide biostimulating metabolites for ekofertile.

"Ekofertile revitalises unhealthy plants and increases immunity against pathogens and resistance to high temperatures. It also increases yield, while improving root systems and fruit sugar content," notes Štyriaková.

The second product, microfertile, is based on leaching silicified rock residues, rich in other beneficial microorganisms and their metabolites, and contains all [17 essential plant nutrients](#).

"Microfertile increases chlorophyll and stimulates photosynthesis, with antifreeze proteins preventing frost damage. The nutrients result in more buds and leaves, improving plant quality and yields," adds Štyriaková.

Depending on farming set-ups, the products can be sprayed on leaves or used in drip irrigation for roots.

The fruits of bacterial labour

Six production facilities across central European countries have successfully trialled BioRevolution's range of products.

According to Štyriaková, "tomato yields tripled, with abiotic stress resistance increased up to 35 degrees centigrade. Potatoes were bigger, infection-free and ready for market two weeks earlier, with yields increased by 50 %. Strawberry yields increased 60 % without pesticides, with 150 % more sugar and commercial viability after one growing year. We got similar successes with around 70 other plants."

Reliant only on large basins, not bioreactors, the BioRevolution method is scalable, with no energy consumption needed. The process is also fast, needing only two to seven days processing to generate around 10 billion active bacteria in one litre of biostimulant.

"Our technology simply accelerates a natural process, so that it occurs in days or weeks, not decades," remarks Štyriaková.

'Jack of all trades' technology

Offering a wide variety of possible applications, BioRevolution's technology contributes directly to the EU's [Green Deal](#), with the target of a 50 % reduction in agrochemicals by 2030.

"Aside from providing farmers with higher profits, our solution helps increase food security, saves water, fixes CO₂, decontaminates soil and renews biodiversity," says Štyriaková.

With the technology now mature, the team is currently developing partnerships and preparing a market launch. "To change the mindset of many farmers disappointed by previous bio-alternative products, first we are working with big corporates. Thankfully, the [evidence speaks for itself](#)," concludes Štyriaková.

PROJECT

BioRevolution – Biosolution for global mineral crisis and increased food production without chemicals

COORDINATED BY

ekolive in Slovakia

FUNDED UNDER

Horizon 2020-FOOD

CORDIS FACTSHEET

cordis.europa.eu/project/id/101071680

PROJECT WEBSITE

ekolive.eu



Circular agronomics techniques benefit diverse farming scenarios

More effective nutrient and carbon management increases waste recycling and boosts soil fertility while reducing the emissions of Europe's agri-food industry.



© towaipphoto/stock.adobe.com

Agriculture relies on soils with a healthy mix of carbon, nitrogen, phosphorus and potassium. However, agricultural practices, such as the use of fertilisers, are often inefficient.

Globally, only about a fifth of nitrogen compounds reach useful products. The remaining 80 % is lost as waste, depleting air, water and soil quality, while threatening biodiversity and contributing to accelerated climate change.

Similarly, as phosphate rock is only found in a limited number of countries (Finland has the only significant deposits in the EU), more phosphates are imported to the EU than exported. Owing to current inefficient agricultural practices, large amounts of phosphates also accumulate in water and soil as waste.

"Recovery and reuse of nutrients and carbon from different agri-food waste streams reduces dependence on mineral fertilisers and fossil fuels. This is good for the environment, the circular economy and longer-term EU agri-food security," explains Victor Riau, coordinator of the EU-funded [Circular Agronomics](#) (Efficient Carbon, Nitrogen and Phosphorus cycling in the European Agri-food System and related up- and down-stream processes to mitigate emissions) project.

The project has trialled a range of circular agronomics techniques across six European case studies, each representing different biogeographical conditions and so challenges faced by that region's agri-food sector.

The team conducted impact assessments of nitrogen, phosphorus and carbon stocks, flows and emissions, for the six regions, as well as surveying and interviewing 149 farmers and 5 000 consumers, to better understand their relationship with agri-food issues and acceptance of circular agronomic techniques.

"Our [evaluations](#) of possible agri-food solutions from both an environmental (using Life Cycle Assessment) and socio-economic perspective will offer evidence-based support for the adoption of some of these circular nutrient management practices," says Riau from the [Institute of Agrifood Research and Technology](#) in Spain.

Closing loops across six case studies

The project's case studies represent a range of climates – Mediterranean Catalonia (Spain) and Emilia-Romagna (Italy), continental Brandenburg (Germany), Alpine Lungau (Austria), Atlantic Gelderland (Netherlands) and hot continental South Moravia (Czechia) – each with unique farming characteristics and challenges.

Taking dairy farming as an example, Mediterranean Catalonia represents an intensive farming approach to ruminant livestock and fodder crops production. Applying precision feeding techniques in a dairy farm, the project reduced ammonia nitrogen excretion by about 20 %, while reducing ammonia emissions during manure storage. The manure was then used to fertilise ryegrass fields, improving crop protein content.

Meanwhile, the Alpine Lungau case study was an extensive farming approach. The effects of two feeding strategies on dairy cow methane production were tested – a conventional one (grass silage, maize silage, hay, around 25 % concentrates) and the so-called 'Lungau' diet (grass silage, hay, around 10 % concentrates). The latter was shown to reduce methane emissions by 23 %, as measured by a respiration chamber.

Further innovations across all the case studies also recovered nitrogen, phosphorus and carbon from livestock manure and food waste. For example, bio-based fertilisers were obtained from digestates by separating manure into solid and liquid.

"Solar drying and acidifying the solid fraction recovered about 1.3 times more ammonia nitrogen, reducing ammonia emissions by 72-94 % during the drying process. The liquid fraction was microfiltered for liquid fertiliser and scrubbed to recover nitrogen as ammonium sulphate, an inorganic fertiliser. When tested in crops rotations, the resultant bio-based fertilisers gave the same crop yields as mineral fertilisers," adds Riau.

Using [hyperspectral imaging](#) techniques, the team has also been [analysing the soil profiles](#) of the case studies, mapping carbon, nitrogen and phosphorus distribution, stability and bioavailability, after applying various recovery techniques.



Recovery and reuse of nutrients and carbon from different agri-food waste streams reduces dependence on mineral fertilisers and fossil fuels.

Benefiting a menu of EU strategies

The Circular Agronomics project aligns with many European strategies such as [Farm to Fork](#) (with its target of reducing nutrient losses along the agri-food chain by 50 % by 2030) and the [Green Deal](#), alongside the [nitrate directive](#) and the [new fertilising products regulation](#).

After analysing current policies, the project's [agri-food policy recommendations](#) (pending publication) highlight support for farmers to invest in sustainable technologies and practices, alongside increased access to information and more consumer awareness.

"Our focus now is to get the technologies to market. Some, such as the manure and digestate solar drying and the liquid fraction microfiltration, are almost ready. Others need to be further optimised and scaled up," concludes Riau.

PROJECT

Circular Agronomics – Efficient Carbon, Nitrogen and Phosphorus cycling in the European Agri-food System and related up- and down-stream processes to mitigate emissions

COORDINATED BY

Institute of Agrifood Research and Technology
in Spain

FUNDED UNDER

Horizon 2020-FOOD

CORDIS FACTSHEET

cordis.europa.eu/project/id/773649

PROJECT WEBSITE

circularagronomics.eu



Nitrogen-fixing microalgae produce quality organic fertiliser

The Cyanobacteria project's circular biotechnology – integrated into their AlgaeNite management system – produces high-quality, clean, liquid biofertiliser, maintaining crop yields with zero emissions.



