DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

D6.6 Practice Abstracts – batch 1

29/11/24 Version 0.1

Pamela Cardillo, ERINN Innovation

PU – Public

Funded by the European Union

Funded by the European Union under the Horizon Europe Programme, Grant Agreement No. 101112855 (DeliSoil). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them. Swiss partners (FiBL) have received funding from the Swiss State Secretariat for Education, Research and Innovation (SERI).

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EXECUTIVE SUMMARY

DeliSoil aims to provide industry stakeholders, farmers, and local communities with innovative and practical solutions to improve soil health and productivity through the co-creation of sustainable soil improvers derived from food industry byproducts. The project focuses on enhancing the circular use of organic resources while addressing challenges such as soil degradation, nutrient loss, and carbon sequestration. DeliSoil activities are primarily concentrated in five European regional Living Labs located in Finland, Denmark, Germany, Spain, Italy. These Living Labs represent diverse agricultural and environmental settings, serving as real-world testing grounds for the project's methodologies and innovations.

Through establishing five regional Living Labs and various Lighthouses, DeliSoil facilitates collaboration among researchers, farmers, industries, and citizens to co-develop and implement solutions tailored to local conditions. The anticipated project results include tested methodologies, training and workshops, new technical solutions for processing food industry byproducts into organic soil improvers and fertiliser products and the creation of new value chains for food industry side-streams, among others. All of the results and resources created by the project aim to empower stakeholders to adopt circular and sustainable soil management practices while contributing to improved economic and environmental outcomes.

Aligned with the project's goal of scaling its solutions across Europe and beyond, DeliSoil will produce numerous practice abstracts in formats inspired by EIP-AGRI. These abstracts will summarise the project's findings and tools for practical application by various stakeholders. They will be compiled in two batches and submitted as deliverables entitled *"D6.6 Practice Abstracts – batch 1"* at month 18 and *"D6.7 Practice Abstracts – batch 2"* in month 42. The practice abstracts will follow a consistent format, capturing general and specific information about each practice, including audiovisual resources developed as part of the project. A graphically designed template has been developed for the practice abstracts to increase their visual attractiveness, encourage their uptake and make them easier for practitioners to navigate.

This report *"D6.6 Practice Abstracts – batch 1"* outlines the objectives, methodology, and outcomes from the first batch of practice abstracts. In total 8 abstracts were collected, of these 7 are included in the first batch, and one is awaiting further results before progression. These abstracts come from Finland, Italy, Spain, Austria, Poland and Germany. They are diverse in their subject matter ranging from testing of technologies to highlighting co-creation methodologies employed within the Living Labs; all provide a foundation for scaling and replicating DeliSoil's innovations in other contexts.

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INTRODUCTION

WHAT IS A PRACTICE ABSTRACT?

An EIP Practice Abstract is a concise summary of practical information and innovative practices in agriculture, produced in line with the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI). These abstracts are designed to disseminate knowledge and innovations among farmers, advisors, researchers, and other stakeholders in the agricultural sector.

Key characteristics of an EIP Practice Abstract include:

- **Practical Focus:** They provide practical insights and recommendations that can be directly applied by farmers and other practitioners in the field.
- **Conciseness:** Each abstract is typically limited to 1500 characters, making it easy to read and understand quickly.
- **Content:** They cover a wide range of topics related to agriculture, including new technologies, farming practices, sustainability measures, and research findings.
- **Accessibility:** These abstracts are meant to be widely accessible, often translated into multiple languages to reach a broader audience across Europe.
- **Public Dissemination:** The abstracts are publicly available, aiming to foster knowledge exchange and collaboration within the agricultural community.

By summarising key findings and practical recommendations, EIP Practice Abstracts play a crucial role in bridging the gap between research and practical application in agriculture, promoting innovation and sustainability in the sector.

PRACTICE ABSTRACTS IN DELISOIL

Practice Abstracts are detailed in the project's Description of Action as follows:

*"The project details will be **submitted to the EIP-AGRI** platform with the first deliverable submission (D6.6, M18). **End-user material** will be produced in the form of a number of **summaries for practitioners** (D 6.7, M42) in the **EIP common format** ("practice abstracts")."*

Table 1. Practice Abstract Deliverables

Deliverable No	Deliverable Name	Work Package	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D6.6	Practice Abstracts – batch 1	WP6	ERINN	R-Report	Public	18
D6.7	Practice Abstracts – batch 2	WP6	ERINN	R-Report	Public	42

DeliSoil project has been submitted to the EIP-AGRI platform and we are currently awaiting confirmation of our acceptance on same (as of November 2024). The Practice Abstracts in this deliverable will be added to the EIP-AGRI platform upon acceptance.

METHODOLOGY FOR THE COLLECTION OF PRACTICE ABSTRACTS

PROCESS FOR COLLECTION

Phase 1: Capturing of Practice Abstracts using Knowledge Transfer Methodology.

Effective Knowledge Transfer (KT) relies on careful identification and description of Practice Abstracts (PA) to ensure that all key information is provided which will result in effective transfer. Quality control measures will be performed to ensure that the PAs can be clearly understood by others who may not be experts in the relevant disciplines. Each partner will treat information from other partners as confidential unless otherwise stated and not disclose it to other parties unless the information is publicly available. This stage aims to understand the positioning of a PA to be better able to carry out impactful KT activities and clarify how the PA could be beneficial to different target and end users.

It's important to consider that PAs are likely to be further developed over the course of DeliSoil, particularly those captured at the beginning of the project. This knowledge will be regularly reviewed by ERINN and partners asked to provide updates as necessary.

