

PLENARY SESSION

14:30 - 15:15 | Sustainability assessment of circular fertilisers

Jan Landert, FiBL, Sea2Land

Jorge Senan, BETA-UVIC, Novafert

15:15 - 16:45 | Business models for circular fertilisers

Ana-Marija Špicnagel, IPS Konzalting, Sea2Land

Presentation of lighthouse demos, Daniel de la Nogal, EIT Food, Novafert

Sustainability assessment of circular fertilisers

- **Approaches:** cornerstones of sustainability assessments
- **Hotspots:** what are the sustainability hotspots of circular fertiliser production and use?
- **Way forward:** how can we improve circular fertiliser production?
how to improve method alignment?



Jorge Senán Salinas, BETA-UVIC (Novafert)



Jan Landert, FiBL (SEA2LAND)





Circular fertilizers from fish sludge and fish processing waste: sustainable by default?

Sea2Land and Novafert final conference, 5 June 2025, Brussels

Jan Landert¹, Nicolas Wittmann¹, Jean-François Fabre², Claire Vialle², Caroline Sablayrolles², Diogo A. Teixeira³, Helena I. Monteiro³, Bruna C. Moura³, Carlos Bald⁴, Bruno Iñarra Chastagnol⁴ and Laura de Baan⁴

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WHY IS IT RELEVANT?

Sustainability issues...



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- Which circular fertilizers?
- Mineral vs. organic circular fertilizers:
 - Mineral: High nutrient bioavailability (for plants)
 - Organic fertilizers: Slow release during decomposition.
 - (more forms: slow release mineral fertilizers, hybrid etc.)
- **Sea2Land**: 4 organic and 1 hybrid fertilizer assessed.
- Impacts environmental performance:
 - E.g. potential risk of nutrient loss in case of mineral fertiliser.
 - E.g. potential soil improvement by organic fertiliser.
- → Different functions and effects on different time scale.