Currently, fertilisers are presenting a barrier to more sustainable agriculture and European food security. Inorganic (mineral fertilisers) are based on synthetic ammonia, which can be hazardous to health. Additionally, the significant amounts of energy required to produce ammonia fertilisers typically come from climate-damaging fossil fuels.

The 150 million tons of ammonia produced globally in 2010 accounted for over [450 million tons of CO₂](#) – about 1 % of CO₂ emissions. Ammonia fertilisers can also compromise soil fertility over time. Added to which, the European supply of mineral fertilisers has been severely impacted by the war in Ukraine, with much previously imported from Russia.

However, more eco-friendly organic products frequently prove inadequate. If integrated into [fertigation](#) systems, their often low levels of nitrogen are not readily available to plants. Animal manure or sewage can also introduce toxic heavy metals and pathogens, alongside hormone and antibiotic residues.

“More expensive than chemical fertilisers but with less yield, organics simply aren’t offering a commercial alternative for the rapidly developing precision agriculture sector,” says Lior Hessel, coordinator of the EU-funded Cyanobacteria (Developing an organic fertilizer production system using nitrogen fixing Cyanobacteria) project.

The project has developed a biotechnology driven by [blue-green algae](#) and powered by the sun, to provide high-quality bio liquid fertiliser. The process is managed through the project's monitoring technology, dubbed AlgaeNite.

"As well as being effective for plant growth, our fertiliser production generates almost no pollution, and with our reduced electricity needs sourced from renewables, is virtually greenhouse gas neutral," adds Hessel from project host, Go Green FoodTech (known as [Growponics](#) globally), pioneers in [hydroponics](#).

The microalgae technology

Cyanobacteria (blue-green microalgae) are first grown in automated light-sensitive photo-bioreactors, which can be placed at the agricultural sites where the fertiliser is needed, minimising transportation, and so costs and emissions.

Powered by the energy of the sun, the cyanobacteria 'fix' nitrogen from the air, synthesising it into a stable form of ammonium, which is then extracted and oxidised by nitrification bacteria to produce nitrate for fertiliser. Negative environmental impacts are avoided, as the water needed for microalgae growth is recycled and the CO₂ emitted from the oxidation process is further used for microalgae growth.

Testing the amount of ammonium, nitrate and other essential minerals, the team found that their reactor's raw stream contains over 2 400 parts per million of ammonium, that can be concentrated to 2 % to 5 % for a final product.

"We also produce more 'available nitrogen' – the type necessary for plant growth – than conventional organic fertilisers," notes Hessel. "Our biofertiliser-grown crops do as well as those grown with top-quality chemical fertilisers. This contrasted to conventional organic fertilisers which reduce crop production by 35 %."

Monitoring for optimisation

To test the technology's operational ability to fertilise commercial quantities of greenhouse crops, the team built a 3 000 litre photo-bioreactor facility at the [Growponics](#) facility in Kfar Bialik, Israel.

For almost a year, this facility has produced enough fertiliser (with a nitrogen content of around 2 500 parts per million) to

continuously feed a hydroponic unit of about 800 metres squared, evidencing the method's ability to complement agricultural water savings.

The project has also developed a management system, AlgaeNite. In this package, a robot uses sensors and cameras, alongside dedicated software, to gather and upload data about the status of the bioreactors. This is then analysed by artificial intelligence, with the results and predictions presented to end users to help decision-making.

"Our automated management solution can be operated remotely to help users optimise bioreactor processing," adds Hessel. With the robot prototype successfully tested, it will now be manufactured in Kfar Bialik for integration into future bioreactor installations.

Coming on stream

The team already has two orders for beta installations. One is from a commercial propagation nursery in Israel, the other an American Growponics farm to help its customers (large agri-food businesses) meet demand for organic produce.

The team now plans to build a full-sized commercial installation, containing both a semi-commercial biofertiliser production site and a research and development campus in Shaar Efraim, Israel.



In 2010, global ammonia production accounted for over 450 million tons of CO₂ – about 1 % of annual emissions.

PROJECT

Cyanobacteria – Developing an organic fertilizer production system using nitrogen fixing Cyanobacteria

COORDINATED BY

Go Green FoodTech in Israel

FUNDED UNDER

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

CORDIS FACTSHEET

cordis.europa.eu/project/id/961930



Identifying microbes that can boost plant growth in saline soils

Beneficial bacteria hold great potential for reducing fertiliser use, but strains must be suited to the soil they are used in. Identifying such strains can help European agriculture towards a more sustainable future.



[Plant growth-promoting rhizobacteria](#) (PGPR) are beneficial microorganisms that live in soil adjacent to the roots of plants, as well as on root surfaces and inside root tissues. There is increasing recognition that these organisms can help provide plants with the necessary elements they need for growth, in a similar way to mineral fertilisers.

“For example, PGPR can fix nitrogen from the air and decompose proteins,” explains NitroFixSal (N fixing bacteria from extreme

environments as a remedy for nitrogen deficiency in saline soils) project coordinator Agnieszka Kalwasińska from [Nicolaus Copernicus University](#) in Poland. “This supplies the soil with ammonium.”

PGPR also produce phytohormones that stimulate plant development, and enzymes that are able to decompose fungal cell walls, protecting plants against pathogens.

Reducing mineral fertiliser and pesticide use

There is significant opportunity to reduce the use of mineral fertilisers and pesticides by exploiting the potential of these naturally occurring bacteria. To be successful at a commercial scale however, scientists need to be able to identify and isolate bacteria species with sufficient survival rates, and use amounts that suit both the soil type and the plant species.



Microorganisms naturally adapted to high-salinity conditions can better promote plant growth under salt stress.

This could be important for both economic and environmental reasons. Prices for chemical fertilisers – including ammonium nitrate, phosphorus and potassium – have increased sharply due to the rising cost of natural gas. Meanwhile, the EU is obliged to reduce the use of these fertilisers in order to meet its [green objectives](#).

“In the NitroFixSal project, we took bacteria with PGPR properties from extreme saline environments,” says Sweta Binod Kumar, a biotechnologist who also worked on the project. “This is because microorganisms naturally adapted to high-salinity conditions can better promote plant growth under salt stress, and contribute to increased plant biomass and protection against pathogens.”

The PGPR strains that the project team extracted underwent extensive investigations in order to characterise their PGPR properties. The strains were applied as biostimulants, to improve the germination of wheat in laboratory conditions.

“The next step involved a field study, in which selected strains were applied to non-sterile soil,” adds Kalwasińska. “Finally, the interactions between bacteria and wheat plants were investigated using advanced molecular methods. This enabled us to better understand the mechanisms of their action.”

Several new strains were characterised. Two bacterial strains were shown to significantly mitigate salt stress in cereals. One of these has since been submitted to the [Polish Collection of Microorganisms](#). Two patents of the isolate, together with its growth promotion effects on wheat, are ready to be submitted to the Polish Patent Office.

“These isolated PGPRs are now potential candidates for biofertilisers,” notes Kalwasińska. “These could eventually benefit in particular farmers facing yield loss of their crops due to high-salinity conditions of the soil.”

Data generated from the project will also help researchers to better understand plant-PGPR interactions at the molecular level. Researchers hope to unravel lesser-known plant growth activity, which could lead to the development of new biostimulator formulations and tools for designing new breeding strategies.