PROTOCOL – KNOWLEDGE COLLECTION AND VALIDATION

a. *ERINN will circulate a **Practice Abstract Collection Template** (see below for template) to DeliSoil WP Leaders (or Task Leaders where appropriate) throughout the project to capture any potential knowledge outputs which could be submitted as Practice Abstracts.*
b. *ERINN will then refine the Practice Abstract description and share with the knowledge owner, who will be asked to review for accuracy and suggest additions.*
c. *Once all are satisfied with the accuracy of the captured knowledge, the Practice Abstract(s) will be marked as "confirmed".*
d. *Next, **the Executive Board will carry out an IP assessment for each Practice Abstract collected**. To provide guidance on whether the information is apt for public dissemination.*
e. *Should Researchers have any IP concerns related to the Practice Abstract they should engage with their institution's technology transfer office to seek guidance on the appropriateness of public dissemination of the knowledge.*
f. *If required, the Practice Abstract(s) owner will be asked to provide further information to the Executive Board, who will provide guidance until all relevant parties are satisfied with IP protection and future public dissemination, communication, and exploitation of the Practice Abstract.*
g. *Once the IP assessment is completed, or if an IP assessment is not deemed necessary, Practice Abstract(s) will progress to the analysis stage.*

ANALYSE FOR KNOWLEDGE TRANSFER

Phase 2: The collected Practice Abstracts are reviewed for potential application and impact.

Once validated, PAs go through a Due Diligence process, whereby a more thorough examination and evaluation of the PA and its applicability and readiness for inclusion in the Practice Abstract Deliverables (D6.6, D6.7) and its submission to the EIP-AGRI platform will be investigated. Following Due Diligence, PAs will be prioritised and those ready for transfer will be included in the Practice Abstract Deliverables and submitted to the EIP-AGRI platform.

Any PA that is not included in D6.6 and D6.7 will continue to be regularly reviewed and any remaining at the end of the project will still be captured as evidence of project results and included in final reporting and/or submitted to the EIP-AGRI platform as appropriate. The exercises in this phase may also serve to identify potential stakeholders that are worth connecting with, even in cases where the knowledge may not yet be ready for transfer.

PROTOCOL – KNOWLEDGE ANALYSIS

a. *At periodic intervals,* ***ERINN will organise "expert analysis meetings" together with the Executive Board.*** *These meetings could include for example relevant task leaders, WP5 relevant stakeholders, and other experts appointed by the Executive Board. The frequency and makeup of these meetings will be determined in collaboration with the Project Coordinator as well as based on the current status of knowledge collection and management in the project.*
b. *The expert analysis meetings will conduct a comprehensive examination and evaluation of the Practice Abstracts (collected so far) and their applicability and readiness for submission to D6.6/D6.7 and the EIP-AGRI Platform. Participants in these meetings will be asked to:*
    i. *Confirm accuracy and feasibility of each presented PA, to the best of their understanding.*
    ii. *Assign to each PA a ranking to determine whether it should be prioritised for progression based on its current status.*
    iii. *Discuss and identify potential target users to whom the knowledge should be transferred to progress it towards its eventual impact.*
c. *After each expert analysis meeting, ERINN will review the PA description to identify any progression of knowledge.*
d. *Practice abstracts which are green-lighted for inclusion in D6.6/D6.7 and submission to the EIP-AGRI Platform will go through a translation process if deemed appropriate.*

If any questions emerge from the expert analysis meeting, ERINN will reach out to the relevant PA owners to attempt to provide an answer.

PRACTICE ABSTRACT COLLECTION TEMPLATE

PRACTICE ABSTRACT TEMPLATE

Knowledge Output Owners:
Knowledge Output Contact:
Please provide the name, organisation and contact details of the individual(s) who should act as the contact person for this KO. If the beneficiary/owner of the KO differs from the contact person then please indicate so. ***For internal DeliSoil use.***

Last Updated: *The date of validation*

Status:

IP Disclaimer: Practice Abstracts may be publicly disseminated. Therefore, please do not provide any information that is confidential, proprietary, or that you do not wish to be made public. Ensure all submissions are free of sensitive intellectual property or trade secrets. By submitting information, you agree that it may be shared publicly without restriction.

Author(s)/organisation/entities:

Practice Abstract Title in English: *Please provide a short and concise title to describe the Practice Abstract.*

EIP Practice Abstracts Format
Short summary for practitioners in English on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). This summary should at least contain the following information:

- *Main results/outcomes of the activity (expected or final);*
- *The main practical recommendation(s): what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results?*

This summary should be as interesting as possible for farmers/end-users, using direct and easily understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.

Region(s), country:

Stakeholders:

Audiovisual material which is useful and attractive for practitioners (e.g. YouTube link, videos, other dissemination material)

Contact:

Consent to Publicly Disseminate

☐ **I acknowledge that Practice Abstracts may be publicly disseminated. I consent to the sharing of the information I provide, understanding that it may be made public. I confirm that I have not included any confidential, proprietary, or sensitive intellectual property in my submission.**

Legend:

Green Box: Information may be shared publicly

Purple Box: Information to inform consent of public dissemination

White Box: Information internal to DeliSoil project

PRACTICE ABSTRACTS

DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Pyrolysis: A Sustainable Solution for Fish-Processing Waste Management and Soil Health Improvement

Practice Abstract 1

Summary

Pyrolysis technology offers a valuable solution for managing fish-processing waste, especially fish bones, creating high-value products that enhance agricultural productivity and sustainability. Through heating fish bones in an oxygen-free environment, pyrolysis produces biochar rich in essential minerals like calcium and phosphorous. This biochar not only improves soil structure, water retention, and nutrient availability but also serves as an effective soil amendment that can boost crop yields with fewer inputs like synthetic fertilizers. Additionally, it sequesters carbon, contributing to environmental sustainability by reducing greenhouse gas emissions.

