BBioNets

Boosting the adoption of Bio-Based Technologies

Deliverable D3.4

Practice Abstracts - batch 1

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APRIL 2025

Funded by the European Union

Document information

Document ID	D3.4		
Title	Practice Abstracts - batch 1		
Work Package	WP3 - Knowledge creation & transfer		
Due Date	30/04/2025	**Delivery Date**	25/04/2025
Dissemination Level	PU - Public		
Partner Responsible	AFS		
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Document history

Version	Date	Main Modifications	Author(s)
0.1	09/04/25	Abbreviations reviewed and properly introduced. Formatting and spelling corrections. Results aligned with KPIs.	AFS
1.0	25/04/25	**Final version ready for submission**	**AFS**

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Table of Abbreviations

Abbreviation	Description
BBT	Bio-based Technology
FAN	Forestry and Agricultural Network
OG	Operational Group
PA	Practice Abstract
RPFA	Regional Partners for Forestry and Agriculture
RR	Represented Region
WP	Work Package

Executive Summary

Practice Abstracts are a fundamental part of the Educational and Training Materials developed within the BBioNets Project. The creation of these Practice Abstracts (PAs) draws on tools and information that were developed and gathered in previous Work Packages, specifically Work Packages 1 and 2. A well-defined methodology was adopted for their development, addressing key elements such as relevant topics, standardized structure, quality control, and content. This methodology ensures that the PAs align with the objectives of the BBioNets Project as well as the specific goals of WP3, in which their creation is incorporated. Additionally, the potential application of these PAs in future project activities was carefully considered. As a result, a total of 20 PAs have been successfully submitted to the EU-CAP Network Portal, marking a significant milestone in the project.

1 Introduction

The Educational and Training Material developed under BBioNets serves as a vital tool to bridge knowledge gaps, raise awareness of Bio-based Technologies (BBTs) benefits, and equip stakeholders with the skills and insights needed to embrace these innovations. Tailored to the diverse needs of farmers, policymakers, researchers, and industry professionals, the Educational and Training Material ensures that key messages resonate across varying levels of expertise and regional contexts.

In the context of the BBioNets Project, the following formats of Educational and Training Material are foreseen:

(1) *40 factsheets* - structured and concise overviews of key topics related to BBTs summarizing barriers, opportunities, and regional challenges;
(2) *10 infographics* - visuals simplifying complex topics by combining images, charts, and brief text;
(3) *40 PAs* - focused summary of actionable insights and recommendations; and
(4) *18 videos* - showcasing BBTs and real-life applications by primary producers, which are further divided into the following two subcategories:

   (4.1) *9 short BBT-descriptive videos* - engaging way to explain the fundamentals of BBTs and their benefits; and
   (4.2) *9 storytelling videos* - creating motivation through testimonials of primary producers who have applied specific BBTs.

This document includes the first batch of 20 PAs, whose presentation was scheduled for completion by the M18 of the project and marks the halfway point toward the overall target of 40 PAs.

A PA is a summary whose primary objective is to provide non-specialist audiences / end-users with practical information/recommendation about innovative approaches that address identified needs and/or wants. In the context of the BBioNets Project, the content of each PA focuses on BBTs identified by both Operational Groups (OGs) and other EU-funded projects or initiatives, tailored to the specific context of each Represented Region (RR).

PAs offer a focused summary of actionable insights and recommendations. They are particularly effective tools for sharing best practices related to training and knowledge transfer, helping stakeholders understand how BBTs can be practically applied to overcome specific barriers or respond to regional challenges. Written in clear and direct language, they are accessible to practitioners and decision-makers alike. By highlighting measurable outcomes, they promote the adoption and replication of successful strategies.

2 Practice Abstracts

Under the BBioNets Project, the PAs created are intended to serve a twofold function:

(1) raise primary producers' awareness of BBTs and OG potential, and
(2) be leveraged as part of the Knowledge Transfer Activities to be carried out.

To ensure that the above-mentioned conditions were met, the development of the PAs was guided by three distinct focus areas in:

(1) identifying the relevant topics;
(2) adopting a common, standardized structure;
(3) ensuring quality control through compliance with specific principles and guidelines.

2.1 Topics

In order for the Educational and Training Material and consequently the PAs to achieve maximum impact and fulfill their objectives, it is recommended that they address a diverse range of topics. These topics have been identified through the analysis of previous activities/tasks (consortium/FAN meetings; Project Deliverables, e.g. D1.5 Identified regional needs and challenges, D2.4 Report on the high-level study of regional dynamics) and aim to cover all critical aspects that influence the acceptance, implementation, and effectiveness of BBTs at the local and regional level.

The content is designed not only to provide knowledge and technical information, but also to enhance the understanding of the social, institutional, and economic factors that shape the transition towards more sustainable production models. Emphasis is placed on empowering producers through knowledge exchange, strengthening collaboration, improving skills, and making effective use of available resources.

The PAs produced is not generic or detached from reality; rather, it is practically applicable and tailored to the field. In this way, it seeks to meaningfully enhance producers' capacity to actively participate in the bio-based economy, fostering innovation and regional development. Below is the list of topics that the educational material is set to address, presented in alphabetical order.

(1) Barriers to the adoption of BBTs
Identifying barriers to the adoption of BBTs is critical to addressing challenges such as high costs, regulatory complexity, and lack of awareness. Overcoming these barriers can accelerate the transition to sustainable practices in agri-food systems.
(2) Description of BBTs
BBTs utilize renewable biological resources to create innovative products and processes. Understanding their mechanisms and benefits is essential to demonstrate their potential in transforming agricultural and food industries.
(3) Fostering collaboration
Collaboration among stakeholders, including researchers, policymakers, and industry players, is vital for the effective adoption of BBTs. It enables knowledge sharing, resource pooling, and the development of synergistic solutions.
(4) Fostering knowledge transfer

Promoting knowledge transfer ensures that advancements in BBTs are accessible to practitioners and policymakers. This process bridges the gap between innovation and application, driving sustainable growth in the agri-food sector.

(5) Good practices in data collection and data management
Reliable data collection and management are foundational for evaluating the performance and scalability of BBTs. Adopting standardized practices enhances decision-making and supports evidence-based strategies.

(6) Good practices in training
Effective training programs equip stakeholders with the skills and knowledge to implement BBTs successfully. Tailored training approaches foster confidence and competence in bio-based solutions.

(7) Opportunities and good practices that foster adoption of BBTs
Highlighting opportunities and showcasing success stories build trust in BBTs. Demonstrating their economic and environmental benefits can inspire widespread adoption across agri-food systems.

(8) Pathways to impact
Developing clear pathways to impact ensures that BBTs deliver measurable benefits, such as reducing emissions and enhancing resource efficiency. Aligning technologies with societal goals amplifies their relevance and effectiveness.

(9) Regional needs and challenges
Understanding regional needs and challenges enables the customization of BBTs for local contexts. Addressing specific conditions ensures greater adoption and maximizes their impact in diverse settings.

(10) Value chain creation for biomass processing and utilization
Establishing robust value chains for biomass processing enhances the economic viability of BBTs. Integrating stakeholders across the chain promotes efficiency, innovation, and sustainability.

Specifically for batch 1 of the PAs, the project concentrated on developing only one topic, namely the "Description of BBTs." This decision was driven by the following reasons:

- primary focus on understanding the BBTs
  The description of BBTs serves as the fundamental foundation for understanding the project. It is essential for developing the other topics, such as "adoption" and "collaboration".
- stage of the project's implementation
  During these project's stages, the consortium focused on clarifying the technologies before progressing to more complex topics, such as barriers or strategic impacts.