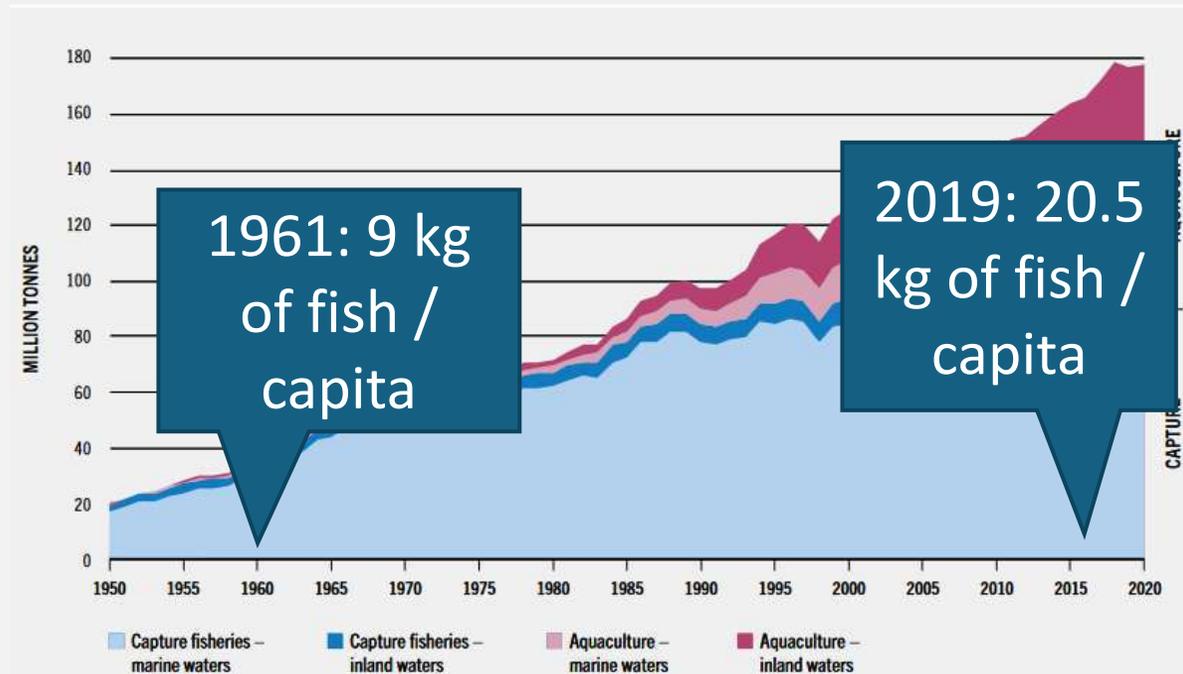


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WHY CIRCULAR FERTILIZERS FROM FISH PROCESSING WASTE? SEA2LAND

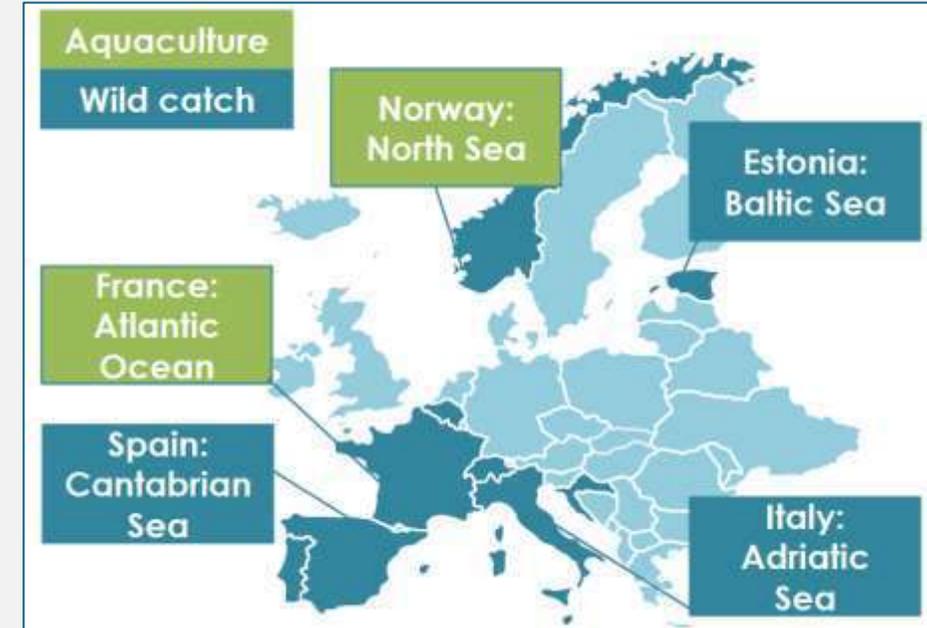
- High amounts of fish waste produced (Villamil et al., 2017)
 - 50 – 70 % waste (viscera etc.)
 - 50% of waste directly discarded.
- High nutrient content of waste (Zang et al., 2023)
- → High potential to be valorised to biobased fertilizers.

FIGURE 1 WORLD CAPTURE FISHERIES AND AQUACULTURE PRODUCTION



FAO (2022)

- **Assessment** of BBF production based on data from 5 pilot plants in all dimensions of sustainability:
 - **Norway:** BBF from dried fish sludge
 - **Estonia:** BBF from bokashi ferment
 - **Italy:** BBF based on hydrolysate (enzy.)
 - **Spain:** Hybrid BBF based on hydrolysate (autol.)
 - **France:** BBF based on extrudate



Pilot plants Sea2Land

OVERVIEW OF APPROACHES AND THEIR INDICATORS

- **LCA (Life Cycle Assessment):**

- Environmental impacts
- Indicators: Global Warming, Terrestrial Acidification, Eutrophication, Mineral Resources

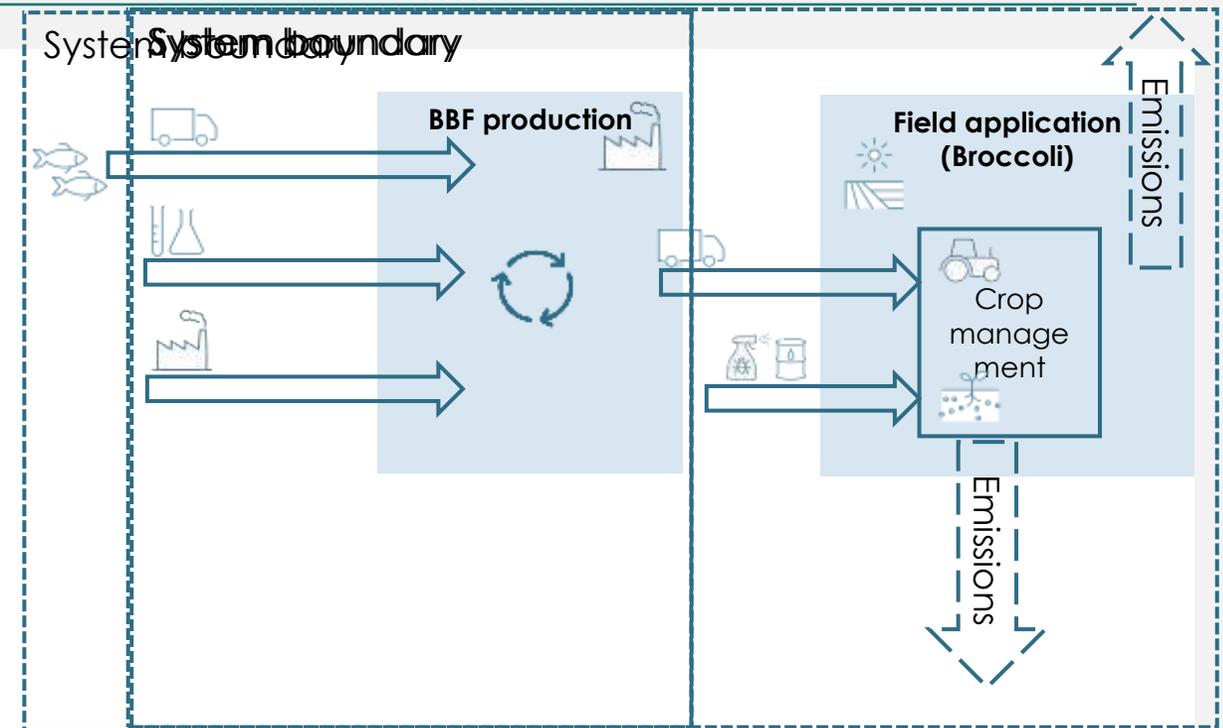
- **LCC (Life Cycle Costing):**

- Type: Conventional
- Detection of economic hotspots

- Indicators: 10 cost categories for BBF production (e.g. transport)

- **S-LCA (Social Life Cycle Assessment):**

- Identify social hotspots
- Impact categories: Labour rights & Decent work, Health and Safety, Human Rights, Governance, Community



- **BBF production vs. use phase: what is more relevant?**
 - **BBF production** matters for:
 - Mineral Resources Use (41 – 71% of environmental impacts), Global Warming (16 - 55%), and Terrestrial Acidification (11 - 32%)
 - **Use phase** (field emissions from Broccoli production) dominates:
 - Freshwater Eutrophication (83 - 99% of environmental impacts) and Marine Eutrophication (97 - 100%)
- **What are common hotspots in production?**
 - Transport of fresh raw materials to factory, e.g. + 150 km → increase up to 10% in overall impacts
 - Energy intense drying processes, e.g. reduction of production impacts up to 77% possible change in energy source.
 - Packaging



- Social hotspots in the supply chain:
 - Fishing sector dominating social hotspots (if taken into account): 50% of EU fishers earn below national minimum **wage** (Carpenter et al., 2021) – high variations among countries.
 - **Gender equity:** gender pay gap in the fertilizing sector, underrepresentation of women. In fisheries and aquaculture, around 20% of women.
 - High **health and safety risks** (incl. fatal injuries) in fishing, aquaculture and fertilizing sector → Confirms importance of SSbD guidelines.