“Our project very much aims to contribute towards sustainable agriculture,” says Kalwasińska.

PROJECT

NitroFixSal – N fixing bacteria from extreme environments as a remedy for nitrogen deficiency in saline soils

COORDINATED BY

Nicolaus Copernicus University in Poland

FUNDED UNDER

Horizon 2020-Spreading excellence; widening participation

CORDIS FACTSHEET

cordis.europa.eu/project/id/101038072

Identifying potential biofertiliser candidates

The NitroFixSal project successfully demonstrated that saline environments are a valuable source of nitrogen-fixing bacteria with various plant growth-promoting potential.



Mobile technology turns organic waste into fertiliser

Technology pioneered by EU researchers brings the equipment necessary to convert digestate into fertiliser to farmers and biogas plants. This could help reduce waste going to landfill and enable European agriculture to transition towards more sustainable and circular practices.

[Anaerobic digestion](#) describes an industrial process where microbes are used to break down organic material, producing renewable biogas. At the end of the process, a nutrient- and microbe-rich material called digestate is left over.

“Digestate is a liquid fertiliser that contains valuable recovered nutrients and fibre that can support crop growth,” explains [NOMAD](#) (Novel Organic recovery using Mobile ADvanced technology) project coordinator Kyriakos Panopoulos from the [Centre for Research and Technology Hellas](#) in Greece. “The characteristics of this digestate stem from the original feedstock source, as well as the process itself.”

A key challenge is that the raw digestate still needs processing to be turned into biofertiliser products that can deliver soil benefits without harming the environment. This is not always possible for farmers or even digestion plants to achieve, as they often lack the equipment to meet necessary quality and safety standards.

In addition, producing large amounts of digestate can create major management issues for small biogas plants, in terms of storage utilisation and disposal. Given that Europe’s climate, waste, energy and agricultural policies are now all oriented towards achieving circularity, overcoming these technical issues has become a matter of urgency.



Mobile solution for sustainable fertilisers

The EU-funded NOMAD project was launched specifically to address these challenges. The goal was to develop a mobile solution – equipped with all necessary technologies – in order to supply farmers directly with digestate-derived fertilisers and soil amenders tailored to their soil and crop requirements.

“Our idea was to develop modular, mobile processing technology that could serve multiple plants,” says Panopoulos. “This would result in shared costs, making it more economically viable than installing systems at individual plants.”

The project brought together partners from China, Greece, Italy, Malta, the Netherlands, Romania and the United Kingdom. The team began by developing innovative, small-scale tech solutions, capable of recovering fibre and specific nutrients from digestate for formulation into high-performance biofertiliser products.

Each stage of the process – from pasteurisation and heat recovery through to digestate separation and nutrient recovery – was then placed onto transportable trailers. “The aim was to really unlock the potential of digestate nutrients and fibre for use in fertilisers,” adds Panopoulos. “Our flexible, modular process can be adapted to address regional challenges.”

Increasing viability of biogas plants

The NOMAD solution was successfully trialled at pilot sites in Greece, Italy, Malta and now the United Kingdom. These demonstrated the versatility of the technology in different geographical locations, climates and soil conditions. The trials also helped to identify specific digestate and regulatory bottlenecks that must be addressed.

“We showed that the NOMAD process is capable of tackling a diverse range of digestates,” notes Panopoulos. “We are still testing at different biogas plants. Technically, the most difficult part of the process is solids handling, and removing these from the digestates.”

The project team plans to finish up their tour of biogas plants in the United Kingdom later this year. A Life Cycle Analysis and business model are also being developed, with a view to commercialising the most promising applications.

“NOMAD’s strategy could lead to pioneering changes in the way digestate is used, in line with the EU’s [bioeconomy strategy](#),” says Panopoulos. “This will help to capture the full value of organic waste for local reuse, and also help to make small biogas plants more economically viable.”



Digestate is a liquid fertiliser that contains valuable recovered nutrients and fibre that can support crop growth.

PROJECT

NOMAD – Novel Organic recovery using Mobile Advanced technology

COORDINATED BY

Centre for Research and Technology Hellas in Greece

FUNDED UNDER

Horizon 2020-FOOD

CORDIS FACTSHEET

cordis.europa.eu/project/id/863000

PROJECT WEBSITE

projectnomad.eu



Towards a more carbon- and nutrient-efficient agriculture sector

By addressing the agriculture sector's nutrient imbalances, researchers are helping to decrease greenhouse gas emissions and reduce soil degradation.



© last19/stock.adobe.com

European agriculture is often characterised by nutrient imbalances, in which an excess of nutrients can negatively impact the environment. "Today's agriculture sector puts great pressure on primary nutrients and energy, which creates gaps in nitrogen, phosphorus and carbon cycles and causes environmental and economic challenges in the EU food supply," say Erik Meers, a professor at [Ghent University](#) and project coordinator of [Nutri2Cycle](#) (Transition towards a more carbon and nutrient efficient agriculture in Europe).

"After use, these nutrients are simply discarded, a practice that can have a negative impact on soil productivity, food security and the environment," adds Çağrı Akyol, a postdoctoral project manager at Ghent University.

With the support of the EU-funded Nutri2Cycle project, Ghent University is leading an effort to close the nutrient cycle. "Tackling the existing nutrient flow gaps in Europe will help decrease greenhouse gas emissions, reduce soil degradation and make the EU more energy- and nutrient-independent," explains Meers.

Putting carbon back into the soil

To start, researchers looked at the nutrient flows and management techniques of various farms across Europe. They also defined indicators to monitor and demonstrate the environmental advantages of more efficient, closed nutrient loops.

Based on this work, the project established 14 innovative pilot cases, so-called [lighthouse demos](#), to test the integration of various on-farm techniques that could help move European agriculture towards a more sustainable future. For example, by creating a better connection between animal husbandry design, agricultural flows and plant production, researchers were able to help farmers sequester carbon in the soil.



Today's agriculture sector puts great pressure on primary nutrients and energy, which causes environmental and economic challenges in the EU food supply.

"The recovery of nitrogen and phosphorus in farms can be significantly improved by creating better synergies between animal breeding and crop production and by integrating the use of such agro-residues as anaerobic digestion," remarks Akyol.

"These improvements will facilitate the return of carbon to the soil and reduce greenhouse gas emissions, which could be combined with the production of energy for self-consumption on-farm," notes Meers.

Most recently, the group was invited by the European Commission to discuss how research and innovation can help address the challenge of food security. "By using the right amount of nitrogen where plants need it most, circular, bio-based fertilisers can help mitigate nutrient loss, boost crop productivity and reduce farming costs," says Meers.

Market-ready techniques

Nutri2Cycle successfully brought forward innovative, market-ready techniques and practices in nutrient recovery and recycling. In fact, as of March 2023, the project has published articles in 38 Science Citation Index Expanded (SCIE) publications.

"We also provided evidence-based, farm-ready solutions for better nutrient management and translated these solutions into practical policy recommendations," concludes Akyol.

Building on the success of the Nutri2Cycle project, researchers have already launched several new EU-funded projects, including [NutriBudget](#) and [Novafert](#), both of which focus on nutrient recovery- and recycling-related activities.

Addressing the food security challenge

To put these concepts into practice, the project established [national task forces](#) in each of the 12 partnering countries. These groups were charged with translating the project's outcomes into the local context and the local language.