The remaining PAs, along with the rest of the Educational and Training Material, will focus on topics that have not yet been adequately addressed. To ensure comprehensive coverage of all topics – both within the PAs and across the other formats of Educational and Training Material – a dedicated tool has already been developed. This tool, referred to as the Educational and Training Material Tracking Tool, is available on the shared Microsoft Teams platform of BBioNets. It enables the systematic monitoring of the topics covered in both the PAs as well as all the Educational and Training Materials, aiming to maximize coverage of the suggested topics while minimizing thematic overlaps.

2.2 Structure

The following guidelines are derived from instructions provided by the EU CAP Network portal.

(1) Title of the Practice Abstract
- Provide a self-explanatory title that briefly summarizes the challenge or opportunity and the project result(s) that address it.
- Keep it relevant and clear for practitioners (max. 255 characters).
- Focus on the key problem or opportunity.
- Use language that practitioners can immediately understand.
- Avoid jargon or overly technical terms.
- Example: "Innovative Water Management Solutions for Sustainable Agriculture" or "Reducing Food Waste in the Supply Chain: Practical Approaches."

(2) Summary for Practitioners on Main Findings/Innovative Solutions
- Describe concisely how the challenges/opportunities can be solved/seized.
- Include the following elements (max. 2000 characters):
  - Objective(s): Specify what challenge(s) or opportunity(ies) the project addresses and why they are relevant for practitioners or end-users.
    - Specify the context (e.g., agricultural, industrial, or environmental challenges).
    - Focus on practical issues like efficiency, cost reduction, sustainability, etc.
    - Be specific about the problem, e.g., "High energy consumption in food processing plants."
    - Keep the language simple and avoid theoretical explanations.
  - Result(s): Detail the knowledge/innovative solution(s) developed to solve the challenge(s) or seize the opportunity(ies).
    - Focus on what was actually achieved, whether it's a process, technology, or methodology.
    - Avoid abstract descriptions; include specific examples of how the solution works.
    - Mention any outcomes like increased productivity, lower costs, improved sustainability, etc.
  - Practical Implications/Recommendations: Explain how practitioners can apply the results in practice, highlighting costs, benefits, and potential impacts for end-users.
    - Explain how the results can be applied in real-world scenarios.
    - Highlight cost-effectiveness, scalability, and the practical advantages of applying the solution.
    - Discuss potential hurdles (e.g., technical, financial) and how to overcome them.
    - Use a direct and actionable tone. For instance, "Adopting this technology reduces water consumption by 20% annually, leading to a 15% reduction in

costs."

- Use simple, direct, and easily understandable language. Avoid technical terminology and avoid presenting real needs of practitioners as theoretical scenarios.

(3) Additional Dissemination and Exploitation Materials

- Provide a URL linking to useful materials for practitioners (e.g., relevant websites, social media, videos, pictures, PDF files).
- Ensure the link is external and clearly titled or described.

(4) Geographical Location

- Mention where the research and innovation activities took place.
- Drag and reorder items as needed.

(5) Additional Information

- List elements facilitating or obstructing the implementation of the results.
- Suggest future actions/research and provide recommendations or messages to end-users.
- Content limit: 2000 characters.

Note: All practice abstracts must be written in English. However, we strongly encourage partners to translate their practice abstracts themselves into the official EU languages, as the automated translation tool often produces low-quality results.

2.3 Quality Control

PAs are intended to deliver concise, actionable information to end-users and practitioners. Their purpose is to facilitate the transfer of practical knowledge, particularly in relation to the application of BBTs in regionally relevant contexts. When developing the PAs, it is essential to consistently consider the following factors:

- Objective
  The primary aim of the PAs is to provide practical, solution-oriented content that addresses specific needs or challenges. The information is tailored to support end-users, such as farmers, foresters, and advisors, in making informed decisions.
- Format
  Each PA follows the standard structure recommended by the EU CAP Network Portal, ensuring alignment with established EU guidelines for knowledge dissemination.
- Content Validation
  Content is subject to a validation process that includes:
  - Assessment of the technical feasibility and practical applicability of the proposed solutions.
  - Verification of the accuracy, evidence base, and timeliness of the information presented.
  - Expert input to ensure the relevance and credibility of the proposed practices.
- Structure and Organization

The internal structure of each PA follows a clear and logical flow, beginning with the identification of a specific problem or need, followed by the proposed solution, and concluding with the anticipated outcomes. This approach enhances readability and supports efficient knowledge transfer.

- Language and Style
  Language is deliberately non-technical and accessible to non-specialist audiences. The tone remains professional yet clear, avoiding jargon and ensuring that the information can be readily understood by the target user groups.
- Visual Design
  Where appropriate, visual elements such as diagrams, flowcharts, or icons are integrated to support the textual content. These visuals aim to improve comprehension and highlight key points without distracting from the core message.
- Accessibility and Usability
  The PAs are developed in accordance with the dissemination and accessibility requirements of the Horizon Europe programme. Attention is given to formatting and presentation to ensure that documents are user-friendly across various platforms and devices.
- Compliance
  All PAs include the required EU Horizon and BBioNets branding elements, such as logos and disclaimers. In addition, they adhere fully to the communication and dissemination standards set by Horizon Europe, ensuring consistency and compliance throughout.

2.4 Content

The Inventory serves as the main reference source for the creation, documentation, dissemination, and transfer of knowledge through the PAs. It was developed within the framework of Work Package WP2 - Bio-Based Technologies and Regional Dynamics, and specifically under Task 2.1 - BBioNets Inventory and Knowledge Collection. It represents a systematic recording and mapping of existing BBTs that have already been developed or implemented within OGs and other national or European projects and initiatives.

The Inventory is not static; it is enriched throughout the duration of the project, incorporating new findings and projects, thus functioning as an updated and useful knowledge base.

As previously stated, the Inventory acts as the primary source of documentation for the selection and description of BBTs that will be transformed into PAs. Its role is:

- to provide a well-documented foundation for selecting the most relevant and applicable BBTs, based on clear and transparent criteria;
- to ensure alignment with the needs of end users (farmers, foresters), so that the PAs are practical, targeted, and useful;
- to facilitate the identification of examples that have already yielded results or show promise for further evaluation and dissemination.

Arguments presented in the PAs can be supported, where appropriate, by relevant literature, as long as it reinforces the PAs content. Including additional evidence not explicitly captured in the Inventory is encouraged, provided it strengthens and complements PAs content.

Table 1: First Batch of 20 Submitted PAs

Title	Topic	Partner	Country/ Region
Autonomous Precision Spraying for Sustainable Berry Farming: Reducing Chemical Inputs with AI-Driven Pest Control	Description of BBTs	IUNG	Poland
Benefit of Biochar Addition to Improve Compost Quality and Speed up the Composting Process	Description of BBTs	HUB-CR	Czech Republic
BIO2CHP Project: A Sustainable, Modular On-Site Energy Solution for Agro-Food SMEs Using Solid Organic Residues to Generate Electricity and Heat, Demonstrating Cost-Effective Waste Management and Energy Efficiency	Description of BBTs	AFS	Greece
Biomass to Activated Carbon: Transforming Agricultural Residues into a Sustainable Resource	Description of BBTs	TEPRO	Spain
Citrus Biochar: Obtaining and Uses of Biochar from Citrus Prunings in the Western Coast of Huelva	Description of BBTs	CTA	Spain
Enhancing Biomass Utilisation and Circular Bioeconomy Practices in Spanish Agriculture and Forestry	Regional Needs and Challenges	CTA	Spain
From Bio-waste to Bio-materials: Turning Unwanted Agricultural Waste into Valuable Biodegradable Plastic Products	Description of BBTs	IUNG	Poland
Grassification: Transforming Grass into Sustainable Bio-Based Products	Description of BBTs	MTU	Ireland
Growing Maize as a Mixed Culture to Produce Silage for Use in a Biogas Plant	Description of BBTs	HUB-CR	Czech Republic
Incorporating Dried Oregano as a Natural Fungicide for Controlling Downy Mildew in Tomato Crops: A Sustainable, Circular Economy-Based Approach for Enhancing Plant Protection and Reducing Crop Losses in Greenhouse and Organic Farming Systems	Description of BBTs	AFS	Greece