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- **Labour costs:** Up to 2 EUR / kg of BBF (Italy) – but positive contribution to local job market in S-LCA.
- **Raw materials:** If 0.25 EUR / kg assumed, they can contribute up to ~60% of the costs (Estonia) → Most likely, growing relevance in a future bio-economy.
- Economic dependency on **markets for co-products** (fish oil in France)



Credits: Corinne Andreola

- Each **additional process step** (e.g. hydrolysis) adds new environmental impacts and costs → **Agronomically justifiable?**
- Process re-design can tackle all dimensions of sustainability:
 - **Reducing chemical input** can reduce costs, occupational hazards and environmental impacts at once.
 - **Reducing transport of raw materials** (slightly) reduces production costs and environmental impacts.



- Should waste-streams come with environmental and social impacts?
 - (Some) current limits of LCA:
 - Missing environmental impacts, e.g. soil quality: How to account for soil potential quality improvement in case of organic fertilizers?
 - --> **Next presentation.**
 - Field emissions: Emissions factors either very generic or too context specific (if derived from project's data). →
 - More measurements are needed and new, finer grained, models that take advantage of the existing data.
- **Streamline different applications. See next presentation!**

- Some more assessment challenges:
 - S-LCA: Primary data on social conditions from companies difficult to obtain (confidential data).
 - Replacement with published reports leads to bias?
 - **Upscaling of pilot scale production data for all assessments.**



- Sustainability rather a process than a state.
 - Room for improvement of processes and value chains.
- But yes, BBF indeed offer a solution to:
 - the needed to substitution of finite P source
 - reducing political dependency (if not increasing elsewhere)



Credits: René Schulte (Bio Suisse)

- **Sustainability in agriculture goes beyond the choice of BBF:**
 - Good fertilization practices to avoid nutrient loss
 - Agroecological practices such as high crop and livestock diversity, cover crops, reduced tillage, etc.
 - Living wages etc.

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- Pradel, M., Aissani, L., Villot, J., Baudez, J. C., & Laforest, V. (2016). From waste to added value product: towards a paradigm shift in life cycle assessment applied to wastewater sludge – a review. *Journal of Cleaner Production*, 131, 60–75. <https://doi.org/10.1016/J.JCLEPRO.2016.05.076>
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- Zhang J., Akyol Ç., and Meers E. 2023. Nutrient Recovery and Recycling from Fishery Waste and By-Products. *Journal of Environmental Management* 348.
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SEALAND



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PARTNERS





Novafert

NOVAFERT-SEA2Land: Final event

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Joan Colon, **Jorge Senán-Salinas, PhD**
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Instytut Gospodarki Surowcami Mineralnymi i Energią PAN (MEERI)