For practitioners, pyrolysis offers cost-effective waste management, turning farm residues into valuable soil amendments. This reduces reliance on synthetic inputs and provides a sustainable solution for boosting long-term productivity. With minimal investment and scalability options, farmers can integrate this technology into their daily operations, gaining both economic and environmental benefits.

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Country:
Spain, Europe

Keywords:
Soil health
Circular economy

Stakeholders:
Industry
Farmers
Farmer Associations

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Practice Abstract 1

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Practical Recommendations

For optimal use, farmers can apply fish-bone biochar to soil as a natural source of calcium and phosphorous. Combining it with compost enhances nutrient availability, supporting better crop yields and soil health.

Needs addressed by the practice

Alleviating challenges in implementing pyrolysis technology, including technical, regulatory and economic issues, and for farmers using biochar, understanding its optimal application, overcoming sourcing, and ensuring cost-effectiveness.

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About DeliSoil

The EU-funded DeliSoil project is a four-year initiative that aims to transform food industry byproducts into safe, sustainable, and tailored soil improvers. This project addresses two pressing challenges: the poor recycling of industrial food processing byproducts and the degradation of soil health.

By harnessing a circular approach, DeliSoil will contribute to improving soil health and productivity, supporting the EU Mission "A Soil Deal for Europe" and the Farm to Fork Strategy, as well as other Circular and Bioeconomy Strategies and Plans.

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Delivering soil improvers from circular food production processes to boost soil health

Practice Abstract 2

Organising Effective Co-creation Workshops for Soil Projects: Insights from the DeliSoil Experience

Summary

On October 22nd, the DeliSoil and NutriBudget projects hosted an international co-creation workshop that brought together 48 participants across the soil and nutrient management sectors. This workshop aimed to foster collaboration among diverse stakeholders—ranging from industry representatives and financing institutions to farmers and NGOs—while gathering input on project needs and priorities. The sessions were structured such that each project had a brief 15-minute presentation, followed by a 55-minute interactive online survey via Mentimeter where participants were asked to provide insights on a range of topics relevant to guiding research in the projects.

Participants represented a balanced mix from the food value chain, providing quality feedback that could shape the project's direction. Insights and comments were collected via the Mentimeter inquiry, enabling real-time input from stakeholders across Europe. Key takeaways emphasised the importance of high-quality stakeholder engagement, the value of having international perspectives, and the benefits of maintaining high engagement levels throughout the session.

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Country:

Primarily Europe, with a focus on international perspectives within the soil management sector.

Keywords:

Soil health
Circular economy
Co-creation

Stakeholders:

Industry
Farmers
Farmer Associations
NGOs
Financial Institutions
Others involved in the Food-Value Chain

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Practice Abstract 2

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Practical Recommendations

Start Planning Early to manage logistics, secure speakers, create engaging content, and coordinate with project teams effectively.

Identify Key Stakeholder Groups and understand their needs to engage them personally and encourage participation.

Co-Host with Related Projects, combine events, enhancing impact, reducing stakeholder fatigue, and enriching experiences.

Curate Content to Match Stakeholder Interests with tailored presentations and discussions, ensuring relevance and encouraging active engagement.

Incorporate Interactive Elements like Mentimeter surveys, breakout sessions, Miro board groups, or Q&A segments. This fosters collaboration, real-time insights, and caters to attendees' interests.

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Limit Event Duration and Focus on Key Topics identified through feedback, ensuring targeted content that prevents fatigue and maintains engagement.

Post-Event Follow-Up to strengthen connections and maintain stakeholder interest by sharing materials and requesting feedback after the event.

Analyse and Apply Feedback Data from tools like Mentimeter to refine strategies for legislative considerations, financing options, and product development, based on stakeholder group insights.

Needs addressed by the practice

Supporting practitioners in designing and conducting engaging, effective co-creation workshops that promote collaboration and high-quality stakeholder input in soil and nutrient management projects.

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By harnessing a circular approach, DeliSoil will contribute to improving soil health and productivity, supporting the EU Mission "A Soil Deal for Europe" and the Farm to Fork Strategy, as well as other Circular and Bioeconomy Strategies and Plans.

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Practice Abstract 3

Food Industry By-Products and Waste Derived Fertilising Products for Soil Health – Barriers and Enablers in Legislation and Policies

Summary

A study focusing on the barriers and enablers within current EU and member state legislation, as well as soft law frameworks, that affect the transformation of food industry by-products into recycled soil amendments and fertilizers. The research analyzes how these regulatory and policy frameworks either hinder or facilitate the upscaling of innovative circular practices.

The study examines 17 value chains across five European countries (Finland, Denmark, Germany, Italy, and Spain) and their respective Living Labs. These value chains were analyzed in detail through stakeholder surveys conducted in each Living Lab, to assess the legislative and soft law contexts, and provide recommendations for improving these frameworks in their country and region. Stakeholder input was crucial to understanding the regulatory landscape throughout the value chains, from input to final fertilizing product, focusing on both enablers and barriers within the policy frameworks.

In addition to the country-specific value chains, the study also explores four innovative technologies at the EU level: pyrolysis of food-grade animal bone grist for biophosphate production, solar-powered algal treatment for fruit and vegetable processing wastewater, mobile advanced technology for conversion of digestate to high-quality fertilizers, and CAP and aerobic fermentation to yield microbial proteins from agricultural bio-waste. These technologies are analyzed separately to evaluate how current legislative and policy frameworks at the EU level support or present challenges to their scalability and broader adoption.