Led by Ghent University, the group also works to evaluate legislative barriers to implementing the project's most promising solutions, and advises the European Commission on policy recommendations.

PROJECT

Nutri2Cycle – Transition towards a more carbon and nutrient efficient agriculture in Europe

COORDINATED BY

Ghent University in Belgium

FUNDED UNDER

Horizon 2020-FOOD

CORDIS FACTSHEET

cordis.europa.eu/project/id/773682

PROJECT WEBSITE

nutri2cycle.eu



Absorbing phosphate fertilisers from agriculture waste water

EU researchers created zirconium-based metal-organic frameworks to absorb pollutants from agriculture waste water and reuse them in new fertilisers.

Although chemical fertilisers are an essential part of modern agriculture, they are far from perfect. "Not only are conventional fertilisers highly inefficient, many leak phosphorus into the soil, which has a negative impact on the environment and on human health," says Jorge Rodríguez Navarro, a professor at the [University of Granada](#).

With the support of the EU-funded PSust-MOF (Metal-Organic Frameworks as multifunctional materials toward P-sustainability) project, Rodríguez Navarro, along with his colleague and researcher Francisco Carmona, led an effort to create a circular phosphorous economy.



"The key aim of the project was to develop an innovative adsorbent capable of detoxifying agriculture waste water by recovering – and reusing – phosphate fertilisers," explains Carmona.

Sustainable metal-organic frameworks

To accomplish this goal, the project, which received support from the [Marie Skłodowska-Curie Actions programme](#), focused on an emerging class of porous materials called zirconium-based metal-organic frameworks, or Zr-MOF, which have a high affinity for phosphate groups.

But researchers didn't want to simply create Zr-MOF, they wanted to do so sustainably. "The exceptional properties of metal-organic frameworks make them promising materials for a myriad of applications," remarks Rodríguez Navarro. "Unfortunately, they are typically prepared using toxic solvents and in harsh conditions."

Instead, researchers demonstrated the feasibility of synthesising Zr-MOFs through a microwave-assisted approach. The innovative process uses water as a solvent and can easily and finely modulate the particle size of the resulting materials.

"By making their industrial production easier, less expensive and more sustainable, this process will facilitate the real-world use of these materials," adds Carmona.

Ability to absorb phosphate ions

Beyond developing a sustainable process for making Zr-MOF materials, the project also proved these materials' ability to efficiently absorb phosphate ions at relevant concentrations. Once the phosphate ions are captured, they can then be reused in the making of new phosphate-adsorbent fertilisers.

"We have shown that Zr-MOFs can not only reversibly adsorb phosphate ions, but are able to simultaneously degrade toxic organophosphorous pesticide into innocuous compounds," says Rodríguez Navarro. "This capability opens the door to being able to detoxify the waste water derived from agricultural activities."

Addressing the scarcity and inefficiency challenges

Phosphorous scarcity and fertiliser inefficiency are two pivotal roadblocks to achieving a sustainably productive agricultural sector. The PSust-MOF project has helped overcome both.

"By recovering phosphorus from agricultural waste water and then reusing that phosphorus in the creation of new, effective fertilisers, our work demonstrates the potential of metal-organic frameworks to simultaneously address both the scarcity and the inefficiency challenges by creating a phosphate circular economy," notes Carmona.

"This project successfully raised awareness about phosphorous sustainability and showed how research is the key to finding strategies and solutions to overcome these important challenges," adds Rodríguez Navarro.

Researchers are currently working to advance the processability of metal-organic materials using composites or mixed membrane matrices – an advancement that would allow them to be produced at scale.



Not only are conventional fertilisers highly inefficient, many leak phosphorus into the soil, which has a negative impact on the environment and on human health.

PROJECT

PSust-MOF – Metal-Organic Frameworks as multifunctional materials toward P-sustainability

COORDINATED BY

University of Granada in Spain

FUNDED UNDER

Horizon 2020-MSCA-IF

CORDIS FACTSHEET

cordis.europa.eu/project/id/888972



Creating more productive soils with fewer fertilisers

With a better understanding of how soil's rhizosphere layer is formed, and how it helps nutrients flow into crop roots, researchers hope to be able to create a healthier soil.



The use of chemical fertilisers, providing crops with the nutrients they need to grow, is synonymous with modern farming. Unfortunately, many of our crops – and farmers – have become overly dependent on their use.

This overuse has resulted in soil contamination, in some cases making it nearly impossible to grow crops without the use of environmentally harmful fertilisers. "The challenge is to find solutions that allow farmers to increase yields while reducing

the use of fertilisers," says Lionel Dupuy, a researcher at [Neiker](#), a research centre focused on improving the Basque agro-livestock and forestry sector.

For Dupuy and the Neiker team, the answer wasn't to create a better fertiliser, but rather a healthier soil. With the support of the EU-funded SENSOLS (Sensing soil processes for improved crop nitrogen bioavailability) project, that's exactly what they set out to do.

The dynamics of crop roots and soil microbes

At the heart of the project, which received support from the [European Research Council](#), was an intense study of the dynamics of crop roots and soil microbes. “We focused on rhizosphere, the layer of soil that surrounds plant roots, which is where a lot of biological activity takes place,” explains Dupuy.



The challenge is to find solutions that allow farmers to increase yields while reducing the use of fertilisers.

With a better understanding of how the rhizosphere is formed and how it contributes to nutrients flowing into the roots, researchers hoped to be able to essentially build a better soil. But, as often is the case in research, things don't always go as planned.

“First, the microorganisms we chose to work with ended up being very slow growing, making their genetic transformation very difficult to achieve,” adds Dupuy. “Even working with a more common type of microorganism proved to be more difficult than initially planned.”

Observing changes in the soil's composition

While these challenges may have forced the project to reduce the overall scope of its research, it also allowed them to focus their efforts on the most promising ideas – ideas that included the ability to perform live microscopy within soil pores. “This ability allows us to observe changes in the soil's chemical composition, essentially letting us see the rhizosphere in action,” remarks Dupuy.

One thing they saw was how bacteria coordinate to migrate as flocks through the soil's pores. According to Dupuy, this

discovery is important as it could open the door to developing solutions that maintain populations of beneficial microbes along the roots, ultimately resulting in the creation of healthier, non-fertiliser-dependent crops.

Artificial soils

With this new insight in hand, the project went on to develop a range of artificial soils that can act as sensors and record chemical changes within the soil. “Our research showed that by inventing artificial soils and using innovative imaging technologies, we can track microbial interactions and their impact on crop roots and the chemical composition of the soil itself,” notes Dupuy.

While these outcomes are important, Dupuy says that there's plenty more work to do. “The SENSOILS project is just the start, and its results will keep our lab busy for the foreseeable future,” he concludes. “But I have no doubt that our work in understanding soil ecosystems will ultimately lead to new solutions that will define a more sustainable and more productive agricultural sector of the future.”

PROJECT

SENSOILS – Sensing soil processes for improved crop nitrogen bioavailability

HOSTED BY

Neiker – Basque Institute for Agricultural Research and Development in Spain

FUNDED UNDER

Horizon 2020-ERC

CORDIS FACTSHEET

cordis.europa.eu/project/id/647857



Creating fertiliser from air – and manure

Using a mixture of air, manure and electricity, a company has developed a new, environmentally friendly fertiliser that can be produced where it is needed.