5th June 2025, Brussels



NOVAFERT overview

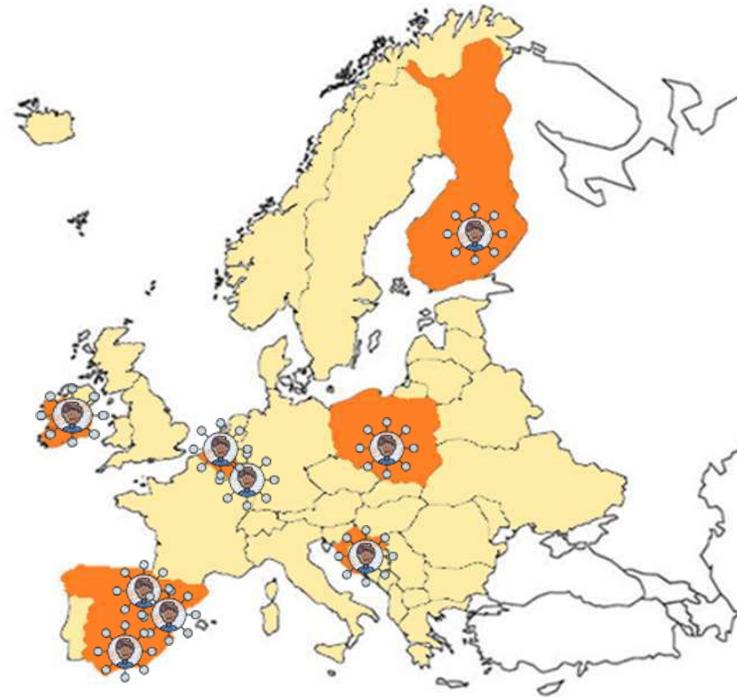
❖ CSA-101060835

❖ 9 PARTNERS

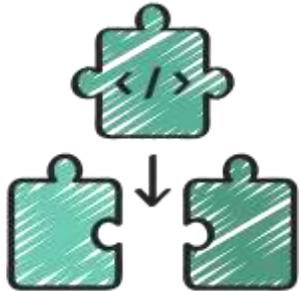
❖ 6 COUNTRIES

❖ 2 Million €

❖ 36 Months



Project aims

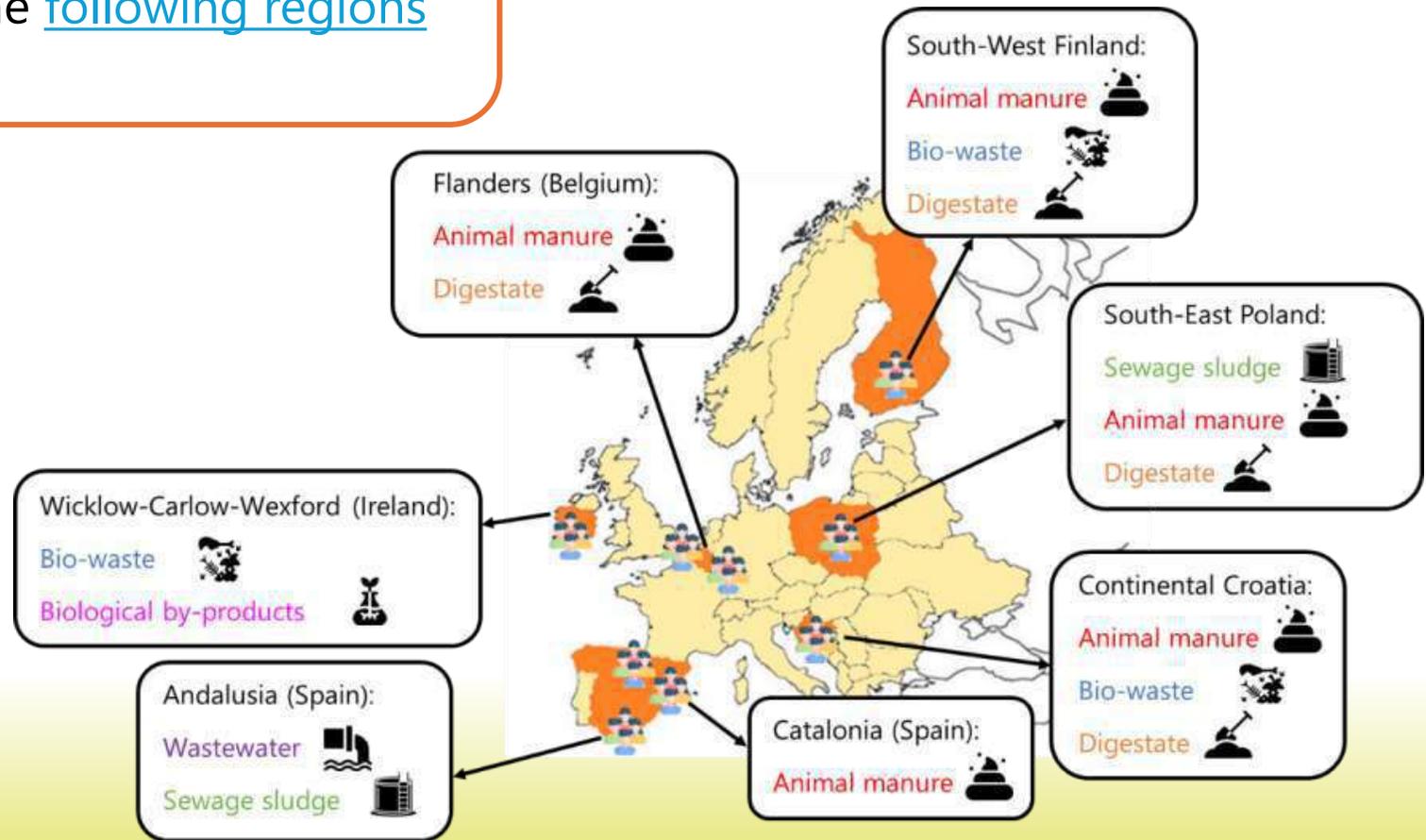


- To demonstrate the **technical, economic, and environmental** feasibility and safe use of a wide portfolio of alternative fertilising products from different waste streams
- To **promote their use** and increase the **awareness** of their benefits



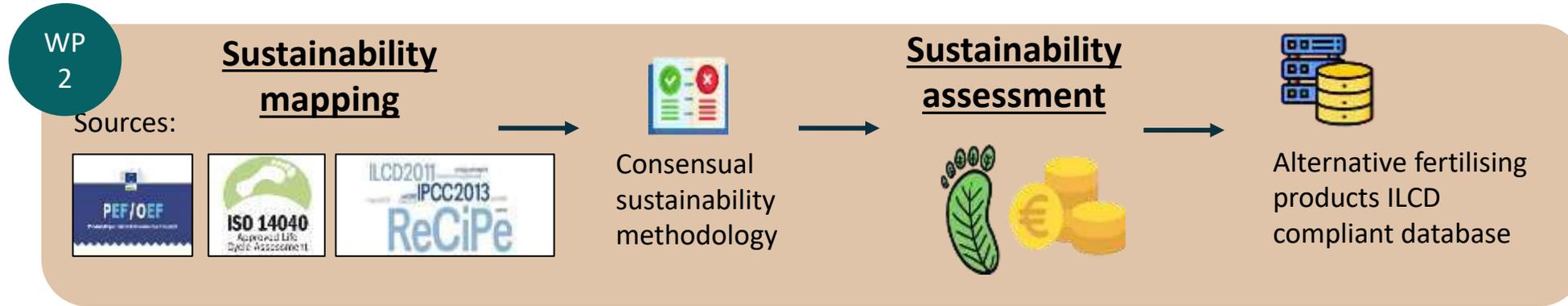
NOVAFERT Overview

7 Regional Working Groups acting as Front Runners for knowledge sharing with the following regions



NOVAFERT regions and their associated waste streams

NOVAFERT methodology



- Develop a **common method for environmental assessment** of alternative fertilising products' production, storage, distribution and application
- **Demonstration of the environmental performance of producing** and using alternative fertilising products by a common PEF compliant methodology
- Development of validated **ILCD compliant datasets**



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What is Product Environmental Footprint-PEF?