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Living Lab Regions, Europe

Keywords:

Soil health
Circular economy
Value Chains

Stakeholders:

Policy Makers
Industry
Research
Farmers

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Practice Abstract 3

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Delivering soil improvers from circular food production processes to boost soil health

Practical Recommendations

The analysis includes a review of relevant legislation, identification of best practices, and suggestions for improvements to foster a more supportive environment for circular innovations in soil management. The results and recommendations, expected to be ready in early 2025, will provide insights into how regulatory frameworks can be adjusted to better support the adoption of these technologies and practices. These insights will help inform policy makers on practical steps that can be taken to create a more favourable environment for the use of recycled soil amendments, considering existing barriers and challenges.

The expected added value for practitioners includes better guidance on navigating legislative barriers, understanding enabling policies, and ultimately supporting nutrient recycling and soil health improvements by using innovative technologies.

Needs addressed by the practice

Helping stakeholders to select suitable solutions for improving soil health.

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About DeliSoil

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By harnessing a circular approach, DeliSoil will contribute to improving soil health and productivity, supporting the EU Mission "A Soil Deal for Europe" and the Farm to Fork Strategy, as well as other Circular and Bioeconomy Strategies and Plans.

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DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practice Abstract 4

Generation and Valorisation of Food Industry Side Streams in Finland

Summary

DeliSoil project aims to convert food processing side streams (by-products or waste materials generated during production processes, which can potentially be reused or repurposed into valuable resources) into soil improvers and fertilisers. In order to achieve this goal, it is crucial to identify the status of side stream production and valorisation.

In Finland, the food industry is the fourth largest industrial sector. The food industry employs around 40,000 people, and in 2023 there were approximately 2,600 companies in the food and beverage industry. The food industry side streams in Finland correspond to a total of more than 400,000 tonnes of biomass from different food industries. The largest share of sidestreams is generated in the processing of dairy products. The meat, fish and vegetable processing industries also produce large amounts of by-products each year. However, it is important to note that the data on the production of side streams only include larger industrial actors, excluding small industries such as bakeries.

In Finland, the considerable distances between regions pose challenges for making full use of by-products and waste streams, known as "side streams." These distances increase the costs and logistical complexity of collecting, transporting, and processing these materials, making it harder to turn them into valuable resources effectively.

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Country:
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Keywords:
Soil health
Circular economy
Value chains

Stakeholders:
Policy Makers
Industry
Research

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Practice Abstract 4

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Practical Recommendations

Currently, the valorisation of food industry side streams into fertiliser products is mainly based on conventional processing technologies such as anaerobic digestion and composting. The majority of food industry side streams are currently used as value-added products, i.e. animal feed, fertilisers and soil improvers in agriculture and landscaping, but also as raw materials for other products.

However, there is still a need to develop the processing of side streams in Finland. There is high potential for the production of value-added products through more innovative use of side streams to improve the recovery of organic matter and nutrients and their use in agriculture and food production.

Needs addressed by the practice

Knowledge on the current status of food industry side stream generation, utilisation and valorisation. Helping food producers find circular solutions to increase the value of their side-streams.

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Practice Abstract 5

Key Stakeholder Analysis in the DeliSoil Project

Summary

DeliSoil project is designed to introduce innovative soil improvers by advancing the recycling and processing of food industry residue streams. To comprehend the roles, influence, and interests of various stakeholders a comprehensive analysis was conducted. The results identified a wide range of stakeholders essential for the project's success. The list of DeliSoil key stakeholder follows the Quadruple Helix Model. In the context of the DeliSoil project, this model provides a comprehensive lens through which to analyse and engage with stakeholders across multiple sectors and domains.

- **Science:** Scientists, research institutions, and projects from the Mission Soil group.
- **Policy:** Agriculture associations and policymakers at international, national, and regional levels.
- **Industry and Producers:** Soil amendments producers, fertiliser producers, waste management facilities, food and beverage producers, farmers, and horticulturists, agricultural advisors and EIP groups.
- **Civil Society:** Local communities, citizens, and consumers.

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Europe, Global

Keywords:

Soil health
Circular economy

Stakeholders:

Science
Policy Makers
Industry
Producers
Civil Society

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Practice Abstract 5

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Delivering soil improvers from circular food production processes to boost soil health

Practical Recommendations

The stakeholder analysis presents several advantages. By identifying and engaging with key stakeholders, practitioners can enhance collaboration, driving innovation and the adoption of best practices. Understanding the influence and interests of different stakeholders allows for more strategic planning and resource allocation. Engaging with policymakers ensures compliance with regulations, securing necessary approvals and support, while insights from civil society stakeholders help in adapting products to meet market demands and societal values, thereby enhancing public trust and project legitimacy.

The comprehensive stakeholder analysis conducted in the DeliSoil project emphasises the importance of engaging with a diverse range of stakeholders. The inclusive approach ensures that the project remains resilient, innovative, and aligned with societal needs and regulatory requirements. This practice not only amplifies the project's impact but also contributes to broader environmental sustainability and agricultural resilience.

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Needs addressed by the practice

Identification and engagement with key stakeholders can foster collaboration, driving innovation and adoption of best practices. Understanding the influence and interests of different stakeholders enables more strategic planning and resource allocation.

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DeliSoil

Practice Abstract 6

DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Biochar, Compost, and Digestate Significantly Improve Soil Health Metrics, Crop Yields, and Environmental Sustainability

Summary

An analysis of the impact of different amendments on soil health was carried out through a data mining activity. This involved collecting and analysing datasets from European projects and related long-term experiments. Three main soil improvers were considered:

Biochar: Enhances soil by raising pH, increasing organic carbon by 10–20%, and boosting water and nutrient retention. It supports microbial diversity and activity, improving plant health and resilience against pests. Biochar can raise microbial respiration by up to 40%, promoting nutrient cycling and disease suppression.