Half of the world's population is dependent on food grown with chemical nitrogen fertilisers. The production of these fertilisers relies on fossil gas and coal, which results in significant [greenhouse gas](#) emissions. Nitrogen is also lost – as ammonia into the air, and by leaching into waterways – where it acts as a serious pollutant.

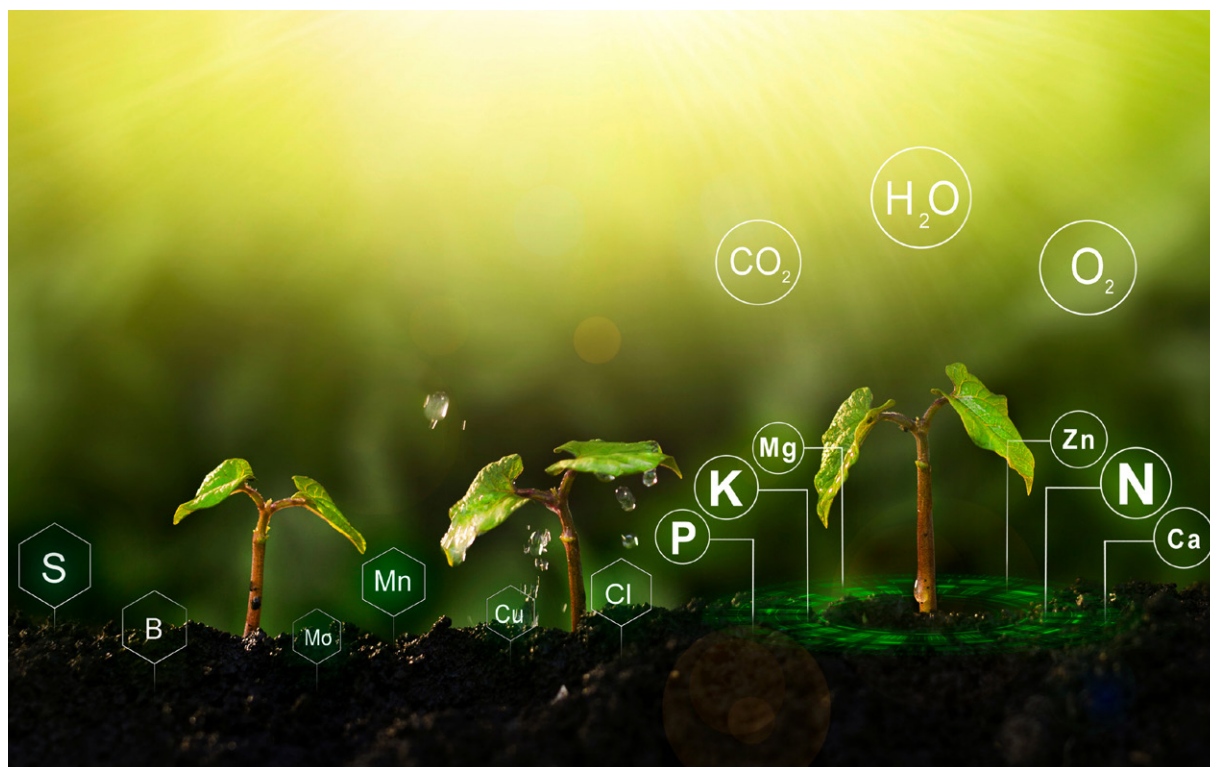
The EU-funded [SmartNitroFarm](#) (Local fertiliser production by plasma treatment) project improved and commercialised a groundbreaking technology to solve both of these problems, providing an environmentally friendly circular solution on the farm.

SmartNitroFarm is a system that uses livestock slurry, air and electricity to produce fertiliser locally, drastically reducing carbon emissions and boosting crop yields at the same time.

"The technology adds nitrogen from the air into slurry, which increases the nitrogen content," explains [Helen Kvande Due](#), business development manager at [N2 Applied](#) in Norway. "The reaction prevents the loss of ammonia and eliminates methane emissions, making it a real solution helping to achieve climate target commitments on an industrial scale," she adds.

Market preparations and pilot trials

N2's unit can be installed locally on farms or in biogas plants. It is roughly the size of a shipping container and easily fits into existing farm infrastructure. Liquid manure is treated prior to storage, and kept available for use when necessary.



By adding air and electricity into the liquid manure, the system creates a nitrogen-enriched organic (NEO) fertiliser, with the same characteristics as slurry, but with a higher nitrogen content. This means it can still be spread using existing farm equipment and boosts yields.



The technology adds nitrogen from the air into slurry.

The overall objective of the SmartNitroFarm project was to prepare the technology for commercialisation. In the first part of the project, the team ran pilot trials in different markets and designed the next generation of the technology based on feedback from this phase. In the second part, the team addressed business and market development, and communication, to ensure a successful market entry.

Six pilot farms were selected to take part in the trials, with a unit installed at each one. This allowed the researchers to test the technology's operation in a real-world environment, and then test the performance of the fertiliser. The results of these trials also fed into the design of the first commercial unit.

Farmer feedback and new partnerships

"The most important results include successfully completing the assembly, installation and operation of the six pilot units in different markets," notes Due. "In addition, results on the business development side include signing a partnership agreement with global agricultural distributor [GEA](#), and launching the next-generation N2 Unit at the [EuroTier trade show](#) in Hannover," she says.

During the project, the team mapped stakeholder and potential customer needs, in addition to a pilot feedback survey with the pilot farmers. "Overall, all pilot customers were satisfied with the project and very interested in the technology," Due adds. "The main issue identified is a lack of subsidies and government support for farmers to reduce emissions."

Future innovation

Through progress made during the SmartNitroFarm project, the technology has reached [technology readiness level \[TRL\] 8](#). "We will work with our new partner, GEA, to bring the technology to TRL 9," says Due. "Additionally, a main focus going forward is working to get governmental support to excel the adoption of the technology."

PROJECT

SmartNitroFarm – Local fertiliser production by plasma treatment

COORDINATED BY

N2 Applied in Norway

FUNDED UNDER

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

CORDIS FACTSHEET

cordis.europa.eu/project/id/101008819

PROJECT WEBSITE

n2applied.com/euprojects/eic



Helping Europe secure water and nutrients

Climate change is expected to hamper European agriculture by affecting water and nutrients needed to grow crops. New crop genotypes and agroecosystem management aim to improve the situation.



© sergei_fish13/stock.adobe.com

Two of the expected impacts of climate change are limitations in water accessibility and shortages of the major nutrients needed to grow crops. “Water is expected to be more limited in many areas of Europe, while nutrients may become less available partly as a consequence of greater water scarcity,” explains [Philippe Hinsinger](#), senior scientist at [INRAE Montpellier](#) and project coordinator of [SolACE](#) (Solutions for improving Agroecosystem and Crop Efficiency for water and nutrient use).

Major nutrients such as nitrogen and phosphorus are also applied by farmers through the use of fertilisers, which carries significant environmental impacts. Increasing the sustainability of European [agriculture](#) thus implies reduced use of fertilisers, resulting in more frequent situations of nitrogen or phosphorus limitation for crops.

The EU-funded SolACE project aimed to overcome these obstacles by designing new crop genotypes able to grow in these challenging conditions. The team also devised a series of management practices to support European agriculture, for both organic and conventional farming systems.