Title	Topic	Partner	Country/ Region
Innovative Energy: A New Model for Energy Savings	Description of BBTs	CREA	Italy
Innovative Solutions for Increasing Plant Immunity While Reducing the Use of Plant Protection Products (PPP)	Description of BBTs	IUNG	Poland
Innovative Use of Digestate and Biochar to Increase Yields and Quality of Agricultural Production	Description of BBTs	HUB-CR	Czech Republic
Nutrient-rich Organic Fertilizer from Biowaste: Compost Enriched with Biochar and Biostimulants	Description of BBTs	AFS	Greece
Optimised Use of Stabilised Litter: Innovative Solutions for Separated Manure in Dairy Cow Bedding	Description of BBTs	TEAGASC	Ireland
Optimization of Biogas Plants through Spirulina Algae Production	Description of BBTs	CREA	Italy
Turning Forest Residues into Value: The Opportunity of Ash	Value Chain Creation For Biomass Processing and Utilization	CREA	Italy
SCARABEO: Valorization of Hemp Residues for Food and Energy Recovery	Description of BBTs	MTU	Ireland
Sustainable Feed Protein: Farm-Based Lignocellulosic Biorefinery of On-Farm Residues	Description of BBTs	TEAGASC	Ireland
Sustainable Valorization of Olive Oil By-Products: From Waste to High-Quality Organic Fertilizers	Description of BBTs	TEPRO	Spain

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2.5 First Batch of 20 Submitted PAs

The first batch of 20 submitted PAs primarily focused on the following thematic areas:

- circular economy and the valorisation of agricultural and forestry residues (5 PAs)
- alternative fertilisers and soil enhancement practices (5 PAs)
- energy recovery and biomass-based energy solutions (3 PAs)
- innovative technologies and the digital transformation of agriculture (3 PAs).

Thematic areas are subsets of topics and can cover multiple topics, which can then be explored through various Educational and Training Material formats. The selection of thematic areas was made independently and spontaneously by each partner. The relevance of the thematic areas chosen for development within the PAs highlights the effectiveness of the tools developed in previous Work Packages (namely WP1 & WP2), as well as the methodology proposed for their creation. As already mentioned, the vast majority of the PAs focused on the "Description of BBTs" topic.

The annex to this document includes the full text of all 20 Practice Abstracts, which are also available on the EU CAP Network (https://eu-cap-network.ec.europa.eu/projects/creation-and-promotion-forest-and-agriculture-networks-boost-bio-based-technologies_en).

2.6 Next steps

PAs are written in English. However, if deemed necessary by the respective Regional Partners for Forestry and Agriculture (RPFA), the PAs will be translated into the corresponding regional languages of the project partners to ensure they are easily understood and user-friendly. All PAs that have been or will be created will be incorporated into the BBioNets Online Knowledge Platform (WP3/T3.2) and communicated to each RR's national AKIS and the EU-FarmBook.

Additionally, as stipulated for all Educational and Training Materials, the PAs will be utilized in the context of:

- Knowledge Transfer Activities (WP3/T3.3);
  PAs provide a valuable opportunity for analyzing BBTs, discussing challenges, and proposing potential solutions tailored to local/regional conditions. PAs encourage exploring and identifying opportunities for adapting BBTs to suit specific local/regional, fostering innovation and practical application. PAs can function as reference materials, providing guidance and practical examples, helping the shape of targeted strategies for sustainable solutions.
- Dissemination and Communication Plan and Activities (WP4/T4.1);
- Dissemination and Communication Activities (WP6/T6.1).

For this purpose, a template has been developed into which the material already submitted to the EU-CAP Network Portal will be integrated, along with additional photographic content and potential (scientific) references, to ensure the most engaging and effective presentation of the PAs.

3 Conclusion

The creation and submission of the first batch of 20 PAs marks a significant turning point for the WP3 - Knowledge Creation and Transfer, as it represents the culmination of efforts carried out under WP1 and WP2. The creation of the PAs relied heavily on the Inventory developed, continuously utilized and advanced under WP2/T2.1.

The development of the PAs was approached as methodically as possible to ensure alignment with the project's objectives and KPIs, and meet the needs and expectations of the RRs. To meet the above conditions, the development of the PAs focused on: (i) identifying relevant topics, (ii) adopting a standardized structure, and (iii) ensuring quality control through adherence to specific principles and guidelines. The methodology adopted for the creation of the PAs proved effective both in achieving the project's KPIs and in advancing the broader objectives of BBioNets, as it highlighted common thematic areas across all RRs in the project.

Initially written in English, PAs will be translated into regional languages as needed to ensure accessibility. They will be integrated into the BBioNets Online Knowledge Platform and shared with national AKIS and the EU-FarmBook. The PAs will support Knowledge Transfer Activities, fostering innovation and adaptation of BBTs to local conditions. They will also be utilized in the Dissemination and Communication Plan and Activities. A template has been developed to enhance the presentation of the PAs with additional content and references.

References

EU CAP Network (2025). *Practice Abstracts.* Available at: https://eu-cap-network.ec.europa.eu/projects/practice-abstracts_en [Accessed 20 Jan. 2025].

Appendix I

Autonomous Precision Spraying for Sustainable Berry Farming: Reducing Chemical Inputs with AI-Driven Pest Control

Objectives:

Poland is the biggest producer of berries in EU, supplying over 75% of blackcurrant and 23% of highbush blueberry, with many plantations located in the Lubelskie region. Responding to the needs of local berry producers, Ribes Technologies developed software and hardware for sustainable fruit farming. This OG offers a solution for autonomous protection of berry plantations, reducing the use of Plant Protection Products (PPPs) and thus enhancing fruit quality, while raising consumer awareness and promoting environmental consciousness.

Results:

A key component of the solution is the vision module, which detects pests on berry bushes and communicates with the sprayer to precisely apply chemicals where needed. The sprayer allows two different selective formulations to be applied at the same time, which allows to control two different types of pests simultaneously: aphid (Aphidomorph) and currant borer (Pandemis Ribeana) and significantly reduce the use of chemicals. The machinery is mounted on an autonomous four-wheeled vehicle that follows a set route on a field. It also features a cargo area e.g. for fruit transportation. The solution can be complemented with a digital pest trap, fully automated and powered by a solar PV system. A built-in camera monitors the situation and predicts when the spraying robot should enter the field, eliminating the need for daily plantation checks.

Practical Implications/Recommendations:

With electric vehicles and systems based on artificial intelligence, the solution enables precise monitoring and application of PPPs. This translates into greater efficiency and a sustainable approach to agriculture. It aims to reduce the costs of PPPs used in orchards, as well as help fulfil the UE requirements for PPP reductions by 50% by the year 2030. The solution can benefit both farmers and consumers – it will not only reduce the PPP costs but also significantly reduce pesticide residues in harvested fruits.

Additional Dissemination and Exploitation Materials:

Official Website: https://www.owoce40.pl/

Geographical Location:

Polska

Additional Information:

Benefit of Biochar Addition to Improve Compost Quality and Speed up the Composting Process

Objectives:

The addition of biochar in composting materials aims to improve their physiochemical properties and enhance the composting process. The goal is to utilise the positive properties of biochar in agriculture and land reclamation, while preventing the introduction of potentially harmful compounds to the environment as well as accelerating the composting process by increasing respiration rates when processing large volumes of materials. Biochar incorporation is done by adding biochar to the raw materials before composting or mixing it into the compost before it is applied to the soil.

Results:

In both cases of incorporation, the addition of biochar regulates the release of nutrients, increases the number of microorganisms capable of decomposing organic matter, optimizes water retention indicated by water capacity and pH values, and improves the environmental impact due to its odour-reducing properties. The biochar-enriched compost has low salinity levels so as not to affect the yield of agricultural crops, while eliminating the risk of agricultural soil salinisation. The addition of 20% biochar to the compost feedstock reduces the concentration of NH3 in emissions by up to 64% and nitrogen losses by 52%.

