BBioNets

Boosting the adoption of Bio-Based Technologies

DELIVERABLE D1.5

Identified regional needs and challenges

TEAGASC

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Main Authors	Thomas McCarthy – Teagasc		
Contributors	Patrick Forrestal – Teagasc Carmen Giron Dominguez – MTU		

Peer reviewers

Reviewer 1	Iakovos Delioglanis – FOCUS
Reviewer 2	Paula Rosa Alvarez - CTA
Reviewer 3	Macarena Ureña - CTA
WP Leader	Teagasc
Coordinator	MTU

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Table of Abbreviations

Abbreviation	Description
AD	Anaerobic digestion
BBT	Bio-based technology
D	Deliverable
DAFM	Irish Department of Agriculture, Food & Marine
EBA	European Biogas Association
EIP	European Innovation Partnership
EPA	Environmental Protection Agency
EU	European Union
FAN	Farm Forest and Agricultureal Network
MAP	Magnesium Ammonium Phosphate
OG	Operational Group
P	Phosphorus
RR	Represented region
TAMS	Targeted Agricultural Modernisation Scheme
WP	Work Package

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Executive Summary

This report examines the key resources and needs of the bioeconomy with respect to primary production in six representative regions of the European Union. The report identifies the resources available in each region, their current uses and practices and the needs and potential improvements required to enhance circularity and sustainability. The purpose of the report is to prioritise these needs to increased adoption of circular practices to feed into Task 2.2 assessment of bio-based technologies (BBTs) available in each region. A methodology was designed to create a Forestry and Agricultural Network (FAN) in each representative region (RR). The purpose of these regional FANs were to bring together experts working in the bioeconomy sphere, from primary production (i.e. farmers, forester etc.), to industry stakeholders, such as those working in biomass processing, and research and policy in (e.g. Governmental Policy Departments) order to identify the key regional resources and processing needs in each region. Events, referred to as 'workshops' were held in each region. A methodology was developed prior to these workshops in which a predetermined set of questions were posed to FAN members and in depth discussions ensued in order to identify these regional resources, as well as the processing needs in the region. Indeed, any regional needs which facilitate the adoption of biomass valorisation were discussed among FAN members in these workshops, ranging from processing needs, infrastructural and funding needs, as well as social perception and acceptance towards biomass adoption. Furthermore, the biomass processing needs in each region were prioritised based on their relative priority in order to enhance transition towards more bio economic circularity in each region. These workshops, depending on the region took place either as in-person, online, or hybrid format. The workshops were successful in characterising the regional resources and prioritisation of needs, and provided a detailed synopsis of the variation in both across the six RRs being analysed. The workshops also brought together a diverse range of experts working in the bioeconomy sphere in each region, further enhancing collaboration, both within each RR, and across the six EU member state regions.

A significant outcome of the workshops was the successful characterised of available resources by region and included, in Ireland for example, livestock manures (cattle and pig slurry), agricultural residues (straw, horticultural waste), food waste, and forestry residues (tree branches), while in Spain forest pruning residues (pine, eucalyptus), agricultural residues (olive stones, pruning residues), and various organic wastes being identified. Greece also identified forest residues, particularly chestnut coppicing, along with greenhouse plant biomass and sheep wool, along with biomass generated from olive production. In Italy, by-products (chestnut skin, olive stones, and olive mill effluents), forest resources, and uncultivated land were identified, and potential for utilising uncultivated land for bioeconomic activities identified. In Poland agricultural residues (straw, fruits and vegetables press waste), manure, and timber formed the greatest resources, while in the Czech Republic, plant and forest wastes, organic wastes from industrial production, and fast-growing woody plants were identified with a strong emphasis on the use of forestry and plant wastes.

The greatest regional needs predominantly referred to better infrastructure for processing of materials into utilisable by products, such as anaerobic digester (AD) plants, composters and root and debris harvesting equipment in the forestry sectors. Other principle needs for the increased adoption of circular processes included increased local and governmental support and funding in order to increase the adoptability and feasibility of investment in appropriate processing technologies for primary producers in order to encourage circularity in each region. Key waste streams are identified in the

context of incorporation into AD and compost in order to improve utilisation efficiency and circularity. The report highlights the importance of existing regional resources available, and also the challenges and barriers associated to social transitioning towards a circular bioeconomy. Importantly, the document also explores social aspects such as discussion around ways in each region to encourage participation by social minority groups, the youth and the unemployed, as well as ways by which to empower women. A number of key means to achieving this social diversity are outlined for each region.

1 Introduction

This document is a report on the needs and challenges as to OG-identified/locally applied BBTs in each targeted region.

This document gathers the needs and current resources available per each RR gathered through Forest and Agriculture Network's events/workshops/webinars. The aim for these activities was to identify needs about biomass processing in their respective environments, value chain creation, technology availability, etc. It was considered to invite representatives from the quadruple helix in each FAN and RR, to discuss the resources at their disposal (land, biomass, monetary, etc.) and socio-ecological transition needs. This ensured that all voices were heard and every specific region's actual needs realistically defined. A list of these workshops with its outputs is displayed per section in this document and a list of organisations per each FAN is included in Appendix 1.

Additionally, these activities also helped identify the existing dissemination channels most consulted by farmers and foresters in their region, as well as social aspects pertaining to current involvement and ways to attract and empower women, unemployed people, and youth to develop green skills in the farm and forest sectors. This information will feed WP3 activities.

Finally, in preparation for the development of said events/workshops/webinars, Teagasc prepared guidelines for partners to follow, so the outputs of these activities could be aligned with T2.1 (creation of BBTs inventory) and T2.2 (development of the BBTs assessment tool). Details of this methodology are also included in this document.

2 Methodology guidelines generated.

The workshops targeted 3 main aspects:

1. The identification of **current resources** and processing techniques of the RR.
2. RR **needs** on the current resources, practices, and techniques to achieve or improve the current circular bioeconomy state of the forest/agriculture sectors.
3. Prioritise said needs.

2.1 Guidelines to identify current resources, practices, and techniques of the RR.

The identification of current resources, practices and techniques could be seen as the first half of the workshops. The aim was to identify the current resources within the attendees' sector (agriculture or forestry) at an RR level, i.e., not focusing on the attendees' personal experiences only but the high-level knowledge the attendees' have of the region or country (RR). **This defined a "state-of-the-art" overview of each region that BBioNets is studying.**

In order to obtain the relevant information from FAN members, two approaches to collecting information could be implemented, as follow;

- Make attendees communicate the current processes/techniques/technologies in their RR by encouraging them to write them down, describe, and possibly draw processes relating to their area of expertise.
- Record qualitative and ordinal data by pre-generating ranges and asking them to choose or to provide a range. **Any missing information should be complemented by each partner through further desk research, a second workshop, a survey, or an interview.** The answers should be provided in one word document to Teagasc to facilitate the writing of the deliverable report.

The 11 questions below were designed to help identify current resources in the agricultural and forestry sectors, their processing capabilities, and the socio-ecological aspects of adopting BBTs.

The available resource quantities provided by FAN members were checked with national statistics where available. For example, most countries have national statistics data on farm/ forest size. Some of these aspects were checked in advance of the workshop by the responsible partner, and verified by Teagasc.

Each FAN identified industries/processors with whom farmers/foresters interact, academic opportunities in their sector, public authorities/decision makers, and advisors/intermediaries. FANs also identified the existing dissemination channels most consulted by farmers and foresters in their region, as well as social aspects about current involvement and ways to attract and empower women, unemployed people, and youth to develop green skills in the farm and forest sectors.

Questions were in certain cases circulated among the FAN members before the workshop. This allowed the FAN members to familiarise themselves with the questions and provide well-thought-out answers.

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Workshop questions

1. **What are the primary or secondary resources available in your representative region?** (e.g., slurry, grass, timber, roots, branches, wood dust, olive press waste, etc.).
2. **What processing equipment is currently being used in your representative region?** (e.g., anaerobic digestion plants). Please describe it and give an example.
3. **What secondary products/by-products are currently being generated in your representative region?** (e.g., bioenergy, biogas, bio-fertiliser, compost, soil conditioner, feed, bioplastic, wood pellets, paper, etc.).
4. **What are your representative region's processing needs regarding primary and secondary resources?** (e.g., slurry separation, anaerobic digestion plants, root harvesting equipment, presses, driers, separators etc.).
5. **What is the size/total area of the farm or forest in your representative region?**
6. **How much would the farmers/foresters in your representative region be willing to invest in the short-term time (2 years) to implement a technology or practice that would help them process their current resources** (e.g., slurry, branches) **into bio-products/by-products** (e.g., bio-gas, bio-fertiliser, wood pellets)**? And in the medium-term time (5 years)?**
7. **What return on investment period (number of years) is acceptable for investment in a bio-based technology?**
8. **What key stakeholders are you currently interacting/collaborating with?** Please indicate the nature of the collaboration and whether your collaboration network is open or closed to new members or partners.
9. **Where do you go for information in your region? –** (e.g., Advisory service, media, other farmers, etc.).
10. **What are the most significant environmental impacts in the region worrying your sector (forest/agriculture)?**
11. **What ideas do you have for involving women, the unemployed, and the youth in this area?**

2.2 Guidelines to identify and prioritise needs for a socio-ecological transition to the circular bioeconomy in the country.

The aim was to identify **needs/potential improvements** related to the current situation that could be solved by a new practice or BBT. This part follows the first half and needs to align with a **socio-ecological transition to the circular bioeconomy in the country**.

- Thinking about the current resources and needs identified, what **improvements could be implemented to make the process more circular**? (e.g., introduction of BBTs, investment, knowledge transfer, etc.).

- **Do you know of a more circular approach/technology that will help your RR work in a more circular way?** (e.g., anaerobic digestion plants to treat slurry and produce secondary product/by-product, etc.).

Finally, at the end of this workshop, a **prioritisation** of established needs was conducted. All attendees chose which need/improvement to be prioritised such that the needs were ranked. A list of needs and a single ranking were provided as an output of this workshop. This prioritisation will target searches while developing T2.1 BBioNets inventory and knowledge collection (see **Appendix I** to read the information to target while developing the T2.1 inventory and at the same time bearing in mind the FAN's needs and current resources).