“Further decreasing the use of these fertilisers in Europe is absolutely needed for environmental reasons, as well as for economic reasons due to the increasing and fluctuating cost of fertilisers,” Hinsinger adds.

Innovative crop genotypes

Novel crop genotypes can better forage and exploit below-ground resources such as water and nutrients at depth, or achieve larger yields with less water or fewer nutrients being consumed.

"In the context of SolACE, we dedicated much of our efforts to improving the acquisition efficiency as related to below-ground traits, which was the grand challenge of our project," Hinsinger says.

The team grew around 250 [crop genotypes](#) of bread wheat and durum wheat, using imaging technologies to assess root traits. Smaller panels for potato genotypes were also investigated.

The SolACE team also formulated a new breeding strategy. Root phenotype data led to the development of genomic selection models, which were successfully tested to improved crop performance in bread and durum wheat. The consortium also used biotechnologies to design hybrids in bread wheat and potatoes.

The researchers devised a range of novel agroecosystem management practices, which were tested in pilot studies in the lab and then through field experiments in various locations across Europe.

To further test these new strategies, the project ran on-farm experiments in seven farmers' networks throughout Europe, and put substantial effort into modelling crop yields under future climate scenarios. "The use of crop models in combination with scenarios for a future climate in different regions of Europe showed a wide diversity of crop responses," explains Hinsinger. "These were negative in southern and eastern regions and rather positive in many other areas: there yield improvement due to increased CO₂ and temperature may occur," he adds.

Policy and future research

SolACE outputs include a range of [EIP-AGRI](#) abstracts, videos, training materials, and publications in specialised and scientific press and communication at conferences. The team also created a series of policy briefs, which provide key policy recommendations to address these specific challenges.

"Further exploitation of some of these findings is currently being considered for the work, involving small and larger biotech companies," says Hinsinger. "Engagement with the project has raised interest and enthusiasm for the tested innovations, especially among farmers."



We dedicated much of our efforts to improving the acquisition efficiency as related to below-ground traits.

PROJECT

SolACE – Solutions for improving Agroecosystem and Crop Efficiency for water and nutrient use

COORDINATED BY

INRAE in France

FUNDED UNDER

Horizon 2020-FOOD

CORDIS FACTSHEET

cordis.europa.eu/project/id/727247

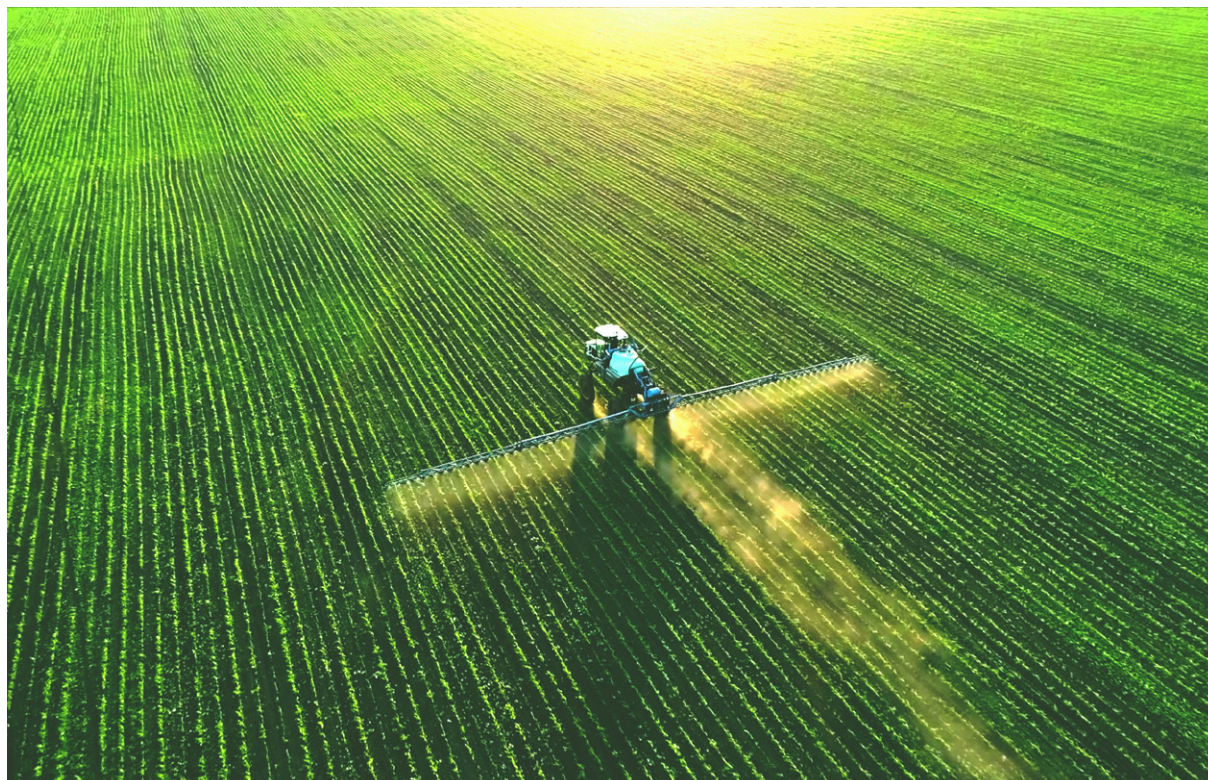
PROJECT WEBSITE

solace-eu.net



Bringing sustainable fertilisers to the market

An innovative new technology creates fertilisers from air, electricity and slurry.
Now the product is being prepared for commercial application.



© Mase Schneider/stockadobe.com

Chemical fertilisers can exert a heavy toll on the environment. Their production typically relies on fossil fuel use, which drives up carbon emissions. In their final application on the farm, nitrogen can escape into the air or nearby waterways, causing further pollution.

The EU-funded [SmartNitroFarm](#) project created an environmentally and ecologically friendly alternative, using air and electricity to turn animal slurry into a high-quality fertiliser. The EU-funded [Sustainable Manure](#) (Fertiliser from air by plasma treatment) project worked to take this idea to the next commercial level.

Bringing an idea to commercial reality

"The Sustainable Manure project focused on developing the next-generation plasma technology," explains [Trond Lund](#), head of business development at [N2 Applied](#). For the technology to become commercially viable, several aspects of the system had

to be improved. The energy input per ton of processed material needed to be brought down, as did the initial capital cost of the system. The team also worked to improve the lifetime and maintenance of consumable plasma electrodes, a fundamental part of the fertiliser system.

The Sustainable Manure project achieved improvements on all these factors and showed that the research in the project can be scaled and used in practical commercial machines on farms.

"The achievement of improved energy efficiency was documented at lab scale and has the potential to change the way we supply nitrogen for food production," says Lund. "The next step is to make this available in full-sized commercial systems which will take some time," he notes.

The project successfully developed the underlying technology and also created a pathway of how to reduce the cost of the plasma system. The next step is to make commercial systems available to the market, which has a short to intermediate time frame.

“On the development of consumables, the results have already been implemented in the next-generation systems already being built and on their way as commercial units to farms in 2023,” remarks Lund.

Forging strategic partnerships

Thanks to the success of the project in demonstrating and improving the technology, the Sustainable Manure team was able to secure a strategic partnership with [GEA](#) to introduce the technology commercially.



Seeing the units on their way to being rolled out in the market really feels that we are on the way to improving global food production.