Practical Implications/Recommendations:

The addition of biochar during composting accelerates the composting rate and reduces nutrient losses. Thermophilic conditions are reached within 12 hours after the addition of biochar and the efficiency of organic matter decomposition increases by 14-16% with a 15% addition of biochar. The addition of biochar should be in the range of 5-10% and should not exceed 20% of the total compost, as higher rates can interfere with the decomposition processes.

Additional Dissemination and Exploitation Materials:

Technology Agency of the Czech Republic (2020) "The biochar addition effect to change the properties of compost": https://starfos.tacr.cz/en/projekty/TH02030681

Geographical Location:

Kraj Vysočina
Česko

Additional Information:

Biochar that can be recommended for agricultural use should have an elemental carbon/organic carbon ratio of >15, organic carbon content of <50 g/kg or volatile combustible content of <25%.

BIO2CHP Project: A Sustainable, Modular On-Site Energy Solution for Agro-Food SMEs Using Solid Organic Residues to Generate Electricity and Heat, Demonstrating Cost-Effective Waste Management and Energy Efficiency

Objectives:

The BIO2CHP project addresses the challenge of energy efficiency and waste management that agro-food SMEs face. It provides a sustainable, on-site solution by converting solid organic residues into electricity and heat, reducing both energy costs and waste disposal expenses. Designed as a modular, automated Combined Heat and Power (CHP) system with minimal infrastructure requirements, BIO2CHP has the size of a container, enabling businesses to utilize their existing biomass residues efficiently while decreasing reliance on conventional energy sources.

Results:

The 25 kWel BIO2CHP unit generates 187,500 kWh of electricity and 502,500 kWh of thermal energy annually, consuming approximately 187.5 tons of solid organic residues. The pilot implementation has demonstrated its ability to efficiently process various types of organic waste, ensuring a reliable energy supply for SMEs, with an annual operating time of approximately 7,500 hours. Its automated control system reduces maintenance requirements, while its capability to handle mixed residues enhances its versatility across different agro-food sectors. Once the system reaches its full production potential, the resulting economic benefits for the producer may surpass the average reported agricultural income for Greek farmers.

Practical Implications/Recommendations:

The BIO2CHP system presents a practical, cost-effective solution for SMEs in the wine, olive oil, and rice sectors, among others, by transforming agricultural residues into valuable energy and optimizing energy use and waste management. To maximize efficiency, selecting appropriate feedstock with moisture levels below 20% is recommended, while further operational data from the pilot phase will continue to refine system performance and economic feasibility.

Additional Dissemination and Exploitation Materials:

https://www.bio2chp.com/chp.html

Geographical Location:

Additional Information:

Full-scale commercial biodrying plants have been operational primarily in Europe for the past three decades. To minimize health risks and environmental effects, it is essential to properly manage the off-gases from biodrying plants.

Biomass to Activated Carbon: Transforming Agricultural Residues into a Sustainable Resource

Objectives:

A key challenge in Spain's biomass sector is managing agricultural waste, which creates difficulties for farmers. Huge volumes of residues are often underutilized or sent to landfills due to limited processing technologies and logistical constraints. Converting agricultural waste into activated carbon provides a sustainable solution, transforming materials like almond shells and rice husks into a high-value adsorbent for pollutant removal. This approach aligns with Circular Economy principles, reducing environmental impact and offering cost-effective solutions for water treatment and industrial applications.

Results:

Agricultural waste is collected and processed to produce activated carbon. The raw materials undergo pyrolysis, a thermal decomposition process in an oxygen-limited environment, yielding biochar with a high surface area. This biochar is then chemically or physically activated to enhance its adsorption properties, making it suitable for pollutant removal in water treatment and industrial applications. Laboratory and pilot-scale tests confirm their efficiency in capturing contaminants, supporting its potential as a sustainable alternative to conventionally activated carbon. These findings align with existing research (Rodríguez-Reinoso et al., 1982), confirming the feasibility of converting agricultural waste into a high-value, eco-friendly material.

Practical Implications/Recommendations:

Bio-based activated carbon can be applied in water treatment, industrial filtration, and environmental remediation as a cost-effective sustainable alternative to conventional materials. Utilizing low-cost agricultural residues reduces operational expenses while minimizing waste. End-users benefit from improved water quality and a lower environmental footprint. Integrating this technology into Circular Economy models enhances resource efficiency, while policy incentives and regional collaborations can further drive adoption and scalability.

Additional Dissemination and Exploitation Materials:

Geographical Location:

Sevilla

Additional Information:

FRodriguez-Reinoso, F., Lopez-Gonzalez, J. de D. and Berenguer, C. (1982) 'Activated carbons from almond shells—I: Preparation and characterization by nitrogen adsorption', Carbon, 20(6), pp. 513–518. doi:10.1016/0008-6223(82)90125-9.

Abstract: Several series of activated carbons have been prepared from almond shells by mean of carbonization in a flow of nitrogen followed by activation in a flow of carbon dioxide. The carbonized material is essentially microporous with pore dimensions close to those of the nitrogen molecule as deduced from the comparison of nitrogen adsorption isotherms at 77 and 90 K. Activation with

carbon dioxide leads to the appearance of micropores and to a considerable increase in surface area. The effects of preparation conditions on the adsorptive capacity of the carbons are also discussed

https://www.sciencedirect.com/science/article/pii/0008622382900884

OG AgriCarbon: http://carbonactivo.eu/proyecto/

Citrus Biochar: Obtaining and Uses of Biochar from Citrus Prunings in the Western Coast of Huelva

Objectives:

The main objective of the Citrus Biochar project is to transform citrus pruning residues into biochar for agricultural soil amendment. The initiative aims to enhance soil quality, promote sustainable agricultural practices and contribute to a circular economy by reusing agricultural waste. The project also seeks to evaluate the agronomic benefits of biochar application in citrus orchards and its impact on soil health and plant productivity.

Results:

The project demonstrated that biochar obtained from citrus pruning improves soil conditions, particularly in terms of water retention, porosity and microbial activity. Additionally, biochar application contributes to increased potassium availability, essential for plant growth. Laboratory analyses confirmed that biochar enhances soil cation exchange capacity, leading to better nutrient retention and reduced leaching. Field trials indicated an improvement in root development and plant vigor, as well as a reduction in water stress during dry periods. Furthermore, biochar applications showed potential in mitigating soil degradation issues, particularly in sandy soils, by increasing organic matter content and microbial biodiversity. These positive outcomes reaffirm biochar as a viable and effective soil amendment for citrus cultivation, offering a sustainable alternative to conventional soil management practices.

Practical Implications/Recommendations:

Soil Improvement: biochar enhances soil porosity, water retention and fertility, leading to healthier and more productive crops.
Sustainable Waste Management: the reuse of citrus pruning residues reduces waste and lowers greenhouse gas emissions from traditional disposal methods.
Circular Economy: the transformation of agricultural residues into valuable resources aligns with sustainable farming practices.

Farmers are encouraged to integrate biochar into their soil management strategies, particularly in sandy soils where its benefits are most pronounced.

Additional Dissemination and Exploitation Materials:

Geographical Location:

Huelva
Andalucía
España

Additional Information:

Citrus Biochar is funded by the European Agricultural Fund for Rural Development and co-financed by the Regional Ministry of Agriculture, Fisheries, Water, and Rural Development of the Andalusian

Government. For more details, visit the official project website: citrusbiochar.es.

Enhancing Biomass Management and Circular Bioeconomy in Spain: Innovative Solutions for Sustainable Agriculture and Forestry

Objectives:

The project tackles biomass management challenges in Spain's agriculture and forestry, aiming to improve sustainability, cost efficiency, and resource use. High processing costs and limited access to technology and funding hinder bioeconomy adoption. Raising awareness and implementing innovative solutions can enhance sustainability, reduce waste, and boost rural economies.