3 Overview of FAN Workshops and Key Findings

In each region, a workshop was conducted with experts from the region's FAN as described in section 1. The details of each workshop, including the date held, and the main outputs from the workshop, detailing the resources and needs associated to effective transition towards bioeconomic circularity in each region are displayed in Table 1 below.

Table 1. Overview of results from each workshop detailing date held, key resources and needs identified in each region.

Country	Date	Resources Identified	Needs Identified
Czech Republic	30/05/2024	• Plant and forest wastes • Organic wastes from industrial production • Wastes from livestock production • Municipal organic waste • Fast-growing woody plants • Grape seeds and Pecky • Sewage sludge	• Building a buyer network for compost generation Improved communication between composting plants, biogas plants and wastewater treatment plants • Availability of biomass combustion boilers • Motivation for brewers & distillers to make processes more circular • Use of gastro food waste for biogas and compost production • Promotion of wastewater treatment for algal biomass cultivation
Ireland	23/04/2024	• Cattle slurry, pig & poultry manure • Timber felling waste • Digestate from AD plants • Dairy & brewer's sludge • Straw • Poultry ash • Rushes and gorse • Horticultural • Green manures e.g cover crops • Vegetables waste	• Greater number of AD plants • Incinerators for wood by-product ashes generation • Mulchers and chippers for processing wood by-products • Making processes more circular • Slurry separation technology • Root harvesting equipment • Biomass • Regionally funded shared technology and infrastructure
Greece	09/05/2024	• Chestnut skin • Greenhouse Vegetable Plant biomass • Olive and olive oil-production biomass and prunings • Sheep wool • Prunings and grass from fruit trees	• collaboration with other sectors in order to avoid contamination of residue bio-mass with micro-plastics, petrol residue and other foreign matter • A system (i.e. public funding body, leasing model etc) for wide availability of processing technology and know-how to farmers • Piloting/demonstration/experimental schemes and educational purposes

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Country	Date	Resources Identified	Needs Identified
		• Stone-fruit residue	• Education on specific treatment protocols for the quality of the bio-mass streams that is intended for cyclic use. • Wool processing technology for use in agriculture
Italy	18/04/2024	• Wastewater • Chestnut coppicing • Forest resources • Woody & herbaceous pruning residues • Olive mill effluents • Depleted substrates • Olive pomace • Grape marc • Manure • Whey • Male claves	• Transformation of plant residues into secondary materials - e.g. Biostimulants, phytosanitary products • Innovation • Dissemination visibility– e.g. advertising • Recovery of depleted substrates from floriculture • Material and assortment storage yards • Forestry and woodworking mobile equipment – e.g. mobile sawmill, wood chippers, etc. • Drying equipment • Production of thermoplastic starch for the manufacturing of biodegradable materials - e.g. bags, pots and containers
Poland	21/03/2024	• Straw • manure • slurry • fruits and vegetables press waste • grass • timber • roots • branches	• root harvesting equipment • Biogas production with farm-scale anaerobic digesters • Press cake and protein for cattle and pig feed, respectively, using green biorefineries processing grasses and other green leaves • Biochar production • RENURE fertiliser production- Recovery Nitrogen from manure
Spain	10/04/2024	• Pine forest pruning residues • Eucalyptus forest pruning debris • Wood • Olive stone and olive pruning residues • Fruits and vegetables biomass	• Moisture reduction of products to lower cost of transport • Product valorisation to make transport profitable • Seasonality of some products cannot guarantee stable prices for bio-based products • Lack of awareness about circular economy concepts

4 Czech FAN

4.1 Workshop details

Venue	Vysočina: Demo Field at Vysočina, Jihomoravský: Agricultural Research centre at Troubsko (ART)
Date	30/05/2024 (Vysočina) and 25/05/2024 (Jihomoravský)
Format	Both online and in-person
Name of the event	BBioNets Czech 1st FAN meeting

4.2 Identification and Prioritisation of resources and needs for a socio-ecological transition to the circular economy

In the context of the Czech bioeconomy, a number of key needs for a socio-ecological transition to the circular economy were identified by the FAN members. The Czech region has been separated into two regions for the purpose of this report, namely the Vysočina Region and the Jihomoravský Region.

In the Vysočina Region, improvements that could be implemented to make processes more circular included the use of Pellets as an Energy Source, with a calorific value equivalent to charcoal and similar to 500 m^3 of natural gas per tonne. This high energy yield makes them a valuable asset for reducing dependence on fossil fuels. There is a need for processing of liquid residues in biogas plants, as their low dry matter content makes them ideal for anaerobic fermentation. It was reported that one tonne of digestate can produce 60 m^3 of biogas, contributing to renewable energy production and waste management. The use of biomas boilers was also identified as a need in the FAN, as these can provide a clean and efficient way to utilise organic waste for energy production, reducing greenhouse gas emissions and reliance on non-renewable energy sources. Another need identified is for the cultivation of energy herbs and trees which can provide a sustainable source of biomass. The use of gastro and kitchen waste for biogas or composting is seen as a need in order to reduce landfill use and generation valuable by-products. There is a need to manage fallow land, eliminating the negative impacts of spontaneous fallow by appropriately using or conserving fallow land, which can prevent land degradation, promote soil health, and increase agricultural productivity in the region.

In the Jihomoravský Region, the increased utilisation of composting plants is needed, as the current capacity of composting plants is not fully utilising the resources. There is a lack of suitable facilities for sludge treatment and processing in the region, which would enable technological interconnection with composting plants. There is also a need to use kilns as their calorific value is similar to charcoal, and can be an effective energy source. One tonne of pellets equals the energy content of 500 m^3 of natural gas, supporting a shift towards renewable energy. Similar to the Vysočina region, processing liquid residues in biogas plants can generate 60 m^3 of biogas per tonne of digestate, contributing to the region's renewable energy portfolio, there is a need to adopt the appropriate technologies to enable this process. Another need identified in the region is for the cultivation of algal biomass. The region's suitability for algal biomass cultivation presents an opportunity to produce biofuels and other valuable bioproducts, contributing to a diversified bioeconomy. There is also a need in this region to increase the use of biomass boilers, cultivate energy crops and trees and use the waste generated in gastro and kitchen waste as feedstock in biogas production of composting, as well as better management of fallow land.

4.3 Vysočina Region Resources at their disposal and their current uses.

4.3.1 Feedstock

In the Vysočina Region, there is a reported 196 670 ha of forestry and therefore, plant and forest wastes represent a source of biomass for energy and compost. Organic wastes from industrial production are usable for biogas production and composting. Manure generated from livestock production can be used as a feedstock for biogas plants, as can municipal organic waste and fast-growing woody plants. Grapeseeds are extracted for biomass, while pecky, the by-products of fruit processing, is usable for bio-energy. Sewage sludge is used for fertiliser and for the production of biogas, and used cooking oil can be used to produce biodiesel.

4.3.2 Process

Biogas plants are used to process organic wastes and produce biomethane, while composting units are used to convert organic wastes into compost. Cooking oil is used to produce biodiesel using the appropriate biodiesel facilities.

4.3.3 Social

Circular processes increase employment opportunities in waste management and renewable energy sectors, and also increase employment in rural areas. The promotion of sustainable practices can foster community engagement.

4.3.4 Environmental

Circular processes can lead to a reduction in waste going to landfill. Composting can improve soil health and nutrient cycling and retention. The use of biomethane and biodiesel reduces dependency on fossil fuels and their associated greenhouse gas emissions.

4.3.5 Cost

There is potential for savings on energy costs through local renewable energy production. The upcycling and selling of by-products such as compost and biodiesel can generate new income streams. For example, the collection and transportation of plant and forest wastes, in which costs can vary depending on the distance from the source to processing facilities. Remote areas might incur higher transportation costs. However these wastes can generate revenue being sold a biomass for energy production.

4.4 Jihomoravský Region Resources at their disposal and their current uses

In the Jihomoravský Region, a variety of feedstocks are available to support the circular economy and sustainable practices. Plant and forest wastes from the region's 186,722 hectares of forestry can be utilised as biomass for energy production and composting, providing a renewable source of energy and improving soil health. Organic wastes from industrial production can serve as inputs for biogas plants and composting, effectively managing industrial by-products. Wastes from livestock production, including manure, can be processed in biogas plants to produce energy and fertilisers, enhancing agricultural productivity. Municipal organic waste, often abundant in urban areas, can be converted into biogas and compost, reducing landfill waste. Fast-growing woody plants offer a reliable source of biomass, supporting energy generation. Grape seeds, a by-product of the region's wine industry, can be used for oil extraction and biomass. Agricultural and forestry residues, as well as pecky can also be repurposed for energy and compost. Sewage sludge can be processed in biogas plants to generate energy and fertilisers, while used cooking oil can be transformed into biodiesel, providing a sustainable alternative to fossil fuels.

4.4.1 Process

Biogas plants play a crucial role by converting various organic wastes, including livestock manure, municipal organic waste, and sewage sludge, into biogas. The digestate generated can be used as a fertiliser. Composting is another vital process, turning plant and forest wastes, organic industrial wastes, and municipal organic waste into nutrient-rich compost, which enhances soil quality and supports sustainable agriculture. Additionally, biodiesel is a cleaner alternative to traditional diesel fuels.

4.4.2 Social

The shift towards a circular economy in the Jihomoravský Region has significant social benefits. Enhanced job creation in the renewable energy and waste management sectors provides new employment opportunities, stimulating local economies. Educational programs and awareness campaigns can further encourage sustainable practices, ensuring long-term commitment to environmental stewardship.

4.4.3 Environmental

The significant reduction in waste sent to landfills decreases the environmental burden of waste management, reducing land and water pollution. Lower greenhouse gas emissions are achieved through the use of renewable energy sources like biogas and biodiesel, contributing to climate change mitigation. Improved soil quality from the application of compost enhances agricultural productivity and biodiversity, creating healthier ecosystems.