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PEF : European Commission methodology to guide the environmental impact metrics of products within the framework of life cycle analysis in various sectors. I.e: beverages, construction, batteries, etc.

- LCA based methodology oriented to product benchmarking
- It develops sectorial /product rules for the definition of main LCA methodological features (PEF-Category Rules)
- It is ruled by DG ENV and the Technical Advisory Board and supported by the JRC.





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T2.2 Mapping of other relevant environmental/sustainability (UVIC-LUKE)

- Main goal was to map out the available standards to assess the environmentally relevant aspects not well covered by LCA methodology.
 - Affections to soil
 - Carbon sequestration
 - Biodiversity
 - Pollutants (heavy metals, pathogens, emerging pollutants such as PFAS and microplastics)
 - Others such as the odour
- The mapping included the parameters and methods for measuring them since chemical analysis to earth observation systems.
- The main conclusions of the literature as well as the potential controversies were as well compiled.
- The analyses began with a bibliometric analysis to systematised the compilation of literature. Moreover, other standards and reports from the United nation (UN) or Food and Agriculture Organization of the United Nations (FAO) were consulted and integrated.
- Other activities to get feedback from LCA community:
 - ESNI 2023 Webinar **“Biogenic Carbon accounting modelling in bio-based fertilisers: State of the art, limitations, and global trends towards the integration of realistic modelling in LCA”**
- Results in Deliverable 2.1



Table 5. Terms of queries for the main sentence. For crossing both queries the operator AND was used that is, a term each query had to be contained in the publication to be considered¹⁶.

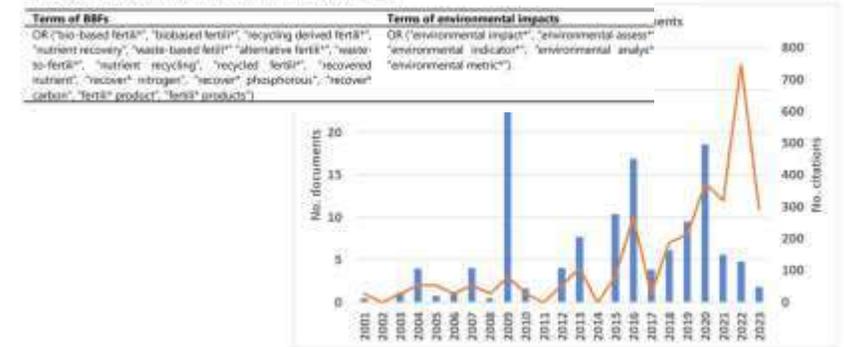


Figure 1. Overall production of scientific production about environmental concerns of BBFs.

Table 6. Selection of the most relevant references about the non-LCA environmental concerns of BBFs.

| Environmental concern | Importance | Trade-offs sign | Main references |
|---|--|---|---|
| Affections on soil properties (physical and chemical) | BBF can induce modifications in soil properties. There are some evidence in favour, physical properties, and biological activity. However, there are also risks associated with decreasing efficiency of soil nutritional management. | Positive or Negative | Ashley et al. 2020; Santos et al. 2019; Ren et al. 2020; Barri et al. 2022; Gilbrigham et al. 2022; Rozali et al. 2022; Barri et al. 2022; Marilou Salazar et al. 2022; Ho et al. 2019; Barri et al. 2022; Mendez et al. 2022; Holmiga et al. 2021; Poch et al. 2022; Wymer-Larsen et al. 2022; Dilo et al. 2022; Preiner et al. 2022; Raza et al. 2021; Collaguerri et al. 2022; Mahon-Landy et al. 2019; Carre et al. 2019; Nganga et al. 2019. |
| Heavy metals | The presence of toxic substances in livestock manure and sewage (the most common secondary raw material) can result in damage to ecosystems and human health. Thus, it is very important to develop specific frameworks and datasets to assess them to prevent environmental impacts and human risks. | Negative | Riga et al. 2019; Kubicek et al. 2020; Krasovic et al. 2012; Wang et al. 2024; Khatibkhani, Zou et al. 2021; Tawal et al. 2021; Karim et al. 2022; Gilbrigham et al. 2022; Rozali et al. 2022; Barri et al. 2022; Zabalaia and Ruzic 2019; Barri et al. 2022; Gonzalez et al. 2020; Dilo et al. 2022; Preiner et al. 2022; Collaguerri et al. 2022; Carre et al. 2019; Nganga et al. 2019. |
| Soil carbon sink and sequestration | Soil carbon dynamics are affected by BBF application as well as various land management measures (e.g. ploughing). Therefore, should be incorporated the measuring of the different Carbon stocks in the soil and their transformation. | Potentially positive (under discussion) | Ashley et al. 2020; Arnes et al. 2021; Ren et al. 2020; Barri et al. 2022; Marilou Salazar et al. 2022; Salazar et al. 2022; Lu et al. 2022; Riga et al. 2019. |
| Biodiversity | Assessing the impacts caused by BBF on biodiversity is crucial due to the potential effects on ecosystem stability and functioning such as changes in soil microbial communities. | Positive or Negative | Baskin et al. 2019; Christie et al. 2019; Ren et al. 2020; Salazar et al. 2022; Zou et al. 2021; Arnes et al. 2022; Gilbrigham et al. 2022; Barri et al. 2022. |
| Organic emerging | Their presence is related to the secondary raw materials quality and the bioconversion parameters. Their application may lead to bioaccumulated soil, uptake by the crop or leached to the groundwater, causing potentially severe risks to human health and the environment. | Negative | Riga et al. 2019; Kubicek et al. 2020; Barri et al. 2020; Salazar et al. 2022; Karim et al. 2022; Rozali et al. 2022; Dilo et al. 2022; Preiner et al. 2022. |
| Others | The use of BBFs can introduce microplastics into soil and water, causing important damage to human health and affecting ecosystem services. Risks included in organic fertiliser code. | Negative | Barri et al. 2018; Salazar et al. 2022. |
| Odour | Excesses of odours from organic fertilisers, rich in organic matter, may lead to the release of compounds like ammonia, impacting air quality and causing disturbances in the nearby community. Furthermore, the detection of odours may indicate the decomposition of organic matter and the potential release of substances that could be harmful. | Negative | Rosa et al. 2016; Zabalaia and Ruzic 2019. |