Results:

The project promotes innovative biomass management solutions, including on-site processing models for cost-effective use and raffia separation in greenhouses to improve waste processing. Drying and separation technologies reduce moisture, cutting transport costs and increasing market value. Biomass management plants in forestry areas support circular bioeconomy and local jobs. Using agricultural residues for biogas and compost reduces waste and boosts renewable energy. The project also tailors bio-based technologies to each region´s needs for sustainable biomass use.

Practical Implications/Recommendations:

To implement these solutions, farmers and foresters should invest in drying and separation technologies to improve processing efficiency and reduce transport costs. Accessing available funding and incentives will be essential for adopting these innovations and scaling up pilot technologies. Engaging in local biomass management initiatives can support the creation of circular bioeconomy microclimates, improving resource efficiency and employment opportunities. Collaboration with cooperatives, research institutions, and technology providers will facilitate knowledge transfer and access to new market opportunities. Raising awareness and providing training programs, particularly for youth, unemployed individuals, and women, will help develop the necessary green skills to support the transition to a sustainable bioeconomy. By integrating these approaches, practitioners can increase productivity, enhance environmental sustainability, and improve the economic viability of biomass resources.

Additional Dissemination and Exploitation Materials:

Geographical Location:

Sevilla

Additional Information:

Part of the information presented in this analysis has been gathered through the working sessions held with the Forest and Agricultural Network (FAN) of Andalusia. These sessions allowed for the collection of key information regarding the needs, barriers, and opportunities of the sector, as well as promoting knowledge exchange among the various stakeholders involved in the circular bioeconomy in the region.

From Bio-waste to Bio-materials: Turning Unwanted Agricultural Waste into Valuable Biodegradable Plastic Products

Objectives:

As plastic pollution is a serious problem acknowledged worldwide, environmentally-aware consumers nowadays tend to look for eco-friendly options. However, popular bioplastics are not as green as most people think. Often they are produced from food raw materials, which is not the best use of resources. They also require specific conditions to degrade or compost, but many countries lack suitable industrial composting plants. The answer to this problem may be utilizing agricultural waste for biomaterial production, which is a significant contribution to circular bioeconomy: it can both reduce waste and decrease the demand for traditional petroleum-based plastics, counteracting the depletion of fossil fuels.

Results:

SeaSoil is a Polish biotech company fighting plastic pollution by transforming unwanted agricultural and food waste into biodegradable plastic-like material. Their technology involves novel extraction methods without environmentally-hazardous chemical solvents. The product is similar to popular rigid plastics (e.g. polypropylene and polyethylene), biodegradable in all conditions of microbial contamination (e.g. in the sea, soil, forest). Such created material can be used e.g. for production of food or cosmetics packaging, but also in other industries, as it is waterproof, impact-resistant, easily moulded into various shapes. Thanks to biodegradable properties, it can be used in agriculture as well, e.g. for the production of agro-textiles, which will decompose into micronutrients enriching the soil.

Practical Implications/Recommendations:

Production of such biomaterial generates lower GHG emissions in comparison to petroleum-based plastic. Utilizing renewable sources like agricultural waste also lowers production costs, potentially reducing consumer prices. Replacing traditional plastic in packaging can help raise awareness about the environmental impact of the purchased products and encourage consumers to make more sustainable choices.

Additional Dissemination and Exploitation Materials:

https://www.theseasoil.com/

Geographical Location:

Polska

Additional Information:

Grassification: Transforming Grass into Sustainable Bio-Based Products

Objectives:

Roadside grass clippings are often considered waste, but they hold significant potential as a renewable resource. This project addressed the logistical, technical, and policy challenges of transforming these clippings into valuable bio-based products, such as biogas and biocomposites, while promoting sustainability and circularity.

The Grassification project aimed to valorise roadside grass clippings by optimizing their supply chain and processing, demonstrating their market potential, and formulating policy recommendations to support their recycling. The goal was to increase the volume of usable material, reduce costs, and create higher added value for this renewable resource, boosting its market value and attractiveness for the biobased and circular economy.

Results:

A novel mowing head to improve the quality and reduce the sand content of grass clippings.
Decentralized biogas production technology through co-digestion of grass clippings with other feedstocks.
Bulk processing technology for converting grass into biogas.
Biocomposite products like picnic sets, stepping stones, and construction materials.
A supply chain optimization model and a policy roadmap to support the valorisation of grass clippings.
Techno-economic and life cycle assessments of the most promising value chains (biogas and biocomposites).

These outputs benefit road and land managers, SMEs, large enterprises, research institutes, policymakers, and sectors like construction.

Practical Implications/Recommendations:

Practitioners can adopt these technologies and models to turn roadside grass clippings into valuable resources. Key benefits include cost reduction, increased sustainability, and new revenue streams. To overcome initial implementation hurdles, such as investment costs, stakeholders can explore joint procurement and performance contracting models. Training and collaboration among stakeholders are essential for successful adoption.

Additional Dissemination and Exploitation Materials:

The project was implemented in Flanders, Belgium. For more information, visit the project's deliverables page: https://www.biorefine.eu/publications/?_sf_s=grassification

Geographical Location:	Belgique/België Prov. Oost-Vlaanderen Prov. West-Vlaanderen Zeeuwsch-Vlaanderen

Additional Information:

Growing Maize as a Mixed Culture to Produce Silage for Use in a Biogas Plant

Objectives:

The goal is to introduce a more economically viable and environmentally friendly mixed culture of maize (Zea mays) with legume crops. The aim is to determine whether silage from mixed culture can be used in biogas plants for biogas production and at the same time increase the sustainability of agriculture. The structure of a mixed culture stand composed of sown maize and legume crop represents an advantage for farmers as it saves on fertilizer costs and provides higher biomass yields of both components of the mixed culture per unit area. Furthermore, it increases the anti-erosion effect on land where sown maize is grown. Growing crops in a mixed culture system is an element of sustainable agriculture.

Results:

White sweetclover appears to be a particularly suitable legume for creating a mixed field crop with maize. Different model silages were prepared, varying in the content (from 10 wt.% to 70 wt.%) of the added legume. The optimum ratio of maize (Zea mays L.) and white sweetclover (Melilotus albus Med.) in mixed culture for biomethane production was determined and the effect of legume addition on biogas quality was also noted.

Practical Implications/Recommendations:

The proportion of white sweetclover in the silage must not exceed 20% by weight to avoid negatively affecting biogas and methane yields. These silages showed an average methane content of 55% in biogas, while the average methane content when using maize silage alone was 56.5%.

Additional Dissemination and Exploitation Materials:

Technology Agency of the Czech Republic (2020) "Application of maize growing technology using mixed culture for the production of silage for a biogas plant". Available at: https://starfos.tacr.cz/en/projekty/TH02030681

Geographical Location:

Česko

Additional Information:

Legume crops are generally considered beneficial for the quality of arable land compared to maize monocultures, which often lead to soil degradation.

Incorporating Dried Oregano as a Natural Fungicide for Controlling Downy Mildew in Tomato Crops: A Sustainable, Circular Economy-Based Approach for Enhancing Plant Protection and Reducing Crop Losses in Greenhouse and Organic Farming Systems

Objectives:

Downy mildew is a persistent threat to greenhouse and outdoor vegetables, particularly harmful for crops such as tomatoes, eggplants and onions. In organic farming, where sustainable agricultural practices are required, alternative approaches for treating the aforementioned disease are limited, if not minimal. Aifora Kipeftika (eɪˈfɔːrə kiːˈpɛftɪkɑ - Sustainable Vegetables) project examines the integration of dried oregano into tomato crops as a natural fungicidal agent, with an emphasis on treating downy mildew. Through field mapping, dose optimization and assessment of disease suppression, the project aims to develop a circular economy-based protocol for sustainable plant protection.