4.4.4 Cost

Energy cost reduction is a key benefit, as local renewable energy sources like biogas and biodiesel provide cost-effective alternatives to fossil fuels. This shift can lead to significant savings for businesses and households. Additionally, the sale of by-products such as compost and biodiesel generates additional income, creating new revenue streams.

4.5 Needs identified for a socio-ecological transition to circular bioeconomy in the country.

In the Vysočina region, there is a need for building a network of buyers for compost being generated from composting plants, and addressing the challenge of its limited marketability due to sufficient

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manure availability from livestock production. This compost, however, can be effectively utilised in drinking water protection zones and protected landscape areas prevalent in the region. Additionally, there is potential in converting food and kitchen waste into biogas and compost, enhancing resource efficiency. In the Jihomoravský region, a long-term survey by ZERA highlighted insufficient technological interconnection between composting plants, biogas plants, and wastewater treatment facilities. To advance the bioeconomy, it is crucial to improve these interconnections, alongside promoting the use of biomass combustion boilers. There is also a need to motivate cider producers, distilleries, and wineries to recover waste biomass through biogas production, incineration, or composting. Moreover, the region can benefit from utilising gastro and kitchen waste for biogas and compost production, and combining wastewater treatment with algae cultivation for biomass, thereby creating a more integrated and efficient bioeconomic framework.

4.6 Identification of key stakeholders with whom they interact.

The key stakeholders identified in both regions of the Czech FAN include Innovation and Agricultural Practice consultancy. Farmers and foresters in the region collaborate with these institutions to provide feedback and advice on matters pertaining to adoption of bio-based technologies and circularity.

4.7 Identification of dissemination channels and key social aspects.

Farmers and foresters in the FAN use a variety of sources to access information related to the bioeconomy, including agricultural and forestry associations, such as the Agrarian chamber of the Czech Republic, which provides information, training and support to farmers, and the Czech Forestry association, which offers resource and updates on sustainable forestry practices. Government agencies and research institutions, including the Ministry of Agriculture, which disseminate policies, regulations and updates on agricultural practices. Agricultrual extension services offer advice and training session to farmers. Other forms of dissemination used in the Czech Fan include social media and online communities, which are used to share information and engage with the community. Online forums and discussion groups are used where farmers and foresters can exchange ideas and experiences.

4.7.1 Social aspects pertaining to current involvement and ways to attract and empower women, unemployed people, and youth to develop green skills in the farm and forest sectors.

Several ideas are posed for involving women, the unemployed and youths in the two regions of the Czech FAN. In both the Vysočina and the Jihomoravský regions, Training and Capacity Building Programs, i.e. Workshops and Training: focused on modern agricultural practices, sustainable forestry, and bio economy-related technologies are identified. Mentorship and internship programmes are also discussed, such programmes help to educate young people, including women through working with experienced professionals in agriculture and forestry. Community-Based Projects are also useful, promoting community gardens and urban farming projects can encourage local participation and provide fresh produce and cooperative models (shared economy) to establish agricultural and forestry

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cooperatives, which allow members to pool resources, share knowledge, and gain better market access. These cooperatives can provide a supportive network for women and youth to engage in bioeconomy activities.

5 Greek FAN

5.1 Workshop details

Venue	online
Date	09/05/2024
Name of the event	Greek 1st FAN meeting

5.2 Identification and Prioritisation of resources and needs for a socio-ecological transition to the circular economy

In the context of the Greek bioeconomy, critical social-ecological transition needs of farmers and foresters in the region identified by the FAN member's workshop included addressing the high financial burdens associated with processing. Farmers and foresters often encounter significant costs when processing agricultural and forestry products into market-ready goods. Understanding the effectiveness and cost variables of current processing methods is essential for pinpointing areas where efficiency improvements can be made. Moreover, the establishment of pilot plants, experimental, and demonstration schemes play a pivotal role in this transition. These initiatives serve as testing grounds for innovative technologies and practices that aim to streamline processing operations, reduce costs, and minimise environmental impact. By integrating these schemes into the bioeconomy framework, stakeholders can better identify practical solutions to meet the evolving needs of farmers and foresters, ensuring sustainable resource management and economic viability in Greece's agricultural and forestry sectors.

5.3 Resources at their disposal and their current uses.

A variety of resources were identified for their current availability in the Greek FAN. These are summarised as follows:

5.3.1 Feedstock

Chestnut skins are currently used as a feedstock for bio-based materials and biochemical due to being rich in tannins and other compounds suitable to tanning and pharmaceutical industries. Greenhouse Vegetable Plant Biomass is currently used for composting and soil amendments, contributing to soil fertility and structure in agricultural practices. Olive and Olive Oil-Production Biomass and Prunings are a substantial resource in the region, currently being utilised as an energy source for biomass boilers and energy generation, as well as for composting and mulching in agricultural applications. Sheep wool is used in the textile industry for clothing and also in insulation materials, however it has potential for use in bio-based fertilisation technologies as a sustainable nutrient source for crop production. Prunings and grass from fruit trees is also outlined as a key resource in the Greek FAN, which is currently being utilised for mulching and composting in agricultural crop production, promoting soil health and reducing waste. Another resource in the region is stone-fruit residue, which is used in bioenergy production through AD to create biomethane, or combusted in biomass boilers to produce heat energy, contributing to renewable energy generation.

5.3.2 Process

Biorefineries process various biomass feedstocks into biofuels, biochemicals, and biomaterials, enhancing resource efficiency. For example, chestnut skins are used for tannin extraction, greenhouse vegetable plant biomass can be converted into biochar for soil amendment. Olive and olive oil-production biomass and prunings are used for direct combustion or biogas production. Prunings and grass from fruit trees are mulched and incorporated into crop production to improve soil health and water retention.

5.3.3 Social

Bioeconomy initiatives provide employment opportunities in rural areas, supporting local economies and enhancing community resilience. The upcycling of chestnut skin provides additional income for chestnut farmers, while the use of greenhouse vegetable plant biomass can enhance soil fertility and crop productivity, the digestion or combustion of olive and olive oil-production biomass and prunings provides energy independence and economic benefits for olive growers. The upcycling of sheep wool into bioeconomic uses supports traditional wool industries.

5.3.4 Environmental

The utilisation of chestnut skin, olive and olive oil-production biomass prevents waste and reduces environmental impacts, such as water pollution and greenhouse gases. The use of sheep wool in clothing provides a biodegradable and sustainable alternative to synthetic fibres and sustainable fertiliser source. Prunings from fruit trees decrease waste and enhances carbon sequestration while stone-fruit residue enhances sustainability through bioenergy production.

5.3.5 Cost

Chestnut skins provide a low-cost feedstock for bioenergy and tannin extraction, while greenhouse vegetable plant biomass provide low-cost feedstock for biochar production. Olive and olive oil-production biomass and prunings are associated with moderate cost for bioenergy production. Sheep wool is a cost effect material for textiles and fertilisers. Prunings and grass from fruit trees and stone-fruit residues are all low-cost solutions for either soil improvement or bioenergy.

The current processing equipment being used in the region includes composting units for plant residues, aerobic and anaerobic processing equipment, the use of bio-stimulants that support the composting process and sensors for detecting the status of the composting material (temperature, CO_2 levels, and maturity).

5.4 Needs identified for a socio-ecological transition to circular bioeconomy in the country.

The FAN have identified that a combination of increased education, technology and collaboration are key needs for prioritisation in the region to ensure effective transition to circular practices in the bioeconomy. For example, cross-sector collaboration is needed, the establishment of strong partnerships with various industries to prevent contamination of residue biomass with pollutants such as micro-plastics and petrol residue, and the implementation of quality control measures and standards across sectors to maintain the quality of raw material. Access to processing technology, such as through public funding bodies or leasing models to ensure farmers have widespread access to necessary processing technology and expertise, and the provision of financial and technical support to facilitate the adoption and maintenance of advanced biomass processing technologies. Pilot and Demonstration Projects are another key need in the region for prioritisation, such projects can be used as educational tools to showcase the benefits and feasibility of a circular bioeconomy, promoting broader acceptance and participation. There is a strong need in the region for education on treatment protocols, which offer targeted education and training on specific treatment methods and best practice for the proper handling and processing of biomass. Investment and research into wool processing technologies are also in need of prioritisation in the region, innovative approaches to the alternative use of wool in textile production, insulation and as a natural fertiliser source would valorise this resource for farmers.

5.5 Identification of key stakeholders with whom they interact.

Farmers and foresters in the FAN region interact with a range of key stakeholders that provide support and resources. The Mediterranean Agronomic Cooperative Council (MACC) offers expertise and collaborative opportunities to enhance sustainable agricultural practices. KAEM Living Lab functions as an innovation hub, facilitating the testing and implementation of new bioeconomy solutions in real-world settings. The Centre for Research and Technology Hellas (EKETA) provides cutting-edge research and technological advancements to improve bioeconomy processes and outcomes. Robocoop EU is a cooperative network that promotes the use of robotics and automation in agriculture, helping farmers increase efficiency and productivity. Lastly, the BioCycle Hummus Hub focuses on creating high-quality organic compost from agricultural residues, supporting farmers in maintaining soil health and fertility through sustainable practices.

5.6 Identification of dissemination channels and key social aspects.

Farmers and foresters in the Greek FAN utilise a variety of key dissemination channels and social aspects to stay informed and connected within the bioeconomy sector. Advisory services play a crucial role, offering tailored guidance and support on best practices and new technologies. Technology providers supply the latest innovations and tools, often accompanied by training and technical assistance to ensure effective implementation. Peers and social networks are invaluable for sharing experiences, insights, and solutions, fostering a sense of community and collective learning. YouTube channels and other social media communities provide accessible platforms for tutorials, demonstrations, and discussions, enabling farmers to learn from experts and each other. Lastly, EU portals and publications disseminate important information on policies, research findings, and funding opportunities, keeping the agricultural community informed about the broader European context and advancements in the bioeconomy.

6 Irish FAN

6.1 Workshop details

Venue	Teagasc Johnstown Castle Research Centre, Co Wexford, Ireland, Y35 TW55
Date	23/04/2024
Format	in-person
Name of the event	Irish regional FAN workshop to identify local challenges and needs of the bioeconomy
Other highlights	Demonstration to FAN members of ongoing research trials being conducted at the centre using BBTs.