Compost: Raises soil organic carbon by up to 3%, improving soil structure, water retention, and fertility, especially in arid areas. It increases carbon and nitrogen levels, supporting plant nutrition and soil resilience. Compost applications can boost crop yields by 10–30%, depending on soil and crop type.

Digestate: Provides a quick nutrient boost, increasing soil inorganic nitrogen by 30–50%, supporting rapid crop growth. Rich in nitrogen, digestate is beneficial but requires careful management to prevent runoff and odors, with application limited to specific periods in some regions to minimise environmental impact.

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Country:
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Keywords:
Soil health
Circular economy

Stakeholders:
Farmers
Farmer Associations

Practice Abstract 6

DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practical Recommendations

- To enable comprehensive assessment of the impacts of these three soil improvers, or new ones, well-structured field trials should be performed.
- Conduct well-structured field trials and implement regular soil testing as part of continuous monitoring.
- Use randomised block designs to accurately measure effects across different conditions, and conduct long-term monitoring over multiple seasons to adjust practices and optimise soil health.
- Develop targeted strategies to reduce nutrient leaching and greenhouse gas emissions, ensuring sustainable soil health improvements.

Regular soil testing data should inform adaptive management, adjusting soil improver type, quantity, and timing to match changing soil and crop conditions. This approach maximises benefits and minimises environmental impacts.

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Needs addressed by the practice

Summarising main outcomes and recommendations from EU projects that have used soil improvers.

About DeliSoil

The EU-funded DeliSoil project is a four-year initiative that aims to transform food industry byproducts into safe, sustainable, and tailored soil improvers. This project addresses two pressing challenges: the poor recycling of industrial food processing byproducts and the degradation of soil health.

By harnessing a circular approach, DeliSoil will contribute to improving soil health and productivity, supporting the EU Mission "A Soil Deal for Europe" and the Farm to Fork Strategy, as well as other Circular and Bioeconomy Strategies and Plans.

Funded by the European Union

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DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practice Abstract 7

Food Industry By-Products and Waste Derived Fertilising Products for Soil Health

Summary

Farmers and industries that produce agricultural or food processing waste have the potential to convert waste streams into high-quality bio-based fertilizers (BBFs) using a variety of technologies. This guideline helps identify the most suitable waste streams, allowing stakeholders to choose the most efficient technologies for their specific materials. The primary waste types include agricultural residues (e.g., plant clippings, manure), food processing by-products (e.g., animal bone grist, acid whey, fruit peels), and industrial waste such as digestate from biogas production.

Technologies for BBF production are diverse in foundation, costs, and potential results. Examples of these technologies are:

- **Pyrolysis**: Converts woody residues (e.g., tree clippings) into biochar, improving soil, storing carbon, and producing bioenergy.
- **Hydrothermal Carbonisation (HTC)**: Transforms wet waste into hydrochar and nutrient-rich liquid fertilisers without drying.
- **Struvite Precipitation**: Recovers phosphorus from liquid waste to create slow-release fertilisers.
- **Fermentation**: Turns food waste into bio-fertilisers and biostimulants, boosting crop growth and soil health.
- **Anaerobic Digestate with Algae**: Recycles digestate nutrients, producing algae biomass for bio-fertilisers.
- **Membrane Filtration**: Separates nutrients from liquid waste streams using microfiltration, ultrafiltration, or reverse osmosis, recovering clean water and nutrient-rich fertilisers.
- **Mobile Digestate Processing Units**: On-site processing of digestate, reducing transport needs for smaller farms.
- **Enzymatic Hydrolysis**: Breaks down protein-rich wastes into bioavailable plant nutrients.
- **Insect Cultivation**: Uses organic residues to breed insects (e.g., black soldier flies), producing nutrient-rich frass and insect biomass for fertilisers.

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Country:

Europe and Beyond

Keywords:

Soil health
Circular economy

Stakeholders:

Cooperatives
Farmers
Agricultural Advisors

@DeliSoil_EU @DeliSoil DeliSoil.eu

Practice Abstract 7

DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practical Recommendations

Classify Your Waste Stream: Identify waste type (plant, animal, industrial) and form (e.g., woody residues for biochar, liquids for fermentation).

Perform Chemical Analysis: Test waste for nutrients (e.g., nitrogen, phosphorus) and contaminants (e.g., heavy metals) to guide technology choice and ensure safety and compliance.

Select the Right Technology: Match technology to waste type; use Pyrolysis, HTC, and fermentation for solids/slurries, and membrane/algal methods for liquids. Adapt for maximum nutrient recovery.

Optimise Environmental Impact and Compliance with Regulations: Apply the Product Environmental Footprint (PEF) and NOVAFERT framework to minimize environmental impact and ensure regulatory compliance.

Assess Crop Impact: Conduct field trials to measure crop yield, growth, nutrient uptake, and disease resistance. Confirm that BBFs boost productivity, improve soil, and reduce chemical fertilisers

Identify Business Opportunities and Business Barriers: Explore markets beyond fertilisers, like bio-stimulants or bioenergy. Perform cost-benefit analyses and support circular economy goals with resource efficiency. New Living Lab data will refine BBF tech and economic viability.

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Needs Addressed by the Practice

Helping farmers to select suitable solutions, nature based and technical, to improve soil health.

About DeliSoil

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CONCLUSION

DeliSoil is producing a comprehensive set of Practice Abstracts aligned with the EIP-AGRI format to achieve its objective of bringing safe, regulated, sustainable fertiliser products to market and promoting their use. These Practice Abstracts will assist in scaling sustainable soil management solutions across Europe and fostering collaboration with other initiatives that promote circular and sustainable soil practices.