Results:

Preliminary findings suggest that oregano residues exhibit antifungal properties that can reduce downy mildew severity when incorporated into plant rhizosphere. The protocol that Aifora Kipeftika aims to develop, when applied properly, increases protection against Downy mildew and consequently limits production losses, offering a viable alternative to conventional disease control methods. Its widespread adoption across Greece could potential lead to annual gains of €3.25-6.50 million for tomatoes and €0.7-1.75 million for eggplants. In organic farming, where control measures are even more restricted, these benefits are projected to double.

Practical Implications/Recommendations:

Aifora Kipeftika aligns with sustainable agricultural production principles by integrating agro-industrial residues into plant protection strategies. To maximize its impact, farmers should adopt the proposed oregano integration protocol strictly, particularly in high-risk areas. Further validation across diverse cultivars and environmental conditions will enhance protocol reliability, supporting its broader implementation. Adopting this practice not only improves crop resilience but also suggests an alternative way to utilize oregano residues into a valuable agricultural input.

Additional Dissemination and Exploitation Materials:

For more information regarding the "Aromatic plant byproducts utilization for the crop protection of vegetables" you may visit: https://cooperation.agrotikianaptixi.gr/projects/788

Geographical Location:

Additional Information:

It is essential to conduct field trials to determine optimal application guidelines, assess efficacy against downy mildew, and evaluate any "side-effects" on soil health and non-target microorganisms. Collaborating with agricultural researchers and extension services is highly advised for farmers wishing to implement the protocol.

Innovative Energy: A New Model for Energy Savings

Objectives:

In recent years, greenhouse heating costs have reached unsustainable levels for agricultural businesses. Thermal energy production in greenhouses typically relies on diesel-fueled boilers with independent burners and a distribution, regulation, and emission system that operates with low efficiency, resulting in the loss of approximately 60% of the fuel's thermal potential.

Results:

The MERLIn project, funded by the Liguria Region, aims to bridge the knowledge gap between agricultural enterprises and providers of innovative, energy-efficient, and cost-effective technological solutions. As part of the MERLIn project, the University of Genoa has proposed a new system for thermal energy production and distribution. This system features a new generation of fully automated, low-emission biomass-powered boilers arranged in series. The proposed solution not only significantly reduces fuel consumption but also offers substantial savings by using wood chips, lowering the cost of potential energy. Heating an 8,000 m² greenhouse to a temperature suitable for crops -16°C- would require 365 tons of wood chips per year, at an annual cost of €60,000. This is just one-third of the €176,000 needed for diesel heating to maintain the same greenhouse at only 12-13°C.

Practical Implications/Recommendations:

Implementing this greenhouse climate control system represents a significant management improvement for businesses, allowing better control of climatic conditions, regulation of individual zones, and enhanced comfort for crops, all with considerably lower operating costs than current systems.

Additional Dissemination and Exploitation Materials:

The MERLIn project, funded by the Liguria Region, aims to bridge the knowledge gap between agricultural enterprises and providers of innovative, energy-efficient, and cost-effective technological solutions. For more information on the project https://www.pei-merlin.it/

Geographical Location:

Liguria
Italia

Additional Information:

Over time, some businesses have abandoned more energy-intensive crops to reduce production costs. However, innovative technologies are emerging that could increase added value and help differentiate greenhouse production.

Innovative Solutions for Increasing Plant Immunity While Reducing the Use of Plant Protection Products (PPP)

Objectives:

The best defense against abiotic and biotic stresses and pathogens, especially fungal and bacterial diseases, is the inherent immunity of the plant itself. However, when a plant lacks natural resistance, introduction of PPPs becomes necessary. As agriculture faces the challenge of not only feeding a growing population but also adapting to climate change and developing mitigation strategies, it needs to find a way to protect crops and minimize environmental impact without synthetic pesticides and excessive fertilization.

Results:

Understanding the microbial interactions in the rhizosphere and using them to improve plant nutrient intake can successfully reduce the number of fertilisers and PPPs used in agriculture (Ogar et al., 2015), as proved by the Insignes Labs start-up. They offer a unique blend of mineral molecules boosting plant immunity by activating their natural defense mechanisms, resulting in their healthy growth. It acts as a catalyst of important physiological processes in plants, stimulating crop development, and providing plants with essential micronutrients for high quality yields. The technology enables slashing synthetic pesticide usage by up to 50% and synthetic fertilizers up to 20%, thanks to improved nutrient management. Enhanced photosynthetic activity results in the boost of biomass production, contributing to the sequestration of CO2.

Practical Implications/Recommendations

Insignes Labs developed a portfolio of products to address specific agricultural needs. Technology validation processes were conducted across 20+ crops, e.g. wheat, rapeseed, corn, soybean, sugar beet, potatoes, grapes, berries, apples, and other, involving local farmers and food producers to understand the unique challenges and requirements of different regions. The benefits extend to both farmers and consumers. For farmers, it means improved productivity without harming the environment, while consumers can enjoy high-quality, residue-free food on their plates.

Additional Dissemination and Exploitation Materials:

Geographical Location:

Polska

Additional Information:

Ogar, A., Sobczyk, Ł., and Turnau, K. (2015). "Effect of combined microbes on plant tolerance to Zn-Pb contaminations". Environmental Science and Pollution Research, Vol. 22, pp. 19142-19156. https://link.springer.com/article/10.1007/s11356-015-5094-2

Innovative Use of Digestate and Biochar to Increase Yields and Quality of Agricultural Production

Objectives:

The implementation of verified technological procedures is designed to achieve a long-term increase in hectare yields and enhance soil quality through the application of digestate combined with biochar. This approach is relevant for agricultural enterprises seeking sustainable and economically advantageous ways to improve production, soil properties, functional diversity, fertility, and carbon sequestration back into the soil. Due to rising costs of agricultural inputs and industrial fertilizers, it is necessary to find effective ways to utilize by-products of field farming. The combination of digestate and biochar represents a solution that not only improves soil quality but also contributes to the sustainability of agricultural production.

Results:

A new technology has been designed and verified, utilizing processed waste materials, specifically stable organic substances such as digestate and biochar. Adding biochar to digestate and their joint maturation positively affects the dynamics of nutrient bioavailability in the biochar matrix with digestate for nutrient uptake by plants and soil microorganisms. The application of these substances increases the supply of organic matter to the soil, thus preserving its fertility potential and functional diversity of soil organisms.

Practical Implications/Recommendations

The implementation of these technological procedures can significantly improve the management of organic fertilizers and reduce dependence on industrial fertilizers. Economic evaluation shows that the application of biochar-enriched digestate represents an annual total benefit of 1,203 CZK/ha (ca. 50 EUR/ha). This approach leads to a long-term increase in hectare yields, for example, in silage maize by 3.14-6.71 %, winter wheat by 3.44-9.91 %, and winter rapeseed by 10.68-14.90 %. Additionally, it can improve the qualitative parameters of crops and the management of organic matter, which can lead to savings on industrial fertilizers.

Additional Dissemination and Exploitation Materials:

Technology Agency of the Czech Republic (2022) "Promoting the functional diversity of soil organisms by applying classical and modified stable organic matter while preserving the soil's production properties". Available at: https://starfos.tacr.cz/en/projekty/TH03030319?query=4wiyaacruhnq#project-main

Geographical Location:

Česko

Additional Information:

From an economic perspective, the application of biochar-enriched digestate is very suitable. On the other hand, the downside is the high initial cost of acquiring biochar. In the calculation of the total benefit, the usability of biochar is considered for a period of 30 years. However, from the obtained

data, it is not possible to determine how significant the positive effect on crop yields can be expected over this entire period.