6.2 Identification and Prioritisation of resources and needs for a socio-ecological transition to the circular economy

In the context of the Irish bioeconomy, farmers and foresters are facing several challenges and opportunities related to socio-ecological transitioning towards the circular economy. One significant need identified from the Forestry and Agricultural Network (FAN) meeting is the shift towards making processes more circular, ensuring that resources are reused and recycled to minimize waste. This involves advancements in slurry separation techniques to improve nutrient management and reduce environmental impacts. Slurry separation processes increase the feasibility of transporting the material and improve effective handling. The introduction of root harvesting equipment is another critical area, such equipment enables the removal of below ground root biomass, which can be processed further into BBTs.

Biomass utilisation in the forestry sector, with a demand for improved machinery to efficiently collect branches, needles/leaves, and other wood-biomass after thinning and felling operations is required. There is also a need for machines designed to process hemp straw into fibre, supporting the diversification of agricultural outputs. Additionally, the establishment of Anaerobic Digestion (AD) plants for shared storage of biomaterials and the production of biomethane represents a sustainable solution for energy generation and waste management. However, there is a need for incentivising primary producers to grow suitable crops as raw biomaterials for the production of biomethane at local or governmental level.

Regionally funded shared technology and infrastructure can significantly bolster these efforts, providing farmers and foresters with access to smaller and more adaptable processing technologies. For example, portable slurry separation units that can be transported onto farms to separate slurry would significantly enhance farmer’s abilities to successfully handle large volumes of cattle slurry over a relatively short timeframe, enabling effective storage/transport of the material as required. The development of machinery cooperative systems were identified as a key element in facilitating the shared use of advanced equipment, thereby reducing individual costs and improving overall efficiency.

6.3 Resources at their disposal and their current uses.

6.3.1 Feedstock:

The primary and secondary resources available in the region were identified. Irish agriculture is predominantly grassland-based (>90% of agricultural area is used for grassland production). Ruminants grazing grass accounts for the greater part of this, however the majority are stored indoors over the winter period and therefore generate substantial quantities of cattle slurry. Cattle slurry along with manures generated from poultry and pig production along with poultry ash, dairy sludges from dairy processing facilities, and digestate from AD plants were identified as the primary freedstock in the region: these are primarily utilised as fertilisers on farms for crop production, and for biogas production in AD plants. In addition, dairy washings from dairy farms, and bone meal from animal processing facilities were identified.

In the forestry sector, tree branches, the by-products of debarking processes along with sawdust represent the majority of resources available as feedstock for incorporation into circular processing, and to a lesser extent, the collection of pinecones, all of which can be used for production and as raw materials for bio products.

Food-chain losses such as sub-grade vegetables, processing losses and wastes generated from horticultural plants e.g. spent mushroom biomass and tomato plants represented feedstock streams from the sector, while by-products of the brewing industry included brewer's sludge and brewer's grains, many of these products have potential for conversion into biogas and composts. Other feedstock sources include straw generation from arable practices, while marginal and poorly productive land is associated with rushes and gorse production and show potential for incorporation into bio-based products. Green manures (e.g cover crops) and clover swards were acknowledged for their role in sustainably enhancing soil fertility and structure.

6.3.2 Process:

Processing equipment currently being used in the region include AD plants. As of 2024, Ireland has 14 anaerobic digestion (AD) plants currently in operation, primarily within wastewater treatment facilities. This number is expected to increase to 19 as part of Irish Water's National Wastewater Sludge Management Plan, which aims to handle the projected 80% increase in wastewater sludge by 2040 (Engineers Ireland).

In addition to these wastewater treatment plants, there are also approximately 12 agricultural and industrial anaerobic digestion facilities across the country. They are significant contributors to Ireland's renewable energy efforts, processing the various organic wastes such as manure, food waste, along with dedicated energy crops, such as grass-silage and maize and generating biogas (Energy Ireland) (Teagasc). Other processing technologies in Ireland include slurry separation technologies, such as screw press and decanter centrifuge technologies. These technologies help separate the solid and liquid fractions of slurry, allowing for better nutrient management. The solid fraction, which is rich in phosphorus (P), can be economically transported off the farm, while the liquid fraction, containing most of the nitrogen, can be used as a bio-fertiliser that is quickly absorbed by crops (Agriland.ie) (Agri-Food and Biosciences Institute) (Agriland.co.uk).

Research by the Agri-Food and Biosciences Institute (AFBI) highlights that mechanical slurry separation can significantly reduce the phosphorus content applied to fields, which is crucial for improving water quality (Agriland.ie) (AFBI). The separated solids can be used in various applications, such as being added to anaerobic digestion systems or utilised as a fuel source after being pelletized (Agriland.co.uk). The practice helps to improve nutrient management and soil health.

In the forestry sector, specialised equipment is being used to debark and harvest roots and forestry residues.

Industry stakeholders are using mixing equipment to mix poultry and farmyard manures, along with air dryers and pelletisers to create bespoke nutrient rich bio-based fertiliser products. Pyrolysis biochar kilns are being used to incinerate by-products of the tree felling industry to create biochar. Similarly, these kilns are being used to incinerate poultry manure to create poultry ash.

Additional by-products currently being generated in the region include struvite, a crystalline mineral composed of magnesium ammonium phosphate (MAP), is increasingly being utilised in Ireland for phosphorus recovery from wastewater. This technology is particularly relevant for its potential in sustainable agriculture and environmental management. The product is particularly applicable to dairy processing plants, where the wastewater in often P-rich and consequently suitable to the relevant extraction processes involved in struvite production. Inoculated slurry, or bioaugmented slurry, which involves adding specific microbial inoculants to livestock slurry to enhance its properties and efficiency as a fertiliser is also being utilised. This process can improve nutrient availability, reduce odors, and enhance the slurry's overall value. Brewer’s grains are also incinerated to produce an ash-based product which is used as a bio-based fertiliser. The recycling of crop residues and their re-incorporation to the soil, such as straw chopping and topping of potato tops is also common practice in crop production.

6.3.3 Environmental:

Circular processes that aim to recycle nutrient and organic matter minimise waste and environmental impacts in the region. The conversion of organic wastes into valuable products like biogas, compost, and soil amendments through sustainable waste management helps reduce pollution and improve soil health. Biogas production from AD plants reduces reliance on fossil fuels, consequently reducing greenhouse gas (GHG) emissions.

6.3.4 Cost:

Shared technology and cooperative systems help to lower individual investment costs for machinery and technology. The efficient utilisation of biomass optimises resource use through waste reduction, contributing to cost savings. The use of regionally funded infrastructure provides financial support for sustainable practices, enhancing economic viability.

6.4 Needs identified for a socio-ecological transition to circular bioeconomy in the country.

Stakeholders from the FAN meeting identified a key need for incinerators for wood by-product ashes generation. There is currently insufficient incinerator equipment in the FAN, such equipment enables the generation of ash-based products derived from by-products of the tree-felling industry. Incineration of such material to create biochar can help with soil structure, water and nutrient retention capacities as well as carbon sequestration. The incinerated material generates nutrient rich material, of which becomes largely bio-available through pyrolysis, while the reduced volume of the material makes it easier to handle and transport as a fertiliser product.

Equipment necessary to mulch and chip wood by-products were also identified as key needs. These equipment are designed to grind and shred vegetation, turning it into smaller pieces or mulch. The mulched material is easier to handle, allowing for further processing, such as incineration and to consequently conversion into bio-based fertilisers as discussed. The reduced volume allows for greater recovery of plant and tree material and therefore reduces waste in tree-felling.

The need for a greater number of AD plants throughout the country was also identified. The climate and topography of the region is ideally suited to growing energy crops as raw material for AD, while a surplus of cattle and organic manures are already abundant in the FAN, which could be incorporated as a feedstock for AD. There are comparatively few AD plants in operation in Ireland at present, and the European Biogas Association (EBA) predicts that biogas and biomethane production in Europe could double by 2030 and more than quadruple by 2050, with 467 TWh produced across Europe per year by 2030. To match this ambition, the Irish Government estimates that 20 per cent of the current natural gas demand could be met by biomethane by 2030 with the correct supports in place. The rollout of more AD plants across the country is a key requirement to meeting these targets.

6.5 Identification of key stakeholders with whom they interact.

The key stakeholders with whom FAN members interact with include Teagasc, the Food and Agricultural Authority in Ireland, who work in a research and advisory capacity relating the FAN members and the circular bioeconomy. Farmers and primary producers are also key interacting stakeholders, working together with other farmers and members of the FAN to share experiences and generate new ideas relative to circularity at farm level, and how these practices can be implemented and improved. The Environmental Protection Agency (EPA) work with other FAN members in their capacity as a licencing and regulatory body and public authority. The Irish Department of Agriculture, Food and Marine (DAFM) are a key funding body in the country which provide financial support to research projects associated to the bioeconomy, and support the generation of circular economic practices in Irish agriculture. University students, particularly those studying in the remit of biological, agricultural and environmental sciences, along with those in financial, business studies or social sciences are seen as key cohorts for interaction with FAN members as they benefit and contribute to the bioeconomy through their education. Organic certification bodies such as the Irish Organic Association are key stakeholders in the provision of certification for organic production and associated products. Coillte, the Irish state run forestry body are key providers of raw materials, as the overseeing body for state-run forests and associated processing. Companies that specialise in the manufacture of bio-based fertilisers and waste processors alike are key stakeholders for farmers and foresters, providing a destination for by-products from both agriculture and forestry processes through the generation of bio-based and nutrient recovery technologies.