To date, 7 Practice Abstracts have been developed and have been included in this deliverable. They highlight co-creation activities, stakeholder analysis, technologies scoping and other undertakings conducted within the project's Living Labs. These abstracts document the methodologies used, capture key recommendations, and offer insight into the collaborative processes that brought together industry stakeholders, researchers, and local communities. Additional Practice Abstracts will be developed in the coming months, focusing on the applications of soil improvers and sustainable fertiliser products, strategies for circular soil management, and lessons learned from the Living Labs. All outputs will be consolidated and made available by the project's conclusion, ensuring broad accessibility and practical applicability.

The practices collected so far emphasise the importance of participatory, bottom-up approaches that actively involve stakeholders as co-creators of innovative solutions. By prioritising collaboration, DeliSoil empowers participants to play a central role in designing, testing, and implementing soil health strategies that are locally relevant and effective.

The practices shared in this first collection serve as replicable models, offering actionable insights and approaches for others to leverage DeliSoil's outputs. By sharing these practices, the project aims to inspire and support broader adoption of sustainable and circular soil management strategies across diverse contexts.

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ANNEX 1: HIGH QUALITY A4 SIZE PRACTICE ABSTRACTS

DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practice Abstract 1

Pyrolysis: A Sustainable Solution for Fish-Processing Waste Management and Soil Health Improvement

Summary

Pyrolysis technology offers a valuable solution for managing fish-processing waste, especially fish bones, creating high-value products that enhance agricultural productivity and sustainability. Through heating fish bones in an oxygen-free environment, pyrolysis produces biochar rich in essential minerals like calcium and phosphorous. This biochar not only improves soil structure, water retention, and nutrient availability but also serves as an effective soil amendment that can boost crop yields with fewer inputs like synthetic fertilizers. Additionally, it sequesters carbon, contributing to environmental sustainability by reducing greenhouse gas emissions.

For practitioners, pyrolysis offers cost-effective waste management, turning farm residues into valuable soil amendments. This reduces reliance on synthetic inputs and provides a sustainable solution for boosting long-term productivity. With minimal investment and scalability options, farmers can integrate this technology into their daily operations, gaining both economic and environmental benefits.

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Country:

Spain, Europe

Keywords:

Soil health
Circular economy

Stakeholders:

Industry
Farmers
Farmer Associations

Practice Abstract 1

DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practical Recommendations

For optimal use, farmers can apply fish-bone biochar to soil as a natural source of calcium and phosphorous. Combining it with compost enhances nutrient availability, supporting better crop yields and soil health.

Needs addressed by the practice

Alleviating challenges in implementing pyrolysis technology, including technical, regulatory and economic issues, and for farmers using biochar, understanding its optimal application, overcoming sourcing, and ensuring cost-effectiveness.

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DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practice Abstract 2

Organising Effective Co-creation Workshops for Soil Projects:

Insights from the DeliSoil Experience

Summary

On October 22nd, the DeliSoil and NutriBudget projects hosted an international co-creation workshop that brought together 48 participants across the soil and nutrient management sectors. This workshop aimed to foster collaboration among diverse stakeholders—ranging from industry representatives and financing institutions to farmers and NGOs—while gathering input on project needs and priorities. The sessions were structured such that each project had a brief 15-minute presentation, followed by a 55-minute interactive online survey via Mentimeter where participants were asked to provide insights on a range of topics relevant to guiding research in the projects.

Participants represented a balanced mix from the food value chain, providing quality feedback that could shape the project's direction. Insights and comments were collected via the Mentimeter inquiry, enabling real-time input from stakeholders across Europe. Key takeaways emphasised the importance of high-quality stakeholder engagement, the value of having international perspectives, and the benefits of maintaining high engagement levels throughout the session.

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Country:

Primarily Europe, with a focus on international perspectives within the soil management sector.

Keywords:

Soil health
Circular economy
Co-creation

Stakeholders:

Industry
Farmers
Farmer Associations
NGOs
Financial Institutions
Others involved in the Food-Value Chain

Practice Abstract 2

DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practical Recommendations

Start Planning Early to manage logistics, secure speakers, create engaging content, and coordinate with project teams effectively.

Identify Key Stakeholder Groups and understand their needs to engage them personally and encourage participation.

Co-Host with Related Projects, combine events, enhancing impact, reducing stakeholder fatigue, and enriching experiences.

Curate Content to Match Stakeholder Interests with tailored presentations and discussions, ensuring relevance and encouraging active engagement.

Incorporate Interactive Elements like Mentimeter surveys, breakout sessions, Miro board groups, or Q&A segments. This fosters collaboration, real-time insights, and caters to attendees' interests.

Limit Event Duration and Focus on Key Topics identified through feedback, ensuring targeted content that prevents fatigue and maintains engagement.

Post-Event Follow-Up to strengthen connections and maintain stakeholder interest by sharing materials and requesting feedback after the event.

Analyse and Apply Feedback Data from tools like Mentimeter to refine strategies for legislative considerations, financing options, and product development, based on stakeholder group insights.

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Needs addressed by the practice

Supporting practitioners in designing and conducting engaging, effective co-creation workshops that promote collaboration and high-quality stakeholder input in soil and nutrient management projects.

About DeliSoil

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DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practice Abstract 3

Food Industry By-Products and Waste Derived Fertilising Products for Soil Health - Barriers and Enablers in Legislation and Policies

Summary

A study focusing on the barriers and enablers within current EU and member state legislation, as well as soft law frameworks, that affect the transformation of food industry by-products into recycled soil amendments and fertilizers. The research analyzes how these regulatory and policy frameworks either hinder or facilitate the upscaling of innovative circular practices.

The study examines 17 value chains across five European countries (Finland, Denmark, Germany, Italy, and Spain) and their respective Living Labs. These value chains were analyzed in detail through stakeholder surveys conducted in each Living Lab, to assess the legislative and soft law contexts, and provide recommendations for improving these frameworks in their country and region. Stakeholder input was crucial to understanding the regulatory landscape throughout the value chains, from input to final fertilizing product, focusing on both enablers and barriers within the policy frameworks.