Non-LCA environmental concerns



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| Environmental concern | Affections on soil properties | Heavy metals | Soil carbon sequestration | Biodiversity | Microplastics | Organic emerging contaminants | Odour |
|----------------------------------|--|--|---|---|--|---|---|
| N° of papers | 28 | 18 | 8 | 8 | 2 | 2 | 2 |
| Trade-off sign | Positive and Negative (controversial) | Negative | Positive (under discussion) | Positive and Negative (controversial) | Negative (magnitude under discussion) | Negative | Negative |
| Description | They can improve soil structure and biological activity. However, there are also risks associated with decreasing efficiency of soil nutritional management. | The presence of toxic substances secondary raw material can result in damage to ecosystems and human health. | Soil carbon dynamics are affected by BBFs application as well as various land management measures (e.g. ploughing). | Soil structure and xenobiotics could alter ecosystem stability and functioning such as changes in soil fauna or soil microbial communities. | MP into soil and water could potentially damage human health and ecosystem services They accumulate on water reservoirs and impact on biota. | Organic pollutants (bio)accumulates in the soil, can be uptaken by the crop or leached to the groundwater. They are a risk to human health and the environment. | The detection of odours may indicate the release of substances that could be harmful impacting the air quality and human health. |
| Main issues for LCA adaptability | <ul style="list-style-type: none"> -Soil complexity -Limited understanding of long-term effect -Limited standardization of methods and concepts -Limited impact assessment methods | <ul style="list-style-type: none"> -Spatio-temporal variability -Bioavailability consideration -limited fate and transport models -LCIA methods differ | <ul style="list-style-type: none"> -Non consensual methodologies -Uncertainties in the long-term stability -Variability of soils and pedoclimatic conditions | <ul style="list-style-type: none"> -Spatial dimension -Specific data needs -Issues in representing the biodiversity -Human-made impacts effects isolation | <ul style="list-style-type: none"> -Data availability and reliability -Analytical challenges -Uncertainty in environmental fate -Impact assessment limitations | <ul style="list-style-type: none"> -Analytical challenges -Spatio-temporal variability -Impact assessment limitations | <ul style="list-style-type: none"> -Subjectivity -No harmonised method -Data availability -Chemical heterogeneity -Spatio-temporal variability |

Non-LCA environmental concerns



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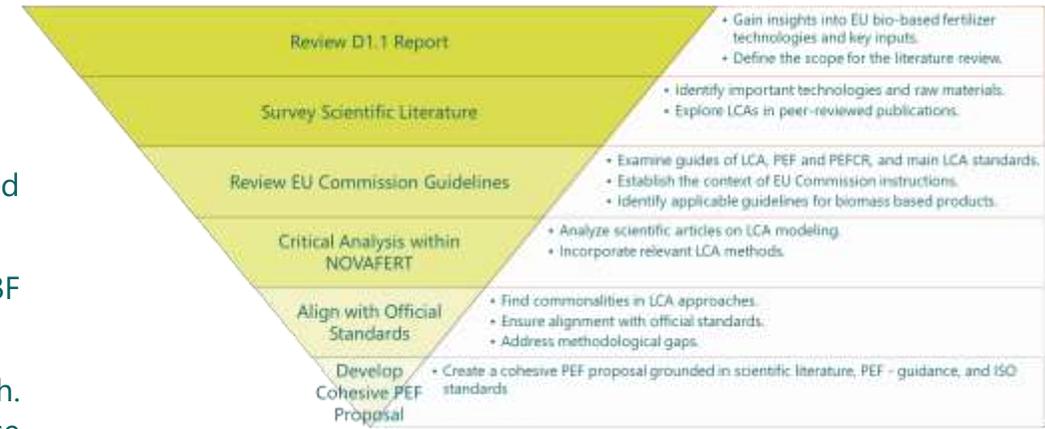
| Environmental concern | Affections on soil properties | Heavy metals | Soil carbon sequestration | Biodiversity | Microplastics | Organic emerging contaminants | Odour |
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| Trade-off sign | Positive and Negative (controversial) | Negative | Positive (under discussion) | Positive and Negative (controversial) | Negative (magnitude under discussion) | Negative | Negative |
| Description | They can improve soil structure and biological activity. However, there are also risks associated with decreasing efficiency of soil nutritional management. | The presence of toxic substances secondary raw material can result in damage to ecosystems and human health. | Soil carbon dynamics are affected by BBFs application as well as various land management measures (e.g. ploughing). | Soil structure and xenobiotics could alter ecosystem stability and functioning such as changes in soil fauna or soil microbial communities. | MP into soil and water could potentially damage human health and ecosystem services They accumulate on water reservoirs and impact on biota. | Organic pollutants (bio)accumulates in the soil, can be uptaken by the crop or leached to the groundwater. They are a risk to human health and the environment. | The detection of odours may indicate the release of substances that could be harmful impacting the air quality and human health. |
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T2.3 Definition of a unified compliant methodology to implement LCA for the environmental assessment of alternative fertilising products (LUKE and UVIC)