6.6 Identification of dissemination channels and key social aspects.

In Ireland, farmers and foresters rely on a diverse range of dissemination channels to engage with the bioeconomy. These include advisory services provided by entities such as Teagasc and the DAFM. For example, the TAMS (Targeted Agricultural Modernisation Scheme) is a scheme operated by DAFM which aims to support the sustainable development of agriculture by providing grants to farmers for the purchase of farm equipment and the construction or improvement of farm buildings and infrastructure. The scheme is designed to enhance efficiency, environmental sustainability, and animal welfare on farms through targeted investments. Teagasc advisors play a central role by educating farmers on the benefits of such schemes, and providing the necessary guidance and associated assistance for farmers in scheme applications. Farmers also value insights from dissemination channels provided from organised events like Teagasc Open Days and the National Ploughing Championships. Teagasc also publish monthly newsletters and technical bulletins for farmers to access. Additionally, they access information via the Internet, social media platforms like X and LinkedIn, and traditional media outlets such as Agriland, Farmers Journal, and radio broadcasts. Certification bodies and organic trusts play pivotal roles in promoting sustainable practices, often through newsletters and updates, while agronomists and technical sales teams from farm supply merchants provide specialised knowledge and products. Pilot farms, European Innovation Partnerships (EIPs) such as EIP-Agri, lighthouse demonstrations, and engagements with County Councils provide further dissemination channels, fostering innovation and knowledge exchange within Ireland's bioeconomy sector for foresters and farmers alike.

6.6.1 Social aspects pertaining to current involvement and ways to attract and empower women, unemployed people, and youth to develop green skills in the farm and forest sectors.

In Ireland, various social initiatives are underway to attract and empower women, unemployed individuals, and youth to develop green skills in the farm and forest sectors. For youth, events like the Young Scientists Exhibition officially known as the BT Young Scientist and Technology Exhibition (BTYSTE), is an annual science competition for secondary school students. Held in Dublin, the exhibition encourages students to develop projects in various scientific disciplines, including biology, physics, chemistry, technology, and social sciences. Participants present their research and innovations to judges and the public, fostering a deep engagement with scientific inquiry and innovation from a young age. This initiative could involve youths into the Irish bioeconomy by encouraging projects that focus on sustainable agricultural practices, renewable resources, and innovative solutions to environmental challenges. Students who study agricultural science for their Leaving Certificate (Irish High School Examinations) could incorporate aspects of the bioeconomy into their projects, fostering early interest and engagement in sustainable practices, in this way youths are successfully and actively involved in the bioeconomy by integrating principles of sustainability, innovation, and practical application into the curriculum. Similarly, Citizen Science projects encourage broader community involvement, while local development initiatives and EIP projects provide practical, hands-on experience in innovative agricultural techniques. These schemes are particularly suited to attracting members of the unemployed into the bioeconomy. Aligning green agendas with youth interests can further drive participation. Efforts to balance gender representation in groups and projects ensure inclusive opportunities.

LEADER funds are part of a European Union initiative aimed at promoting rural development through local action. The acronym LEADER stands for "Liaison Entre Actions de Développement de l'Économie Rurale," which translates to "Links between actions for the development of the rural economy." The LEADER program provides financial support to projects that stimulate economic and community development in rural areas. Such programmes can attract unemployed members of the community into the bioeconomy by providing funding for training programmes and supporting start-up businesses and community projects, as well as promoting awareness and engagement about career opportunities in the Irish bioeconomy. Local County Councils and enterprise boards work in a similar way, offering financial and administrative support. Libraries serve as valuable resources for education and networking, enhancing accessibility to information and opportunities in the green economy.

7 Italian FAN

7.1 Workshop Details

Venue	Online
Date	18/04/2024
Name of the event	The available resources and needs to be met from a circular economy perspective

7.2 Identification and Prioritisation of resources and needs for a socio-ecological transition to the circular economy

In the context of the Italian bioeconomy, critical needs identified by the FAN member's workshop included the need for local-level organisation with specific objectives and strategic actions. It was identified that farmers and foresters must establish clear objectives and strategic actions tailored to sustainable practices. Increased public funding, and its effective use is identified as an important need in the region, requiring streamlined bureaucratic processes to ensure that financial support is accessible and efficiently utilised. Collaborative efforts, such as pooling resources to invest in new technologies, which are crucial for managing costs and maximizing the benefits of innovative practices is identified. Enhancing entrepreneurial capacity among farmers and foresters is discussed as an important need in the region in order to foster a culture of innovation and adaptability. Moreover, reducing the payback periods for investments in sustainable technologies is identified as important as it incentivises adoption of bio-based technologies and sustainable practices, and ensures quicker financial returns, making sustainable practices more appealing and viable in the long term.

In addition, FAN members discussed the innovative composting cycling for depleted floriculture substrates, wastewater treatment methods, and sustainable logistics (e.g electric, hydrogen or bio methane powered trucks) as methods to improve circularity in the region. Public investments or rewards for sustainable practices for businesses or working groups are also highlighted as important aspects of improving circularity in the region.

7.3 Resources at their disposal and their current uses.

A variety of resources available to farmers and foresters in the Italian FAN were identified, categorised below:

7.3.1 Feedstock

Forestry covers a substantial area in Italy, the average sized forest in the country was reported as 9.9 ha, while a total of 11,054,500 ha is currently reported as being afforested. Woody pruning residues represent a considerable resource in the region, and is used as biomass for energy production, compost, and mulch. Herbaceous pruning residues are also utilised for compost, biogas production, and as animal bedding. Ago-food waste represents another resource in the region, occurring due to inefficiencies in production and harvesting, high cosmetic standards for fruit and vegetables and losses during processing, distribution and consumption. Agro-food wastes are converted into biogas, compost, and bio-based products like bio-plastics. Similarly, olive pomace, a byproduct of olive oil production, is a significant agricultural residue in Italy due to the country's large-scale olive oil industry, the resource is employed in energy production through making biofuels or employed in biogas production, animal feed, and extraction of valuable compounds like polyphenols. Grape marc is also used for biogas and biofuel production, or processed to produce bioethanol, compost, and extraction of polyphenols and dietary fibres. Other depleted substrates are reused for composting, biogas production, and soil amendments. While wastewater treatment is associated with nutrient recovery and biomass production in the region.

7.3.2 Process

Wastewater treatment facilities and AD plants are employed to treat wastewater in the region, and for the production of biogas from recovered biomass. Olive mill effluents are managed through advanced treatment processes for irrigation and recovery of valuable compounds like polyphenols. Chestnut coppicing as widely practiced in the region involves the necessary equipment to systematically harvest chestnut trees in order to promote regrowth, providing sustainable timber and biomass.

7.3.3 Social

Uncultivated lands show potential to grow bioenergy crops which provide opportunities for rural development and job creation. Chestnut coppicing supports traditional practices while management of forest resources contribute to local employment and sustainability.

7.3.4 Environmental

Forest resource management enhances biodiversity, carbon sequestration and soil conservation through sustainable management practices. Similarly, the conversion of uncultivated land to energy crop production prevents land degradation and enhances carbon sequestration. Upcycling of woody pruning residues reduces waste and promotes soil health when used as mulch or compost, as does the use of herbaceous residues.

7.3.5 Cost

The reuse of wastewaters post treatment can reduce costs, particularly in periods of water scarcity, as well as benefitting from nutrient recovery. Similarly, the utilisation of agro-food wastes can lower disposal costs and generate additional revenue through bio-gas and bio-based fertiliser product generation. The advanced treatment associated to olive mill effluents can be cost-intensive, however offers benefits over the longer-term through resource recovery and water quality protection. The repurposing of depleted substrates for composting and biogas production can reduce waste, and its associated management returns.

The current processing equipment being used in the region includes the appropriate plant and equipment for generating compost from green pruning residues. Kilns are used to produce biochar from by-products of tree harvesting, while AD plants are used for biogas production from the conversion of farm waste. Plants are also in operation to extract nutraceutical compounds from bio-waste. Distillation plants are in operation in the region to extract bio ethanol from fermentation processes associated to bio-waste products.

7.4 Needs identified for a socio-ecological transition to circular bioeconomy in the country.

The critical areas requiring investment, innovation, development and policy support to facilitate Italy's transition towards a circular bioeconomy were identified, and included the development of processes and technologies for transforming primary residues into other secondary materials such as biostimulants and phytosanitary products. Innovation for fostering bioeconomy technologies such as those valorising agricultural and forestry residues are identified as a priority in the region, as is the need for secure funding and financial incentives to support investments in circular bioeconomy projects, this included the access to grants, loans, and subsidies for businesses and organisations involved in bioeconomy initiatives. Priority is required in the promotion of collaborative projects that integrate stakeholders along the supply chain, from raw material suppliers to end-product manufacturers, and to develop territorial strategies to optimise resource use and minimise environmental impact. Increased awareness and promotion of the benefits of the circular bioeconomy and associated practices is also needed, suggested for achievement through targeted advertising, educational campaigns, and public outreach. It is also proposed to enhance the visibility of bio-based products in the market to encourage consumer adoption. There is a need in the region to establish and expand current facilities for processing plant residues into bio-based materials and fertiliser products, and to upgrade existing transformation plants with advanced technologies for increased efficiency and capacity. In terms of the recovery chain of depleted substrates from floriculture, there is a need to develop systems for collecting and processing depleted substrates from floriculture to produce compost or other valuable products, and to implement regulations and guidelines for the safe handling and reuse of depleted substrates. A need to establish appropriate storage yards and facilities for storing bio-based materials and assortment of products is also identified, this will ensure the proper management of inventories to meet demand and reduce waste. There is a need for investment in mobile equipment such as mobile sawmills and wood chippers for efficient harvesting and processing of forestry residues, and to improve mobility and accessibility in forested areas to optimise resource utilisation. A need for more drying equipment is also required in order to preserve to quality of biomass and plant residues during processing. Lastly, in terms of the production of thermoplastic starch for biodegradable/compostable materials, there is a need identified to establish facilities for producing thermoplastic starch to manufacture biodegradable/compostable products like bags, pots, containers, and clips.