Nutrient-rich Organic Fertilizer from Biowaste: Compost Enriched with Biochar and Biostimulants

Objectives:

A primary challenge (Greek) farmers face is the limited availability of organic matter for direct on-site application. This is exacerbated by difficulties in the transportation of organic material from the areas of their origin to the composting/processing facilities, and then back to application sites. The problem is intensified by farmers' inability to identify ways to transform organic residues into valuable products. The COMPOST-INNO project aims to address these issues by producing high-quality compost from mixed by-products and waste, including market residues, pruning waste, and poultry farming by-products.

Results:

Organic by-products are collected and separated into two parts. One part undergoes traditional composting, while the other is used for biochar production. Among the composts derived from different raw materials, the one with superior physicochemical properties is enriched with microbial biostimulants and biochar, in order to produce a high performance biofertilizer. Preliminary trials in pots and fields show that enriched compost improves plant growth/productivity, by enhancing soil fertility. Biochar also helps stabilize carbon in the soil, reducing CO2 concentrations and mitigating climate change. These results reflect literature (Antón-Herrero et al., 2021), arguing that biochar and biostimulant solutions improve crop growth in polluted soils.

Practical Implications/ Recommendations:

Conventional organic residue management has both economic and environmental costs. The enriched compost product provides a sustainable alternative to chemical fertilizers, helping reduce soil degradation and water contamination. It improves soil structure, boosts nutrient supply and increases crop productivity. This cost-effective solution supports circular economy principles by making good use of agricultural and organic waste. Challenges like waste collection logistics and upfront costs can be tackled through regional collaborations and policy incentives.

Additional Dissemination and Exploitation Materials:

Geographical Location:

Additional Information:

Antón-Herrero, R., Vega-Jara, L., García-Delgado, C., Mayans, B., Camacho-Arévalo, R., Moreno-Jiménez, E., Plaza, C., Eymar, E. (2022). "Synergistic effects of biochar and biostimulants on nutrient and toxic element uptake by pepper in contaminated soils", Journal of the Science of Food and Agriculture, Vol. 102 No. 1, pp. 167-174.

https://scijournals.onlinelibrary.wiley.com/doi/10.1002/jsfa.11343

Optimised Use of Stabilised Litter: Innovative Solutions for Separated Manure in Dairy Cow Bedding

Objectives:

Dairy farms often rely on traditional bedding materials such as straw, wood chips, or sawdust, which can be costly, while effective manure storage is often challenging with larger herds. In the EIP-AGRI Operational Group project, titled "Stabilized litter for dairy cows: optimization of the use of litter derived from the solid fraction separated from manure", dairy cattle slurry is processed in a rotating drum separator with increased temperature to reduce the pathogens to stabilise the resulting solid fraction. This is used as alternative bedding material. The project evaluated the relevant cost of the purchase and stocking of other litter material such as straw, wood chips or sawdust. The goal is to assess if this solution can be implemented in Parmigiano Reggiano dairy farms without negatively impacting cow housing conditions, animal welfare and cleanliness milk quality, or cheese production.

Results:

· Feasibility & Scalability: Large herds (>400 cows) generate significant manure, making this technology viable for sustainable bedding.
· Low carbon sink potential, moderate economic benefits (cost savings from bedding and manure management), and high technical complexity pose challenges for smaller farms.
· Sustainability: Moderate social impact (reduced dust, rural economic support) and environmental benefits (waste recycling, resource efficiency).
· Added Value: Promotes circular economy principles by repurposing waste.
· The approach aligns moderately with agricultural sustainability & bioeconomy initiatives, but requires further integration efforts to maximise impact.

Practical Implications/Recommendations:

· Best suited for larger dairy farms due to required investment in separation and stabilisation technology.
· Lowers bedding costs and improves sustainability.
· Requires technical planning and support to manage initial investment and operational complexity.
· Reduces reliance on external bedding sources.

Additional Dissemination and Exploitation Materials:

Geographical Location:

Parma
Reggio nell'Emilia
Modena
Bologna

Additional Information:

(1) The Stabilised Litter Website
https://lettierastabilizzata.crpa.it/nqcontent.cfm?a_id=14637

(2) The EU CAP Network Stablised Litter Page

https://eu-cap-network.ec.europa.eu/projects/stabilized-litter-dairy-cows-optimization-use-litter-derived-solid-fraction-separated_en

Optimization of Biogas Plants through Spirulina Algae Production

Objectives:

Biogas plants disperse a significant share of their thermal energy into the environment, reducing system efficiency and increasing dependence on energy market fluctuations. The inability to fully utilize this heat represents both an economic and operational weakness. The POWERFOOD project addresses this issue by recovering waste heat from biogas plants and digestate for innovative food-feed production, focusing on Spirulina algae. This high-value superfood is rich in nutrients, aligns with vegan dietary trends, and targets a high-income market segment.

Results:

The BBT (bio-based technology) proposed by POWERFOOD is an innovative solution capable of valorising biogas plant production waste while also providing a risk management tool for local entrepreneurs, allowing them to diversify their income sources. The experimental results showed an annual Spirulina algae yield of approximately 200 kg/acre, using production inputs such as bicarbonate, fertilizers, electricity, labour, and heat. The integration of thermal energy from biogas, as proposed by POWERFOOD, eliminates heat-related costs, which would otherwise amount to €5-10 per kg. Without this thermal integration, Spirulina farming would be restricted to shorter periods.

Practical Implications/Recommendations:

Moreover, this process aligns perfectly with the energy and nutritional goals outlined in the CAP (Common Agricultural Policy). However, since this practice is still relatively uncommon, adequate training and support from the AKIS system are essential. This BBT is not without limitations: dedicated structures for cultivation are required, expertise in this field is not widely available, and production risks are higher compared to traditional crops.

Additional Dissemination and Exploitation Materials:

For more information on the proposed BBT and the POWERFOOD project: https://power-food.eu/

Geographical Location:

Italia
Piemonte

Additional Information:

Turning Forest Residues into Value: The Opportunity of Ash

Objectives:

The spread of biomass-based thermal and electrical energy plants has led to a significant amount of residual ash that must be properly managed. Despite their agronomic value and role in organic soil amendments, these ashes are classified as special waste in Italy. However, due to the limited quantities generated, forestry enterprises typically lack the opportunity to establish agronomic utilization agreements, allowing ashes to exit the waste circuit. As a result, forestry enterprises face high disposal costs (currently exceeding €500/ton) and are forced to waste both economic and agronomic value.

The Probest project promotes the agronomic use of wood ashes, either directly as a by-product or as a component of next-generation, low-energy-impact fertilizers. The goal is to identify organizational and operational solutions that comply with regulatory requirements for secondary raw materials and fully harness the agronomic and economic potential of wood combustion ashes, with a cascading bioeconomy valorization approach.

Results:

Within the ProBest project, it was estimated that each ton of ash could be sold for reuse at a value between €5-10/ton. Conversely, disposal costs at dedicated facilities are significantly high, largely depending on logistics and the disposal area. These costs range between €50-150/ton, posing a substantial burden for companies. In this context, the difference between disposal costs and potential revenue from ash sales could reach up to €160/ton.

Practical Implications/Recommendations:

Ashes can potentially be used as soil amendments and/or fertilizers, in the construction sector and as a supporting material for the development of forest roads. This variety of applications, combined with the fact that in Italy ash is classified as a special waste -making its disposal costly- highlights the potential of ash valorization as a sustainable bio-based technology (BBT) from both an environmental and economic perspective for end-users.

Additional Dissemination and Exploitation Materials:

For more information on the proposed BBT and the PROBEST project, visit:
https://www.goprobest.it/

Geographical Location:

Piemonte
Italia

Additional Information:

The exchange of ashes takes place through local and rather informal channels. Companies interested in obtaining soil amendments or fertilizers typically pay between €5-10/ton of ash to nearby producers also facilitating the logistics and transportation of this BBT. A key aspect of byproduct

exchange is storage. Ash, being powdery, reacts with CO_2 and humidity, altering its properties. To prevent this, it can be compacted into pellets or briquettes using only water, a cheaper but less effective method. However, this pre-treatment requires infrastructure and machinery, leading to additional costs. However, this BBT is not without limitations, notably rising trasnport and commercialization costs. ProBEST is exploring local transformation centers to reduce transport costs, streamline processes, and ensure traceability.