This partnership aims to scale up and accelerate the adoption of the fertiliser technology, to bring the benefits of sustainable manure to a global market. The initial markets being targeted for commercial release are Germany, the Netherlands, the Nordics and the United Kingdom.

“We are very proud of having achieved technical improvements directly affecting the likelihood of commercial

success of the N2 technology,” Lund adds. “As plasma treatment enables local nitrogen production from electricity, recycles the nutrients on the farm and has a big impact on the carbon footprint of the produce, seeing the units on their way to being rolled out in the market really feels that we are on the way to improving global food production.”

PROJECT

Sustainable Manure – Fertiliser from air by plasma treatment

COORDINATED BY

N2 Applied in Norway

FUNDED UNDER

Horizon 2020-Framework Programme, Horizon 2020-Societal Challenges and Horizon 2020-LEIT

CORDIS FACTSHEET

cordis.europa.eu/project/id/965546

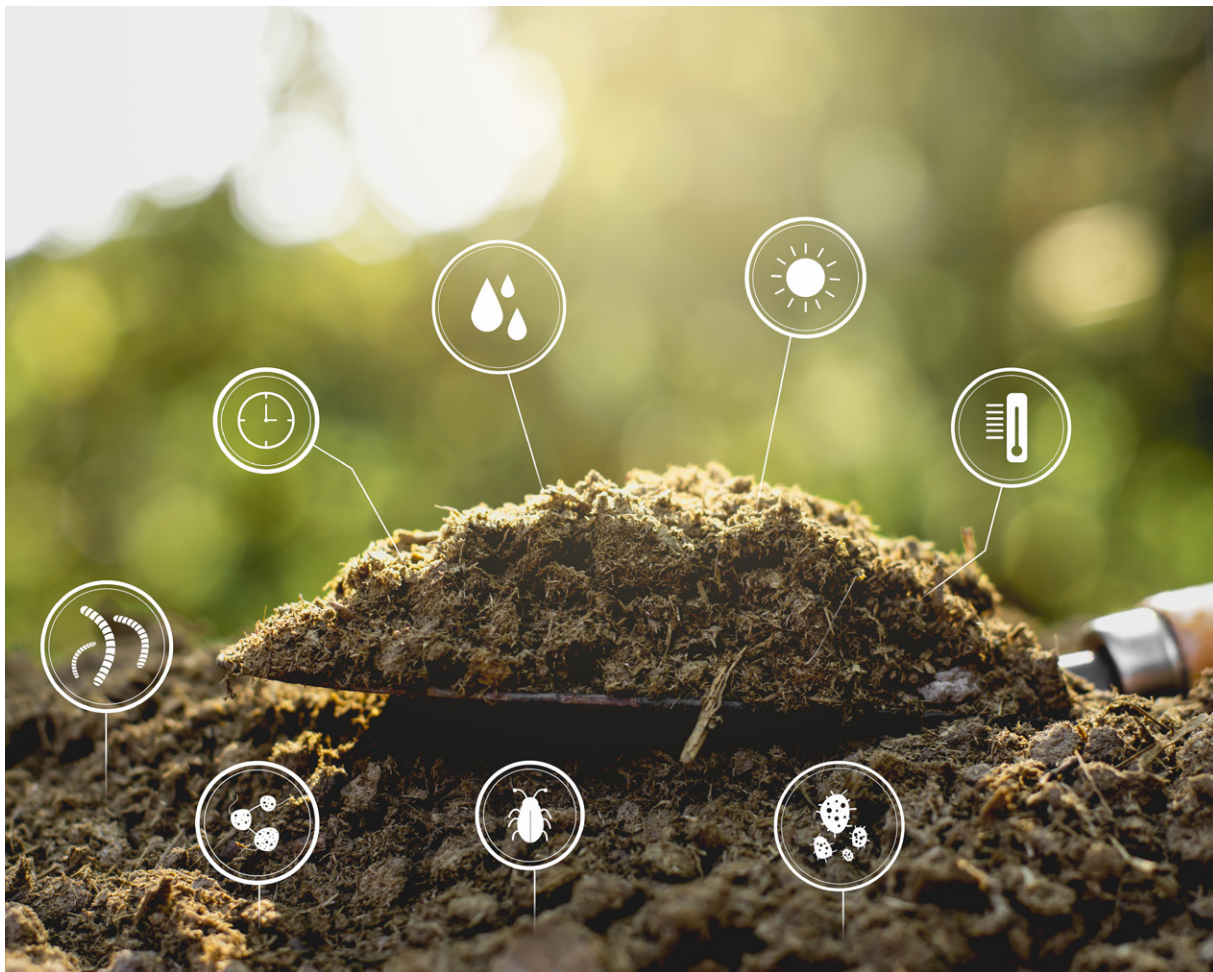
PROJECT WEBSITE

n2applied.com/euprojects/fti



New treatment for better recycling of animal manure

Industrialised farming creates vast amounts of concentrated, environmentally harmful animal manure. A new project devised a way to turn it into a better fertiliser, and an energy source.



Intensified [farming](#) can improve food security for Europe and the world, yet there is a problematic by-product: manure. If not processed correctly, manure has significant environment impacts.

Ammonia emissions from livestock production lead to multiple environmental detriments, such as eutrophication, soil acidification and fine particulate matter formation. Yet less than 8 % of livestock manure in Europe is treated to reduce emissions, according to the Treat2ReUse (Treatment of Animal Waste to Reduce Gaseous Emissions and Promote Nutrient Reuse) project.

Raw or treated manure could also be used as an energy source, for example in biogas energy plants, reducing dependence on fossil fuels. Chemical treatments for this exist, yet carry some

disadvantages: organic farmers cannot use industrial acids required, and the acid-treated manure cannot be used in large quantities in biogas energy plants.

In the EU-funded Treat2ReUse project, undertaken with the support of the [Marie Skłodowska-Curie Actions programme](#), researchers created a biological alternative.

"The main objective of the project was to find a biological treatment method for animal manure to reduce the potentially large amounts of ammonia and greenhouse gas emissions," says [Lars Stoumann Jensen](#), professor in the Department of Plant and Environmental Sciences at the [University of Copenhagen](#) in Denmark and Treat2ReUse project coordinator.

Finding an ecological solution

Jensen and his team developed and tested a new biological acidification practice, which involves fermentation to produce bioacidification by microbes already present in the manure. "The bioacidification treatment could potentially substitute the need for high-tech, high-safety sulfuric acid storage and handling," explains [Iria Regueiro](#), a post-doctoral researcher working on the Treat2ReUse project.



I am proud of being able to work on the development of an alternative manure treatment technology, which could be beneficial for both farmers and the environment.

This fermentation is augmented by adding easily degradable sources of carbon, which the bacteria feed on to produce lactic acid. In real-world settings, this carbon could come from common farm residues, such as straw, sugar beet tops and molasses.

"When manure pH is low, the ammonia is kept in the manure in soluble form and not lost to the atmosphere," adds Regueiro. "Furthermore, the manure

fertiliser value increases, as more ammonium, an essential plant nutrient, is kept in the manure instead of being lost as ammonia, representing a co-benefit of the treatment."

investigated how plant nutrient uptake is affected when the bioacidified manure was applied as a fertiliser.

"The most important result is that bioacidification of manures by fermentation works very effectively, when either sugar or a residue from plant protein biorefining is added," notes Regueiro. The results showed that pH can be reduced to below 5, significantly inhibiting ammonia and methane emissions.