7.5 Identification of key stakeholders with whom they interact.

Farmers and foresters in Italy engage with a diverse network of stakeholders essential to their respective industries and sustainable development practices. For example, CREA (Council for Agricultural Research and Economics) which provides research and innovation in agriculture and forestry, offering scientific expertise and technological advancements. The National Rural Network facilitates knowledge exchange, innovation, and cooperation among rural stakeholders, promoting sustainable development in rural areas. AGRION represents agricultural cooperatives, advocating for farmers' interests and supporting cooperative business models across Italy, while Territorial Forestry Consortia coordinate local forest management activities, including sustainable harvesting, fire prevention, and environmental conservation. The ISPRA (Institute for Environmental Protection and Research) provides scientific support and environmental monitoring, influencing policies related to land use and natural resources. Universities are identified as key stakeholders for farmers and foresters in the FAN as they conduct research, offer education, and collaborate with farmers and foresters on sustainable practices, innovation, and technology transfer. The Forestry division of the Ministry sets national policies and regulations for forestry management, biodiversity conservation, and sustainable forest utilisation, while the Piedmond Region implements regional agricultural and forestry policies, provides funding support, and coordinates local initiatives. Confindustria Cuneo represents industries in Cuneo, supporting economic development and fostering collaboration between agriculture, forestry, and businesses. The CLEVER Innovation Hub promotes innovation in the agro-food sector, connecting farmers with technological solutions and fostering entrepreneurship. Chimica Verde Bionet develop green chemistry solution and collaborate with farmers on sustainable agricultural practices and bio-based products. The Food and Wine Hub supports the food and wine industry, facilitating market access, promoting local products, and enhancing value chains. CIC Composters Consortium manage composting activities which promote organic waste recycling and support soil health improvement. The 4p1000 Initiative advocates for soil carbon sequestration, engaging farmers in sustainable soil management practices and climate change mitigation. The Global Soil Partnership collaborates internationally on soil research and sustainable land management, providing guidance and support to improve soil health in Italy and globally.

7.6 Identification of dissemination channels and key social aspects.

Farmers and foresters use a variety of dissemination channels in the region, for example, LEADER farms disseminate information through field demonstrations, workshops, and peer-to-peer networking. Technical studies, and the use of agronomists, consultants and environmental engineers provide technical advice and disseminate information through reports, seminars, and on-site consultations. International Scientific Publications provide access to and dissemination of research findings and best practices through peer-reviewed journals and scientific conferences which contribute to the adoption of advanced techniques and innovations. A variety of magazines pertaining to agricultural and forestry-focused topics provide practical information, case studies, and updates on technologies and policies, reaching a broad audience of farmers and foresters, while other associations and foundations play a crucial role in disseminating information through workshops, training programs, newsletters, and conferences, fostering collaboration and knowledge exchange among stakeholders.

7.6.1 Social aspects pertaining to current involvement and ways to attract and empower women, unemployed people, and youth to develop green skills in the farm and forest sectors.

Numerous ideas for involving and attracting unemployed people and youths, as well as empowering women were outlined from the FAN. It was observed that younger people are more interested in closing the supply chain and engaging in multifunctional farm activities, and therefore more likely to actively participate in activities associated to the bioeconomy in the region. Both men and women appear to be equally attracted and involved to working in the area. It was noted that higher and more attractive salaries are useful in allowing a better work-life balance in the sector. It is also essential to incorporate smart-working or hybrid working strategies to attract people to work in the sector. In order to empower women in the sector, it is crucial to provide a non-toxic working environment and to provide every opportunity for personal growth at work. The promotion of multi-functionality of forestry and multidisciplinary workforces to manage the forest in a sustainable way and develop ecosystem services were also identified.

8 Polish FAN

8.1 Workshop details

Venue	Online (Zoom)
Date	21/03/2024
Name of the event	BBioNets Polish 1st FAN meeting

8.2 Identification and Prioritisation of resources and needs for a socio-ecological transition to the circular economy

In the context of the Polish bioeconomy, critical needs identified by the FAN members workshop included the need for equipment for effective slurry separation, which can improve nutrient management in agricultural practices, preventing environmental contamination and enhancing soil health. The adoption of advanced root harvesting equipment is required in the region to increase the efficiency of tree harvesting by maximising the use of biomaterial which otherwise goes unused as waste. The necessary equipment to transform animal excrement into fertilisers is required, such as RENURE (Recovered Nitrogen from manure), which exemplifies the innovative recycling of organic waste into valuable agricultural inputs, closing nutrient loops and reducing dependence on synthetic fertilisers. Similarly, increased processing of agro-food waste into useful products is required in the FAN region, thereby preventing landfill accumulation, contributing to a more sustainable food system. The necessary equipment for biochar production, such as kilns are required, the incorporation of biochar into soils enhances circularity by improving soil fertility and carbon sequestration, mitigating climate change impacts. Lastly, producing pellets from agricultural waste is identified as a key need for transition to circularity for agriculture in the region, this requires the appropriate technologies in order to pelletize waste into forms which can be effectively used as fertilisers. The method offers a renewable energy source, reducing reliance on fossil fuels and promoting energy self-sufficiency. Together, these examples highlight the important steps needed for Poland to transition towards a circular economy that balances economic growth with ecological sustainability.

8.3 Resources at their disposal and their current uses.

8.3.1 Feedstock

In the Polish FAN, several key feedstocks are currently available. Total agricultural land in the area is reported 14,952,885 ha and the associated resources represent a large proportion of those available in the region. For example, straw, and other residues from cereal crops, is utilised for bedding, animal feed, or bioenergy production. Manure and cattle slurry is used as natural fertiliser or as the feedstock for biogas production. Fruits and vegetables press waste, a by-product from juice and food processing, is used for animal feed or compost. Grass, either natural or cultivated, is employed for animal feed, silage, or biogas. Forestry in the FAN accounts for 9,464,000 ha and generates a considerable amount of biomass. For example timber, harvested from forestry, finds applications in construction and furniture, or bioenergy. Roots, the residual parts of harvested plants, can be processed for biochar. Lastly, branches, woody biomass from tree pruning or forestry, are used for bioenergy or mulching.

8.3.2 Process

The processing of these feedstocks involves various methods. Straw is baled, stored, and transported for its diverse uses either on farm of for combustion. Manure is collected, composted, and processed into organic fertilisers or biogas. Slurry undergoes storage, agitation, and application as liquid fertiliser or for biogas production. Fruits and vegetables press waste are collected, dried, and processed into feed or compost. Grass is harvested, and ensiled, or processed for biogas. Timber is felled, logged, milled, and processed into various wood products. Roots are collected, cleaned, and potentially processed into feed or biochar. Branches are chipped, shredded, and processed for bioenergy or mulch.

8.3.3 Social

Collaborative networks and cooperative systems are prominent. For straw, there are networks for collection and distribution among farmers. Manure management systems are optimised through cooperative efforts to reduce environmental impact. Community-based biogas plants facilitate collective slurry processing. Partnerships between food processors and farmers help utilise fruits and vegetables press waste. Farmer cooperatives share management and production efforts for grasslands. Forestry associations promote sustainable management and marketing of timber.

8.3.4 Environmental

Environmentally, these resources offer several benefits. Utilising straw reduces burning and soil erosion while improving soil organic matter. Manure enhances soil fertility and structure, reducing chemical fertiliser dependency. Properly managed slurry provides nutrient-rich fertiliser and reduces water pollution. Utilising fruits and vegetables press waste decreases landfill waste and enriches compost for soil health. Grass helps maintain pasture biodiversity, prevent soil erosion, and sequester carbon. Sustainable forestry practices with timber preserve habitats and sequester carbon. Managed branches provide biomass for renewable energy and reduce wildfire risk.

8.3.5 Cost

Straw is a low-cost feedstock with multiple uses, though transportation can be expensive. Manure is generally low-cost but requires investment in handling and processing infrastructure. Slurry is a cost-effective fertiliser with potential income from biogas production, though it needs proper storage and management. Fruits and vegetables press waste are often low-cost or free, but processing can incur costs. Grass is low-cost, especially when grown on-farm, but harvesting and storage add expenses. Timber is a high-value resource requiring significant investment in forestry and processing equipment. Roots are generally low-cost but may require specialised equipment for harvesting and processing. Branches are a low-cost feedstock for bioenergy, but collection and processing infrastructure are necessary.

The current secondary products being generated in the region include bio-fertilisers, soil conditioners, compost, and from AD processes biogas and digestate.

8.4 Needs identified for a socio-ecological transition to circular bioeconomy in the country.

To facilitate a socio-ecological transition to a circular bioeconomy in Poland, several key needs have been identified by FAN members. Investment in specialised root harvesting equipment is identified as essential to efficiently process residual plant parts, enhancing their use as valuable feedstock. The adoption of farm-scale AD plants is crucial for converting farm by-products into biogas, providing a renewable energy source and reducing waste. Additionally, green biorefineries that process grasses and other green leaves into press cake and protein for cattle and pig feed can significantly contribute to sustainable livestock production. The production of biochar from agricultural residues offers a method to sequester carbon and improve soil health, playing a vital role in mitigating climate change. Therefore, there is a need for the appropriate technology, such as kilns to facilitate and promote the production of biochar in the region Furthermore, the development of RENURE (Recovered Nitrogen from Manure) fertiliser production systems can optimise nutrient recycling, reducing reliance on chemical fertilisers and minimising environmental pollution. Collectively, these innovations require supportive policies, investment in technology, and the fostering of collaborative networks among farmers, researchers, and policymakers to ensure a holistic and effective transition to a circular bioeconomy in Poland.

8.5 Identification of key stakeholders with whom they interact.

Farmers and foresters in the Polish FAN utilise a variety of key dissemination channels and social aspects to stay informed. Communication with other farmers is utilised to provide feedback and advice on matters pertaining to adoption of bio-based technologies and circularity. Farmers and foresters in the region collaborate with scientific institutions and entrepreneurs, the nature of this collaboration involves cooperation with the FAN group in researching new technologies and processes to assist with adoption to circularity in the bioeconomy, and the creation of new upcycling methods related to wastes from agricultural and forestry waste streams. Lastly, local government administration who organise workshops and agricultural fairs, at which stakeholders meet and discuss the adoption of new technologies and methods related to the circular bioeconomy.

8.6 Identification of dissemination channels and key social aspects.

Similarly to the stakeholders identified with whom farmers and foresters interact with in the FAN, the predominant sources of information utilised by farmers and foresters in the region include advisory services, as well as the internet.