SCARABEO: Valorization of Hemp Residues for Food and Energy Recovery

Objectives:

The SCARABEO project represents an innovative approach aimed at diversifying and valorising by-products and waste generated from hemp processing. Its main outputs included hemp fibre with potential application as biomaterial, polyphenols with food or pharmaceutical uses, biochar and insect larval biomass for potential feed and biofuel production. Aligned with the principles of circular economy, SCARABEO redesigned the maceration plant to reduce heat loss and enhance energy consumption of operations, using sensors for operation control and reuse of maceration liquids. In addition of hemp fibre retting, the hemp core was carbonized in a pyrogasifier to produce biochar. Also, the maceration was co-processed using the larvae of Black Soldier Fly resulting in better hemp fibre cleaning.

SCARABEO has successfully addressed inefficiencies in Italian hemp industry, and by diversifying revenues, saved on costs and introduced new markets for farmers.

Results:

Innovative maceration plant design to minimize heat loss, reduce energy consumption and maceration liquid reuse
Hemp core carbonization to produce biochar which can be used as soil enhancer and/or fuel source (syngas)
Polyphenols extraction through biochar filtration of maceration liquid (with the enriched biochar serving as a soil conditioner)
Black soldier fly larvae integration during maceration to reduce mucilage on hemp fibres (optimal conditions: 10-day-old larvae, 10% by weight, fed for 6 days)

Practical Implications/Recommendations:

The economic sustainability of the entire supply chain, with the production of fibre and the pyrogasification of hemp core, becomes interesting especially if all products are marketed, including energy, biochar and syngas. The particle size of the biochar proves to be a determining factor for the effectiveness of filtration, thus indicating how to operate in the production of biochar from hemp. The economic advantage of biochar as a carbon sequestration agent is remarkable.

Additional Dissemination and Exploitation Materials:

This project was funded by the Emilia-Romagna Region, Italy under an Operational Group from 2014 to 2020. For further insights on this project, refer to their website https://www.psrscarabeo.it/.

Geographical Location:

Emilia-Romagna
Italia

Additional Information:

Sustainable Feed Protein: Farm-Based Lignocellulosic Biorefinery of On-Farm Residues

Objectives:

Farms generate significant amounts of lignocellulosic residues such as meadow grass, wood, and straw. "Lignocellulosic Biorefinery - Anaerobic digestion of farm residues (wood, grass, straw)" project explores the use of anaerobic digestion to convert farm lignocellulosic residues into valuable products, promoting sustainability without affecting food production.

Many farms often underutilize lignocellulosic residues of limited value. A farm-based lignocellulosic biorefinery, allows producers to convert these residues into high-value feed proteins and bio-materials, reducing reliance on external inputs. This approach enhances farm profitability, supports on-farm sustainability, and contributes to a circular agro-economy. The biorefinery process is easily implemented, allowing farmers to valorize available biomass with minimal additional effort.

Results:

High value chain potential: Abundant feedstock ensures scalability
Climate impact: Carbon sequestration at both feedstock and product levels contribute to climate change mitigation
User benefits: Tailored for farmers and foresters, providing economic and sustainability advantages
Accessibility: Straightforward technology, requiring minimal expertise, making it easy to access and implement for primary producers
Economic sustainability: Offers cost savings on feed, new income sources, and improved resource efficiency
Social impact: Medium potential - job creation, rural development, and enhanced agricultural sustainability
Environmental benefits: Reduces waste, lowers reliance on carbon-intensive feed, and supports carbon sequestration

Practical Implications/Recommendations:

Generates additional revenue while minimising waste and enhancing circularity
Cost-effective operation with low maintenance expenses, though initial setup costs approximate €2M
Long-term viability with a 10-year return on investment
Strong economic and environmental incentives make this process attractive for farms/forestry enterprises

Additional Dissemination and Exploitation Materials:

The Biorefinery Pilot Plant website:
https://konversionstechnologie.uni-hohenheim.de/en/118578/biorefinery-pilot-plant

Geographical Location:

Stuttgart

Additional Information:

Challenges and Future Research

Facilitators: Readily available biomass, rising interest in sustainable agriculture, and growing demand for alternative proteins
Barriers: High initial investment and need for policy support
Next Steps: Optimising microbial processing, improving cost efficiency, and expanding market applications
Recommendations: Farmers and foresters should assess biomass availability and investment capacity. Collaboration with researchers and industry experts can aid successful implementation

Sustainable Valorization of Olive Oil By-Products: From Waste to High-Quality Organic Fertilizers

Objectives:

The olive oil industry in Spain generates significant amounts of by-products, including olive mill effluents and grove residues, which pose environmental and economic challenges. The development of sustainable valorization technologies aims to transform these waste streams into high-quality organic fertilizers, improving soil health and reducing reliance on chemical inputs. Sustainable valorization technologies enhance circular economy practices by integrating agricultural waste back into productive cycles while mitigating pollution risks.

Results:

A composting process combining olive mill sludge and leaf residues has been successfully developed, yielding an effective organic fertilizer. Field trials show it improves soil organic matter, fertility, reduces erosion, and lowers the need for synthetic fertilizers, minimizing water contamination risks. The process is a viable, scalable alternative to traditional waste disposal. Other previous studies confirm the benefits of composted olive residues for soil health and productivity, such as the impact of olive solid waste and compost on soil properties and tomato plant growth, offering insights into sustainable agriculture (Killi and Kavdir, 2013).

Practical Implications/Recommendations:

Applying this composting technology provides olive producers and agricultural sectors with a cost-effective and environmentally friendly solution for managing by-products. This method not only reduces waste disposal costs but also enhances soil sustainability and promotes long-term agricultural productivity. To ensure widespread adoption, collaboration among olive mills, agricultural cooperatives, and research institutions is crucial, enabling efficient knowledge transfer and optimization of the composting process. Policy incentives and regional initiatives can further drive the integration of this sustainable practice into the industry.

Additional Dissemination and Exploitation Materials:

Operational Group – VALORIZA: https://www.valorizasm.com/en/

Geographical Location:

Granada
España

Additional Information:

BBioNets

www.bbionets.eu

Document information

Title	BBioNets - Creation and promotion of Forest and Agriculture Networks to boost Bio-Based Technologies adoption and Value Chain development (GA No 101133904)
Start - end date	1/11/2023 – 31/10/2026 (36 months)
Project type	Coordination and Support Action
Programme	Horizon Europe – Cluster 6
Funding	1,998,636.20 €
Coordinator	Munster Technological University Ms. Carmen Girón Domínguez (carmen.dominguez@mtu.ie)
Project overview	**BBioNets** will constitute a thematic network that will rely on, promote, and further advance the work carried out by EIP AGRI Operational Groups (OGs) with respect to **management and/or processing of agricultural and forest biomass with Bio-Based Technologies (BBTs).** The project will set up 6 regional Forest and Agriculture Networks - FANs (IE, ES, IT, GR, PL, CZ) that will identify local needs, prioritise specific BBTs and share BBT knowledge ready for practice to farmers and foresters, boosting the (re)definition of value chains, stimulating cross-fertilisation beyond borders, and bringing Europe to the forefront of farming, forestry, and bioeconomy with economically viable and sustainable practices.
Consortium	MTU Ollscoil Teicneolaíochta na Mumhan Munster Technological University cagasc IUNG Institute of Soil Science and Plant Cultivation State Research Institute TEPRO Consultores Agrícolas, S.L. CTA crea American Farm School Thessaloniki - Greece FOCUS BIO EAST HUB

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