The team would like to follow up by running a biological treatment on an experimental farm, and to test different residues for their potential in creating biogas and fertilisers.

"I am proud of being able to work on the development of an alternative manure treatment technology, which could be beneficial for both farmers and the environment," Regueiro says. "And that my research proved it actually works!"

Proving the fermentation process

After identifying optimal conditions for the treatment, the team studied how the bioacidification reduced ammonia and greenhouse gas emissions during storage. Finally, they

PROJECT

Treat2ReUse – Treatment of Animal Waste to Reduce Gaseous Emissions and Promote Nutrient Reuse

COORDINATED BY

University of Copenhagen in Denmark

FUNDED UNDER

Horizon 2020-MSCA-IF

CORDIS FACTSHEET

cordis.europa.eu/project/id/795974



A circular economy approach for waste water treatment

An EU-funded project offers a novel solution for recovering and recycling nutrients with high market value in the agricultural sector from slaughterhouse waste water.



© Water2REturn consortium

About 30 % of Europeans are affected by [water stress](#), and approximately [five tonnes of waste](#) are produced by the average European each year. Water scarcity and resource recovery are two issues the EU is focused on finding sustainable solutions for. Such solutions are particularly necessary when dealing with the slaughtering sector, a water-intensive industry producing enormous amounts of waste water containing high proportions of organic matter.

This is where the EU-funded [Water2REturn](#) (REcovery and REcycling of nutrients TURNing wasteWATER into added-value products for a circular economy in agriculture) project steps in. “We propose an integrated solution for slaughterhouse waste water treatment as well as for the recovery of valuable nutrients with a high market value in the agriculture sector,” notes Pilar Zapata, project coordinator.

Water2REturn technology adopts a circular economy approach. Nutrients and energy resources present in waste waters are safely and efficiently recycled in different forms and then injected back into the agricultural system as new raw materials.

“Waste water is, therefore, a source of nutrients, energy and water, and no longer a waste; waste water treatment facilities become ‘biorefineries’,” adds Zapata.

A full-scale demonstration process

To test the Water2REturn technology, the project set up a viable, cross-sectoral and integrated full-scale demonstration process in the real case study ‘Matadero del Sur’, a slaughterhouse in Salteras, Spain.

“We used a novel combination of biochemical and physical technologies and processes in cascade, all while aiming for a positive balance in terms of energy footprint,” explains Zapata.

Discussing the main results, Zapata says: “Not only did we develop an integrated treatment for waste water, but we also developed a nutrients and energy recovery system constituted by four separated but interlinked process units: water line, sludge line, energy line and algae line.”



*Not only did we
develop an
integrated treatment
for waste water, but
we also developed
a nutrients and
energy recovery
system.*

This has led to the recovery of secondary raw materials (SRM): nutrients concentrate (SRM1), hydrolysed sludge (SRM2) and algal biomass (SRM3). Due to the low nitrogen concentration in the waste water of the Matadero del Sur slaughterhouse, SRM1 was deemed commercially unfeasible but instead a good candidate for the direct fertilisation of local fields near the slaughterhouses.

SRM2, on the other hand, has high availability of organic matter, which can be used in other biological processes, such as anaerobic digestion. "It was the base for the formulation of a biostimulant that can increase the productivity of crops," remarks Zapata. And it has been tested on melon, tomato and cucumber crops.

"SRM3 was the base for formulating an effective biostimulant as proven in several crops and fruits such as cucumber and apricot," notes Zapata. Greater vegetative development is obtained when it is applied to soil, and when applied on the leaves it increases the intensity and quality of flowering and sprouting and of the fruit yield.

"It has also been proven to be a competitive product, performing equally well as top products in the market but constituting a much bigger eco-friendly alternative to them," adds Zapata.

"Additionally, thanks to the outcomes of the project's activities, together with the business plan and the techno-economical assessment's conclusions, it is estimated that Water2REturn solutions can generate turnover of EUR 29.4 million in the seventh year after the project, generating direct and indirect jobs," concludes Zapata.

PROJECT

Water2REturn – REcovery and REcycling of nutrients TURNing wasteWATER into added-value products for a circular economy in agriculture

COORDINATED BY

Bioazul in Spain

FUNDED UNDER

Horizon 2020-ENVIRONMENT

CORDIS FACTSHEET

cordis.europa.eu/project/id/730398

PROJECT WEBSITE

water2return.eu

Green jobs and industries for nutrient recovery and recycling

The end user, Matadero del Sur, aims to maintain part of the modules and transform the present demonstrator into a real-scale system.



CORDIS Results Pack

Available online in 6 language versions: cordis.europa.eu/article/id/443142



Published

on behalf of the European Commission by CORDIS at the
Publications Office of the European Union
2, rue Mercier
L-2985 Luxembourg
LUXEMBOURG

cordis@publications.europa.eu

Editorial coordination

Staffan VOWLES, Maria SERFIOTI

Disclaimer

Online project information and links published in the current issue of the CORDIS Results Pack are correct when the publication goes to press. The Publications Office cannot be held responsible for information which is out of date or websites that are no longer live. Neither the Publications Office nor any person acting on its behalf is responsible for the use that may be made of the information contained in this publication or for any errors that may remain in the texts, despite the care taken in preparing them.

The technologies presented in this publication may be covered by intellectual property rights.

This Results Pack is a collaboration between CORDIS, the Directorate-General for Agriculture and Rural Development, the European Innovation Council and SMEs Executive Agency (EISMEA), the European Research Executive Agency (REA), and the European Research Council Executive Agency (ERCEA).



@EUAagri
@HorizonEU



@EUAagri
@EUScienceInnov



@euagrifood
@eu_science



REA LinkedIn
EISMEA LinkedIn

Print	ISBN 978-92-78-43437-3	ISSN 2599-8285	doi:10.2830/378268	ZZ-AK-23-003-EN-C
HTML	ISBN 978-92-78-43493-9	ISSN 2599-8293	doi:10.2830/004644	ZZ-AK-23-003-EN-Q
PDF	ISBN 978-92-78-43438-0	ISSN 2599-8293	doi:10.2830/511080	ZZ-AK-23-003-EN-N

Luxembourg: Publications Office of the European Union, 2023
© European Union, 2023



The reuse policy of European Commission documents is implemented by [Commission Decision 2011/833/EU of 12 December 2011 on the reuse of Commission documents \(OJ L 330, 14.12.2011, p. 39\)](https://eur-lex.europa.eu/eli/reg/2011/833/oj).

Unless otherwise noted, the reuse of this document is authorised under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence (<https://creativecommons.org/licenses/by/4.0/>)

This means that reuse is allowed provided appropriate credit is given and any changes are indicated.

Cover photo: © European Union, 2023

For any use or reproduction of elements that are not owned by the European Union, permission may need to be sought directly from the respective rightholders.

RESULTS PACK ON AGROECOLOGY – NEW EDITION

Europe's farming sector has achieved great success, but this has often come at the cost of environmental degradation, land and water pollution, negative impacts on biodiversity, and a high carbon footprint. Agroecology offers a resilient and sustainable system that can benefit the climate, the ecosystem and society.



Check out the Pack here:
cordis.europa.eu/article/id/442635



Publications Office
of the European Union



Follow us on social media too!
facebook.com/EUresearchResults
twitter.com/CORDIS_EU
youtube.com/CORDISdotEU
instagram.com/eu_science

EN