8.6.1 Social aspects pertaining to current involvement and ways to attract and empower women, unemployed people, and youth to develop green skills in the farm and forest sectors.

Engaging women, the unemployed, and the youth in Poland's circular bioeconomy can be achieved through a multi-faceted approach. Integrating bioeconomy education into school curricula helps to equip young people with knowledge and skills relevant to sustainable practices and innovative

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technologies. Organising workshops that showcase success stories from farms and start-ups can inspire and inform these groups about the potential opportunities in the bioeconomy sector. Open days for farmers can serve as practical learning experiences, demonstrating first-hand the benefits and applications of circular bioeconomy principles. Promoting these initiatives through Rural Housewives' Associations (KGW), which are deeply rooted in Polish tradition and community life, can effectively reach and involve women. These associations can act as platforms for sharing knowledge, fostering collaboration, and encouraging participation in bioeconomy projects. By focusing on education, inspiration, practical experience, and community involvement, these strategies can empower women, the unemployed, and the youth to actively participate in and benefit from Poland's transition to a circular bioeconomy.

9 Spanish FAN

9.1 Workshop details

Venue	Corporación Tecnológica de Andalucía Offices, Spain
Date	10/04/2024
Format	In-person
Name of the event	Andalusian FAN launch and co-creation workshop

9.2 Identification and Prioritisation of resources and needs for a socio-ecological transition to the circular economy

In the context of the Spanish bioeconomy, critical needs identified by the FAN member's workshop included the promotion of new business models that enable on-site biomass management, making it both profitable and cost-effective. These models can significantly enhance the utilisation of biomass, thereby improving overall farm productivity and sustainability. Additionally, implementing raffia separation equipment in greenhouse vegetable production is essential for making this type of biomass usable, reducing waste, and improving resource efficiency.

Raffia separation equipment is a specialised technology designed to handle and process raffia, a natural fibre harvested from the leaves of the raffia palm tree, however synthetic alternatives derived from polypropylene plastic are also often used in agricultural practices, particularly in greenhouses. Raffia is widely utilised for tying plants, creating trellises, and providing structural support to growing crops. The fibrous material's presence in compost material can impede processing and entangle of processing equipment etc. Another key need for farmers and foresters in the FAN is increased access to information regarding available technologies and processes within the bioeconomy. This entails not only educating producers about the opportunities offered by these technologies but also raising social awareness about the importance of sustainability. Furthermore, there is a need for more robust funding mechanisms to help scale up pilot technologies that are currently not available at the market level. Addressing these needs can enhance the effectiveness and cost efficiency of bioeconomic practices, fostering a more sustainable agricultural and forestry sector in Spain.

In addition, FAN members discussed the generation of circular bioeconomy microclimates with biomass management plants in forestry areas in order to incentivise employment and biomass valorisation as an approach which would help circularity in the region, as well as appropriate technology to reduce the size and density of biomass transport in the forestry sector.

9.3 Resources at their disposal and their current uses.

9.3.1 Feedstock

The primary and secondary resources available in the region were identified. There is a total reported forest area in the region of 4.38 million ha, the range on forest size reported which FAN members interact with was reported as 50->500 ha. Therefore, wood processing and associated biomass produced represent a significant source of biomaterial in the region. Pine forest pruning residues in Spain are a valuable feedstock primarily used for biomass energy production. These residues, rich in lignocellulose material, are ideal for creating wood chips or pellets that can be used in energy generation, offering a renewable source of fuel. Eucalyptus forest pruning debris also contributes to biomass energy production. Slurry, primarily collected from livestock from dairy, beef, pig and poultry operations, is utilised in anaerobic digestion to produce biogas and biofertiliser. Wood, harvested from various forest operations, finds extensive use in timber, biomass energy, and construction material. Olive stones, a by-product of olive oil production, are also used for biomass energy production, as are olive pruning residues. Additionally, biomass from fruits and vegetables can be converted into biogas, compost, or animal feed, further diversifying the use of agricultural residues.

9.3.2 Process

Pine forest pruning residues are collected and processed into wood chips or pellets for combustion. Eucalyptus pruning debris undergoes a similar process to be converted into chips or pellets. Slurry is collected from livestock farms and processed in anaerobic digestion plants to produce biogas and bio fertiliser. Wood is harvested, sawed, dried, and processed into various products, including timber, furniture, and construction materials. Olive stones are collected from the waste of olive oil production and processed into biofuel. Olive pruning residues are gathered and chipped for use in bioenergy production. Fruits and vegetables biomass is collected and processed in biogas plants or composting facilities, ensuring the efficient use of agricultural waste.

9.3.3 Social

The utilisation of pine forest pruning residues creates job opportunities in rural areas for collection and processing, contributing to local economies. Eucalyptus pruning debris similarly provides rural employment opportunities for pruning, collection, and processing. The processing of slurry reduces odour and pollution from animal farming, increasing nutrient recovery and efficiency. The forestry industry offers substantial employment in forestry, sawmills, and wood product manufacturing. Olive stone processing supports local economies by adding value to agricultural waste, while the collection and processing of olive pruning residues create further employment opportunities in the bioenergy sector. The use of fruits and vegetables biomass for biogas or composting promotes sustainable agricultural practices and reduces waste from food production.

9.3.4 Environmental

The use of pine forest pruning residues reduces forest fire risks by clearing deadwood and residues, promoting healthier forest ecosystems. Eucalyptus pruning debris management helps in forest health maintenance and fire hazard reduction, though there are concerns about its water use and impact on biodiversity. Processing slurry into biogas and bio-based fertilisers helps mitigate environmental pollution from livestock systems. Sustainable wood harvesting and processing support forest management and conservation efforts. Using olive stones and pruning residues for bioenergy reduces waste and promotes cleaner energy sources. Finally, utilising fruits and vegetables biomass for biogas production or composting reduces agricultural waste and promotes environmental sustainability.

9.3.5 Cost

The collection and processing of pine forest pruning residues involve relatively high costs, which can be mitigated by subsidies and incentives. Eucalyptus pruning debris collection and processing are also costly, though frequent harvests due to the fast growth rates of eucalyptus can offset some expenses. Shared technologies can help to mitigate individual costs. Slurry processing involves initial setup costs for AD plants, but these can be balanced by the long-term benefits of biogas and bio-based fertiliser production. Collecting and processing olive stones and pruning residues is also expensive, but the value-added products from bioenergy production can provide financial returns. Processing fruits and vegetables biomass also involves costs for biogas plants or composting facilities, but the environmental and social benefits often outweigh these expenses.

The current processing equipment being used in the region includes equipment for chopping and crushing wooded material for felled forests. Separation technologies for slurry separation are being used in Spain, primarily in intensive livestock farming operations. Slurry separation involves the mechanical separation of solid and liquid fractions of animal waste, typically manure mixed with water. This process helps in managing and utilising the different components of slurry more effectively. Drying technologies are used to prepare olive stone and olive pruning residues for combustion or biomass energy production. While fermentation is used in the processing of slurry and fruit and vegetable wastes as part of the anaerobic digestion process.

9.4 Needs identified for a socio-ecological transition to circular bioeconomy in the country.

Addressing these processing needs requires coordinated efforts among stakeholders, including investment in infrastructure, technological innovation, market development, and awareness campaigns to foster a sustainable and profitable bioeconomy in the region. For example, stakeholders from the FAN meeting identified a key need for biorefineries or biomass management plants close to production sites for local biomass processing (compost, biogas, etc. both in agriculture and forestry sector). To produce valuable products that make it more profitable, the need for drying or separation technology was also highlighted. The high transportation costs of high moisture products increase the costs associated to transport and storage, and effects the economic viability of biomass processing. In addition, existing technologies in the region for biomass processing are highlighted as often having poor efficiency-to-cost ratios and are mostly at the pilot phase. Many promising technologies from research and development projects are not yet scalable or available in the market, posing challenges for widespread adoption.

Activities such as weeding, storage, and pre-processing of forest biomass contribute significantly to overall biomass production costs. Streamlining these processes and reducing associated costs are seen as critical for improving the economic feasibility of biomass utilisation. The seasonal fluctuations in biomass generation create logistical challenges, impacting supply chain efficiency and market stability for bioproducts. Ensuring stable market prices and addressing logistics issues are crucial for sustaining biomass valorisation efforts. Additionally, a notable lack of awareness about the concept of a circular bioeconomy among agricultural and forest producers (biomass suppliers) and society at large is identified. Increasing awareness and education about the benefits of circular bioeconomy practices could enhance participation and support for biomass valorisation initiatives.

9.5 Identification of key stakeholders with whom they interact.

Members of the FAN interact with a diverse range of stakeholders spanning research institutions, universities, biotech companies, agricultural and forestry organisations, cooperatives, rural development groups, technological centres, and various agricultural associations. These collaborations encompass applied research, innovative technology applications, R&D in biofuels and bioplastics, pilot projects, market access initiatives, technical support for fundraising, promotion of forestry technologies, and direct engagement with landowners for sustainable agricultural and forestry practices. For example, key stakeholders for interaction include Agricultural Research Centres (ceiA3) through applied research projects focused on agricultural innovations and technologies. Other key stakeholders include Universities such as the University of Seville though joint or pilot research projects aimed at applying innovative technologies in agriculture. Biotech companies are involved in collaboration in research and development programs, providing raw materials and exploring innovative solutions for valorisation and production of biofuels and bioplastics. Agricultural and Forestry Organisations, Cooperatives and Associations engage with FAN members through pilot projects, promotional activities, and supporting opportunities to access markets for bio products. Rural Development Groups provide technical support for fundraising efforts related to agricultural and forestry initiatives. Technological Centres collaborate with FAN members to promote forestry technologies and innovations. Pasture and Forestry Exploitations collaborate to engage directly with owners of pasture and forestry lands. Other interactions include Cooperatives for joint projects and market access, Olive oil companies, Agricultural associations and the Spanish National Research Council (CSIC)