In addition to the country-specific value chains, the study also explores four innovative technologies at the EU level: pyrolysis of food-grade animal bone grist for biophosphate production, solar-powered algal treatment for fruit and vegetable processing wastewater, mobile advanced technology for conversion of digestate to high-quality fertilizers, and CAP and aerobic fermentation to yield microbial proteins from agricultural bio-waste. These technologies are analyzed separately to evaluate how current legislative and policy frameworks at the EU level support or present challenges to their scalability and broader adoption.

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Country:

Living Lab Regions, Europe

Keywords:

Soil health
Circular economy
Value Chains

Stakeholders:

Policy Makers
Industry
Research
Farmers

Practice Abstract 3

DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practical Recommendations

The analysis includes a review of relevant legislation, identification of best practices, and suggestions for improvements to foster a more supportive environment for circular innovations in soil management. The results and recommendations, expected to be ready in early 2025, will provide insights into how regulatory frameworks can be adjusted to better support the adoption of these technologies and practices. These insights will help inform policy makers on practical steps that can be taken to create a more favourable environment for the use of recycled soil amendments, considering existing barriers and challenges.

The expected added value for practitioners includes better guidance on navigating legislative barriers, understanding enabling policies, and ultimately supporting nutrient recycling and soil health improvements by using innovative technologies.

Needs addressed by the practice

Helping stakeholders to select suitable solutions for improving soil health.

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DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practice Abstract 4

Generation and Valorisation of Food Industry Side Streams in Finland

Summary

DeliSoil project aims to convert food processing side streams (by-products or waste materials generated during production processes, which can potentially be reused or repurposed into valuable resources) into soil improvers and fertilisers. In order to achieve this goal, it is crucial to identify the status of side stream production and valorisation.

In Finland, the food industry is the fourth largest industrial sector. The food industry employs around 40,000 people, and in 2023 there were approximately 2,600 companies in the food and beverage industry. The food industry side streams in Finland correspond to a total of more than 400,000 tonnes of biomass from different food industries. The largest share of sidestreams is generated in the processing of dairy products. The meat, fish and vegetable processing industries also produce large amounts of by-products each year. However, it is important to note that the data on the production of side streams only include larger industrial actors, excluding small industries such as bakeries.

In Finland, the considerable distances between regions pose challenges for making full use of by-products and waste streams, known as "side streams." These distances increase the costs and logistical complexity of collecting, transporting, and processing these materials, making it harder to turn them into valuable resources effectively.

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Keywords:

Soil health
Circular economy
Value chains

Stakeholders:

Policy Makers
Industry
Research

Practice Abstract 4

DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practical Recommendations

Currently, the valorisation of food industry side streams into fertiliser products is mainly based on conventional processing technologies such as anaerobic digestion and composting. The majority of food industry side streams are currently used as value-added products, i.e. animal feed, fertilisers and soil improvers in agriculture and landscaping, but also as raw materials for other products.

However, there is still a need to develop the processing of side streams in Finland. There is high potential for the production of value-added products through more innovative use of side streams to improve the recovery of organic matter and nutrients and their use in agriculture and food production.

Needs addressed by the practice

Knowledge on the current status of food industry side stream generation, utilisation and valorisation. Helping food producers find circular solutions to increase the value of their side-streams.

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DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practice Abstract 5

Key Stakeholder Analysis in the DeliSoil Project

Summary

DeliSoil project is designed to introduce innovative soil improvers by advancing the recycling and processing of food industry residue streams. To comprehend the roles, influence, and interests of various stakeholders a comprehensive analysis was conducted. The results identified a wide range of stakeholders essential for the project's success. The list of DeliSoil key stakeholder follows the Quadruple Helix Model. In the context of the DeliSoil project, this model provides a comprehensive lens through which to analyse and engage with stakeholders across multiple sectors and domains.

- **Science**: Scientists, research institutions, and projects from the Mission Soil group.
- **Policy:** Agriculture associations and policymakers at international, national, and regional levels.
- **Industry and Producers:** Soil amendments producers, fertiliser producers, waste management facilities, food and beverage producers, farmers, and horticulturists, agricultural advisors and EIP groups.
- **Civil Society:** Local communities, citizens, and consumers.

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Keywords:

Soil health
Circular economy

Stakeholders:

Science
Policy Makers
Industry
Producers
Civil Society

Practice Abstract 5

DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practical Recommendations

The stakeholder analysis presents several advantages. By identifying and engaging with key stakeholders, practitioners can enhance collaboration, driving innovation and the adoption of best practices. Understanding the influence and interests of different stakeholders allows for more strategic planning and resource allocation. Engaging with policymakers ensures compliance with regulations, securing necessary approvals and support, while insights from civil society stakeholders help in adapting products to meet market demands and societal values, thereby enhancing public trust and project legitimacy.

The comprehensive stakeholder analysis conducted in the DeliSoil project emphasises the importance of engaging with a diverse range of stakeholders. The inclusive approach ensures that the project remains resilient, innovative, and aligned with societal needs and regulatory requirements. This practice not only amplifies the project's impact but also contributes to broader environmental sustainability and agricultural resilience.

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Needs addressed by the practice

Identification and engagement with key stakeholders can foster collaboration, driving innovation and adoption of best practices. Understanding the influence and interests of different stakeholders enables more strategic planning and resource allocation.