- Methodology was published in the NOVAFERT website (D2.2) survey created to address the 7 main issues found (Accomplishment of M3)
 - Scope.** The products code: CPAs proposed are common with mineral/fossil-based fertilisers.
 - The representative product:** the variability of products under the umbrella of BBF makes difficult to create one unique representative product for the sector
 - The functional unit:** The kg of BB could be a default unit easy to operate with. However, a complementary unit to refer the main plant nutrient in the BBF will ease the comparability (i.e. 1 kg of N).
 - The system boundaries:** For the present version, the system boundaries cover from the secondary raw materials until the retailer. Application/use phase modelling are variable and depend on the use-application methods (and several parameters such as the weather). Use phase modelling and emission factors are as well recommended for the inclusion in the PEF framework.
 - Burdens allocated from the secondary raw materials:** waste and products dichotomy affects importantly in the allocation of upstream burdens.
 - An adaptation of **Circular Footprint formula** is proposed though under discussion. This point method has been highly criticised and incoherent with the ISO standards.
 - The emission factors** for BBFs are proposed based on their chemical characteristics. Nonetheless, some of them lack robust field tests.





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T2.4 & T2.5 Validation of the methodology with real case studies (UVIC)

PEF-wise proposal was tested in **13 products** from **5 European Companies**. LCIs were developed from primary data of the companies.

The functional unit: The kg of BBF could be a default unit easy to operate with. However, a complementary unit to refer the main plant nutrient in the BBF will ease the comparability (i.e. 1 kg of N, 1kg of P₂O₅ or 1 kg of K₂O).

The use of different functional units based on nutrient provision is valuable to evaluate the environmental intensity based on the needs of the end-user and improves the reliability of decision making (Fig 1)

Functional Unit: 1kg BBF

| Impact category | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 |
|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| AC | 0.76 | 0.13 | 0.23 | 0.11 | 0.11 | 0.22 | 0.02 | 0.00 | 0.66 | 0.53 | 1.00 | 0.54 | 0.30 |
| CC | 0.66 | 0.36 | 0.41 | 0.25 | 0.25 | 0.70 | 0.03 | 0.00 | 1.00 | 0.66 | 0.52 | 0.28 | 0.22 |
| ETfw | 1.00 | 0.03 | 0.04 | 0.02 | 0.02 | 0.00 | 0.00 | 0.00 | 0.10 | 0.08 | 0.00 | 0.00 | 0.07 |
| ERnr | 1.00 | 0.17 | 0.30 | 0.12 | 0.12 | 0.06 | 0.02 | 0.00 | 0.61 | 0.53 | 0.05 | 0.02 | 0.60 |
| Eutrfw | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.04 | 0.00 |
| Eutrm | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.54 | 0.00 |
| Eutrt | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.54 | 0.00 |
| HTc | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.54 | 0.00 |
| HTnc | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.80 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.54 | 0.00 |
| Irhh | 0.12 | 0.02 | 0.26 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.55 | 0.51 | 0.00 | 0.00 | 1.00 |
| LU | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.80 | 0.00 | 0.00 | 0.00 |
| Teae | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.28 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.54 | 0.00 |
| OD | 1.00 | 0.11 | 0.16 | 0.08 | 0.08 | 0.04 | 0.02 | 0.00 | 0.29 | 0.26 | 0.13 | 0.07 | 0.21 |
| Pmf | 1.00 | 0.11 | 0.16 | 0.10 | 0.11 | 0.00 | 0.04 | 0.01 | 0.89 | 0.55 | 0.00 | 0.00 | 0.18 |
| POFhh | 0.46 | 0.10 | 0.15 | 0.09 | 0.09 | 0.00 | 0.02 | 0.00 | 1.00 | 0.66 | 0.00 | 0.00 | 0.14 |
| WU | 1.00 | 0.01 | 0.04 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.68 | 0.47 | 0.00 | 0.00 | 0.13 |

Functional Unit: 1 kg of Nitrogen

| Impact category | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 |
|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| AC | 0.15 | 0.24 | 0.61 | 0.20 | 0.28 | 0.05 | 0.11 | 0.02 | 0.41 | 0.44 | 1.00 | 0.06 | 0.23 |
| CC | 0.12 | 0.62 | 1.00 | 0.43 | 0.57 | 0.15 | 0.14 | 0.03 | 0.57 | 0.50 | 0.47 | 0.03 | 0.16 |
| ETfw | 1.00 | 0.30 | 0.59 | 0.21 | 0.29 | 0.00 | 0.08 | 0.03 | 0.32 | 0.33 | 0.00 | 0.00 | 0.28 |
| ERnr | 0.24 | 0.39 | 1.00 | 0.28 | 0.38 | 0.02 | 0.11 | 0.04 | 0.47 | 0.55 | 0.00 | 0.00 | 0.58 |
| Eutrfw | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.30 | 0.02 | 0.00 |
| Eutrm | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.06 | 0.00 |
| Eutrt | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.06 | 0.00 |
| HTc | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.06 | 0.00 |
| HTnc | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.06 | 0.00 |
| Irhh | 0.03 | 0.04 | 0.91 | 0.03 | 0.04 | 0.00 | 0.01 | 0.00 | 0.43 | 0.54 | 0.00 | 0.00 | 1.00 |
| LU | 0.00 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.94 | 1.00 | 0.00 | 0.00 | 0.00 |
| Teae | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.06 | 0.00 |
| OD | 0.45 | 0.50 | 1.00 | 0.35 | 0.48 | 0.02 | 0.19 | 0.06 | 0.43 | 0.50 | 0.30 | 0.02 | 0.39 |
| Pmf | 0.42 | 0.46 | 0.96 | 0.40 | 0.57 | 0.00 | 0.42 | 0.11 | 0.93 | 1.00 | 0.00 | 0.00 | 0.30 |
| POFhh | 0.14 | 0.31 | 0.66 | 0.26 | 0.37 | 0.00 | 0.15 | 0.03 | 1.00 | 0.88 | 0.00 | 0.00 | 0.18 |
| WU | 0.45 | 0.04 | 0.25 | 0.03 | 0.04 | 0.00 | 0.01 | 0.00 | 1.00 | 0.92 | 0.00 | 0.00 | 0.25 |