9.6 Identification of dissemination channels and key social aspects.

Farmers and foresters in the region use numerous dissemination channels to access information on biomass energy, agricultural practices, and forestry management. These channels include scientific publications, specialised platforms, public administration portals and reports, research centres, agricultural and forestry associations, collaboration networks and projects, expert contacts, internet resources, competitor insights, and consultants. For example, Scientific and Technical Publications (JRC) is used for accessing information from the Joint Research Council, which provide in-depth research and data on biomass and renewable energy topics. Online platforms such as Observatorio Biomasa, Bioplat and Red INtercamBIOM: share innovative practices and projects related to biomass utilisation. APPA Renobales – Biomasa offers information and updates on biomass energy through the Spanish Renewable Energy Association. Dissemination channels such as Public Administration Portals + Reports (MITECO, CAPADR, AAE) are used: These portals and reports from the Ministry for Ecological Transition and Demographic Challenge, CAPADR (Andalusian Center for Agricultural Development and Research), and AAE (Andalusian Energy Agency) provide regulatory updates, policies, and reports on biomass and renewable energy. Technological and Agricultural Research Centers, such as IFAPA, ceiA3 conduct research and provide technical information on agricultural and forestry practices, including biomass utilisation. Additionally, Agricultural and Forestry Organizations and Associations such as AVEBIOM, CLANER, and AgroBioHeat offer resources, training, and advocacy related to biomass energy and sustainable practices in agriculture and forestry. Institutions such as UCO, US and CIEMAT contribute to research and education in biomass energy and environmental technologies, while project such as BIC, ROBIN, SCALE-UP, BIOTRANSFORM, and BIOREFINERY MAP facilitate collaboration, share best practices, and promote innovation in biomass and renewable energy sectors. Contact with experts and technology suppliers through events are highlighted as key dissemination channels where experts engage with farmers and foresters by attending events such as conferences, workshops, and trade fairs focused on biomass and renewable energy. Similarly, consultants and industry professionals provide specialised advice and services related to biomass energy and agricultural technologies. The internet is also utilised by farmers and foresters to access a wide range of information, resources, and updates related to biomass energy, agriculture, and forestry. Monitoring competitor companies, who provide insights into market trends, technological advancements, and competitive strategies in the biomass and renewable energy sectors.

9.6.1 Social aspects pertaining to current involvement and ways to attract and empower women, unemployed people, and youth to develop green skills in the farm and forest sectors.

Numerous ideas for involving and attracting unemployed people and youths, as well as empowering women were outlined from the FAN. These include creating a strategy that makes successful examples visible, promotes cooperation, and improves entry conditions in the sector, as these are essential for fostering inclusivity and accessibility. Offering practical forestry training courses and implementing educational campaigns from an early age in schools can ignite interest and provide foundational knowledge. Skills development programs for university students, along with specific training sessions for targeted segments of the population, can further equip these groups with the necessary expertise. Outreach campaigns and initiatives focused on biomass valorisation can increase awareness and enthusiasm for green careers. Supporting the creation of start-up companies, spinoffs, and business incubators through public and private funding can stimulate innovation and entrepreneurship. Establishing online platforms and digital tools can facilitate involvement and engagement from these populations. Additionally, internships in agricultural and agri-food industries, coupled with investments in reuse plants to generate new job positions, can provide practical experience and sustainable employment opportunities, thereby empowering women, unemployed people, and youth to actively participate and thrive in the green economy.

10 Conclusions

This report has outlined the key resources and needs identified in each region. The **predominant resources** available to the bio economy in each region are largely reflective of the dominant primary industries in that region. For example:

- In **Ireland**, livestock manures (cattle and pig slurry), agricultural residues (straw, horticultural waste), food waste, and forestry residues (tree branches) represented the greater resources,
- In **Spain** forest pruning residues (pine, eucalyptus), agricultural residues (olive stones, pruning residues), and various organic wastes were identified.
- **Greece** also identified forest residues, particularly those associated with chestnut coppicing, along with greenhouse plant biomass and sheep wool, and biomass generated from olive production.
- In **Italy**, by-products (chestnut skin, olive stones, and olive mill effluents), forest resources, and uncultivated land were identified, and potential for utilising uncultivated land for bioeconomic activities.
- In **Poland** agricultural residues (straw, fruits and vegetables press waste), manure, and timber formed the greatest resources,
- In the **Czech Republic**, plant and forest wastes, organic wastes from industrial production, and fast-growing woody plants were identified with a strong emphasis on the use of forestry and plant wastes.

The **key needs** identified in each FAN were largely associated with a lack of appropriate processing technologies in the region. For example:

- Incinerators for producing ashes from wood biomass, mulchers and AD plants were found to be a limiting factor to the adoption of circular processes in **Ireland**.
- Similarly, in **Italy**, there is a key need for the appropriate technologies and machinery to be introduced in order to recover greater quantities of waste from forestry processes.
- Similar needs were identified in **Greece**, along with a need for educating people on specific treatment protocols for the quality of the bio-mass streams that is intended for cyclic use.
- In **Spain**, an absence of biorefineries needed to valorise waste products, along with separation technologies to improve the feasibility of waste transport were identified as key needs.
- In **Poland** farm scale AD plants and press cake technology for cattle slurry are required,
- Members of the **Czechian** FAN outlined a need for the promotion of wastewater treatment facilities combined with algae cultivation for biomass, along with the increased use of gastro and kitchen waste to create biomass.

Along with a greater need for investment in the appropriate technology to facilitate greater transition towards circular processes is the need in regions to seek greater local and governmental organisation and support. Italy emphasises a need for reduced bureaucracy, collaborative investment in new technologies as well as a need for shortening investment payback periods. In Greece there is a need to alleviate financial burdens and establish pilot and demonstration schemes for bioeconomic processes. In all regions, a greater utilisation of composts, sludges and digestates from the related processing treatments are identified in order to improve circularity in each region.

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Appendix I

The below information is given to understand the alignment of the **T1.2 workshops** with the BBioNets Inventory (T2.1) and the BBT assessment tool (T2.2). This information is given so partners performing workshops will understand how the information they retrieve from FANs will help T2.1 and T2.2.

I.1 Effectiveness type of information

In the workshop, **questions 1 to 5** will align with the effectiveness type of information, which will be used to assess the BBTs and create a Reference Scenario (RS). Some examples of effectiveness type of information are:

- Feedstock: qualitative variables. Information on the type of biomasses farmers/foresters generate within their agriculture/forestry activities **in the year,** other than the final product.
    - **Type of feedstock** (e.g., wheat straw, cattle manure). Biomasses the forester/farmer identifies to be generated during their activity other than the final product.
    - **If the feedstock is considered at the moment in the region as a waste, a co-product** (it has value and potential to be used for another process, but it is not used yet), **or is a dedicated biomass** (this feedstock has value and is currently being employed by an established process/another actor of the value chain)**, or both.**
- Process: qualitative and quantitative variables. Information aiming to know the current state of the process established within the region to generate an idea of the "state-of-the-art" of those processes within the region.
    - **Process type (physical, chemical, etc.)** Description of the technology/practice they use at the moment. Details on the type of process are needed, whether physical, chemical or biological.
    - **Processing Capacity (t/day)?** This question will be translated into an ordinal value; ranges need to be adapted to each region's reference scenario, e.g., 50-100 t/day, 100-500 t/day, 500-1000 t/day, 1000-5000 t/day, etc.
    - **If it is a static BBT or mobile,** e.g., a shredder of tree branches that can be moved amongst forests or a static AD plant.
    - **The process scheme (image) is not mandatory**.
    - **Current output/final product of the technologies/practices**
- Social: Qualitative information. Information aiming to know how the technology/practice impacts society.
    - **Benefits or impacts for society from implementing the practice/technology currently used.** The answer will be translated into an ordinal value, from 1 to 4: 4 if the practice/technology is very beneficial for the society in the region, 1 if it presents a major impact for them.
    - If the practice/technology is relatively new, the developer of the practice/technology is useful to know to help transfer the knowledge and improve further implementation.

If the practice/technology has been established for many years, **since when has this practice/technology been used.**

- **Intellectual property associated with the practice/technology.** Yes/No.
- **Where is the practice/technology from?** Country/Region.

- Environmental: Qualitative information. These questions aim to know how the technology/practice impacts the environment.
  - **What are the environmental benefits or burdens associated with the practice/technology?** Bearing in mind related natural capital/ecosystem services, energy consumption and GHG emissions.

I.2 Cost variables

In the workshop, **questions 6 and 7** will align with the cost type of information, which will be used to assess the BBTs and create a Reference Scenario (RS). Some examples of cost-type of information are:

To gather sufficient information to assess the cost of a BBT, the following list must be followed:

I. **Equipment maintenance cost (€/year)** *(request range of costs, e.g., from €1,000-€5,000)*

II. **Investment cost (M€)** Please adapt numbers and units depending on farmers'/foresters' answers.

- ≤1 M€ = very low
- 1 – 5 M€ = low
- 5 – 9 M€ = intermediate
- 9 – 50 M€ = high
- 50 M€ = very high

- **The technology/practice generates one or many of the below:**
  - Energy & Heat
  - Bulk Chemicals & Fuels
  - Bioplastics & Polymers
  - Food/Feed
  - Fine chemicals

III. **Operational costs (€/year)** *(request range of costs, e.g., from €1,000-€5,000)*

IV. **Conditions of access to the technology,** i.e., if high capital is needed, or space/land, machinery, etc.

I.3 List of Representative Regions and the Respective Partners in each

Table 2. List of Partner Organisations in Each Representative Region.

Representative Region	Partner Organisation(s)	Acronym
Czech Republic	BIOEAST HUB CR	HUB-CR
Greece	FOCUS Strategic Thinking Consultants American Farm School	FOCUS AFS
Ireland	Munster Technical University, Circular Bioeconomy Research Group Teagasc – The Agriculture and Food Development Authority	MTU Teagasc
Italy	Council for Agricultural Research and Economics	CREA
Poland	Institute of Soil Science and Plant Cultivation – State Research Institute	IUNG
Spain	Technological Corporation of Andalusia TEPRO Consultores Agrícolas SL	CTA TEPRO

BBioNets

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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, Teagasc, IUNG, TEPRO, CTA, crea, American Farm School Thessaloniki - Greece, FOCUS, Bio East Hub

info@bbionet