About DeliSoil

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DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practice Abstract 6

Biochar, Compost, and Digestate Significantly Improve Soil Health Metrics, Crop Yields, and Environmental Sustainability

Summary

An analysis of the impact of different amendments on soil health was carried out through a data mining activity. This involved collecting and analysing datasets from European projects and related long-term experiments. Three main soil improvers were considered:

Biochar: Enhances soil by raising pH, increasing organic carbon by 10–20%, and boosting water and nutrient retention. It supports microbial diversity and activity, improving plant health and resilience against pests. Biochar can raise microbial respiration by up to 40%, promoting nutrient cycling and disease suppression.

Compost: Raises soil organic carbon by up to 3%, improving soil structure, water retention, and fertility, especially in arid areas. It increases carbon and nitrogen levels, supporting plant nutrition and soil resilience. Compost applications can boost crop yields by 10–30%, depending on soil and crop type.

Digestate: Provides a quick nutrient boost, increasing soil inorganic nitrogen by 30–50%, supporting rapid crop growth. Rich in nitrogen, digestate is beneficial but requires careful management to prevent runoff and odors, with application limited to specific periods in some regions to minimise environmental impact.

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Keywords:

Soil health
Circular economy

Stakeholders:

Farmers
Farmer Associations

DeliSoil

Delivering soil improvers from circular food production processes to boost soil health

Practice Abstract 6

Practical Recommendations

- To enable comprehensive assessment of the impacts of these three soil improvers, or new ones, well-structured field trials should be performed.
- Conduct well-structured field trials and implement regular soil testing as part of continuous monitoring.
- Use randomised block designs to accurately measure effects across different conditions, and conduct long-term monitoring over multiple seasons to adjust practices and optimise soil health.
- Develop targeted strategies to reduce nutrient leaching and greenhouse gas emissions, ensuring sustainable soil health improvements.

Regular soil testing data should inform adaptive management, adjusting soil improver type, quantity, and timing to match changing soil and crop conditions. This approach maximises benefits and minimises environmental impacts.

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Needs addressed by the practice

Summarising main outcomes and recommendations from EU projects that have used soil improvers.

About DeliSoil

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DeliSoil

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Practice Abstract 7

Food Industry By-Products and Waste Derived Fertilising Products for Soil Health

Summary

Farmers and industries that produce agricultural or food processing waste have the potential to convert waste streams into high-quality bio-based fertilizers (BBFs) using a variety of technologies. This guideline helps identify the most suitable waste streams, allowing stakeholders to choose the most efficient technologies for their specific materials. The primary waste types include agricultural residues (e.g., plant clippings, manure), food processing by-products (e.g., animal bone grist, acid whey, fruit peels), and industrial waste such as digestate from biogas production.

Technologies for BBF production are diverse in foundation, costs, and potential results. Examples of these technologies are:

- **Pyrolysis**: Converts woody residues (e.g., tree clippings) into biochar, improving soil, storing carbon, and producing bioenergy.
- **Hydrothermal Carbonisation (HTC)**: Transforms wet waste into hydrochar and nutrient-rich liquid fertilisers without drying.
- **Struvite Precipitation**: Recovers phosphorus from liquid waste to create slow-release fertilisers.
- **Fermentation**: Turns food waste into bio-fertilisers and biostimulants, boosting crop growth and soil health.
- **Anaerobic Digestate with Algae**: Recycles digestate nutrients, producing algae biomass for bio-fertilisers.
- **Membrane Filtration**: Separates nutrients from liquid waste streams using microfiltration, ultrafiltration, or reverse osmosis, recovering clean water and nutrient-rich fertilisers.
- **Mobile Digestate Processing Units**: On-site processing of digestate, reducing transport needs for smaller farms.
- **Enzymatic Hydrolysis**: Breaks down protein-rich wastes into bioavailable plant nutrients.
- **Insect Cultivation**: Uses organic residues to breed insects (e.g., black soldier flies), producing nutrient-rich frass and insect biomass for fertilisers.

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Country:

Europe and Beyond

Keywords:

Soil health
Circular economy

Stakeholders:

Cooperatives
Farmers
Agricultural Advisors

Practice Abstract 7

DeliSoil

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Practical Recommendations

Classify Your Waste Stream: Identify waste type (plant, animal, industrial) and form (e.g., woody residues for biochar, liquids for fermentation).

Perform Chemical Analysis: Test waste for nutrients (e.g., nitrogen, phosphorus) and contaminants (e.g., heavy metals) to guide technology choice and ensure safety and compliance.

Select the Right Technology: Match technology to waste type; use Pyrolysis, HTC, and fermentation for solids/slurries, and membrane/algal methods for liquids. Adapt for maximum nutrient recovery.

Optimise Environmental Impact and Compliance with Regulations: Apply the Product Environmental Footprint (PEF) and NOVAFERT framework to minimize environmental impact and ensure regulatory compliance.

Assess Crop Impact: Conduct field trials to measure crop yield, growth, nutrient uptake, and disease resistance. Confirm that BBFs boost productivity, improve soil, and reduce chemical fertilisers

Identify Business Opportunities and Business Barriers: Explore markets beyond fertilisers, like bio-stimulants or bioenergy. Perform cost-benefit analyses and support circular economy goals with resource efficiency. New Living Lab data will refine BBF tech and economic viability.

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Needs Addressed by the Practice

Helping farmers to select suitable solutions, nature based and technical, to improve soil health.

About DeliSoil

The EU-funded DeliSoil project is a four-year initiative that aims to transform food industry byproducts into safe, sustainable, and tailored soil improvers. This project addresses two pressing challenges: the poor recycling of industrial food processing byproducts and the degradation of soil health.

By harnessing a circular approach, DeliSoil will contribute to improving soil health and productivity, supporting the EU Mission "A Soil Deal for Europe" and the Farm to Fork Strategy, as well as other Circular and Bioeconomy Strategies and Plans.

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