Functional Unit: 1 kg of Phosphorus (P₂O₅)

| Impact category | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 |
|-----------------|------|------|------|------|------|------|------|------|------|------|------|----------------------------------|------|
| AC | 0.03 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.10 | 0.10 | 1.00 | No P ₂ O ₅ | 0.05 |
| CC | 0.05 | 0.04 | 0.04 | 0.02 | 0.02 | 0.02 | 0.03 | 0.01 | 0.31 | 0.25 | 1.00 | No P ₂ O ₅ | 0.07 |
| ETfw | 1.00 | 0.05 | 0.06 | 0.02 | 0.03 | 0.00 | 0.05 | 0.02 | 0.41 | 0.40 | 0.00 | No P ₂ O ₅ | 0.31 |
| ERnr | 0.37 | 0.09 | 0.16 | 0.04 | 0.06 | 0.01 | 0.10 | 0.04 | 0.93 | 1.00 | 0.45 | No P ₂ O ₅ | 1.00 |
| Eutrfw | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.00 | 0.00 | 0.01 | 0.01 | 1.00 | No P ₂ O ₅ | 0.00 |
| Eutrm | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | No P ₂ O ₅ | 0.00 |
| Eutrt | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | No P ₂ O ₅ | 0.00 |
| HTc | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | No P ₂ O ₅ | 0.00 |
| HTnc | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | No P ₂ O ₅ | 0.00 |
| Irhh | 0.03 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 0.57 | 0.00 | No P ₂ O ₅ | 1.00 |
| LU | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.98 | 0.00 | No P ₂ O ₅ | 0.00 |
| Teae | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | No P ₂ O ₅ | 0.00 |
| OD | 0.29 | 0.05 | 0.07 | 0.02 | 0.03 | 0.01 | 0.07 | 0.03 | 0.36 | 0.39 | 1.00 | No P ₂ O ₅ | 0.28 |
| Pmf | 0.35 | 0.06 | 0.09 | 0.03 | 0.05 | 0.00 | 0.21 | 0.06 | 1.00 | 0.99 | 0.01 | No P ₂ O ₅ | 0.28 |
| POFhh | 0.11 | 0.04 | 0.05 | 0.02 | 0.03 | 0.00 | 0.07 | 0.01 | 1.00 | 0.81 | 0.00 | No P ₂ O ₅ | 0.15 |
| WU | 0.35 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 1.00 | 0.85 | 0.00 | No P ₂ O ₅ | 0.22 |

Functional Unit: 1 kg of Potassium (K₂O)

| Impact category | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 |
|-----------------|------|------|------|------|------|------|------|------|------|------|------|---------------------|------|
| AC | 0.25 | 0.72 | 0.82 | 0.04 | 0.14 | 0.04 | 1.00 | 0.23 | 0.77 | 0.96 | 0.46 | No K ₂ O | 0.58 |
| CC | 0.02 | 1.00 | 0.74 | 0.05 | 0.16 | 0.07 | 0.66 | 0.23 | 0.58 | 0.41 | 0.12 | No K ₂ O | 0.21 |
| ETfw | 0.36 | 1.00 | 0.92 | 0.05 | 0.16 | 0.00 | 0.82 | 0.41 | 0.68 | 0.58 | 0.00 | No K ₂ O | 0.79 |
| ERnr | 0.05 | 0.79 | 0.94 | 0.04 | 0.13 | 0.01 | 0.70 | 0.34 | 0.51 | 0.57 | 0.02 | No K ₂ O | 1.00 |
| Eutrfw | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.16 | No K ₂ O | 0.01 |
| Eutrm | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | No K ₂ O | 0.00 |
| Eutrt | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.01 | 0.00 | 0.00 | 0.00 | 1.00 | No K ₂ O | 0.00 |
| HTc | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | No K ₂ O | 0.00 |
| HTnc | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.35 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | No K ₂ O | 0.00 |
| Irhh | 0.00 | 0.04 | 0.50 | 0.00 | 0.01 | 0.00 | 0.03 | 0.01 | 0.33 | 0.33 | 0.00 | No K ₂ O | 1.00 |
| LU | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 1.00 | 0.96 | 0.00 | No K ₂ O | 0.01 |
| Teae | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | No K ₂ O | 0.00 |
| OD | 0.06 | 0.88 | 0.81 | 0.04 | 0.14 | 0.01 | 1.00 | 0.46 | 0.47 | 0.45 | 0.08 | No K ₂ O | 0.57 |
| Pmf | 0.04 | 0.36 | 0.35 | 0.02 | 0.08 | 0.00 | 1.00 | 0.36 | 0.47 | 0.40 | 0.00 | No K ₂ O | 0.20 |
| POFhh | 0.02 | 0.49 | 0.48 | 0.03 | 0.10 | 0.00 | 0.72 | 0.18 | 1.00 | 0.71 | 0.00 | No K ₂ O | 0.24 |
| WU | 0.08 | 0.06 | 0.18 | 0.00 | 0.01 | 0.00 | 0.06 | 0.03 | 1.00 | 0.74 | 0.00 | No K ₂ O | 0.33 |



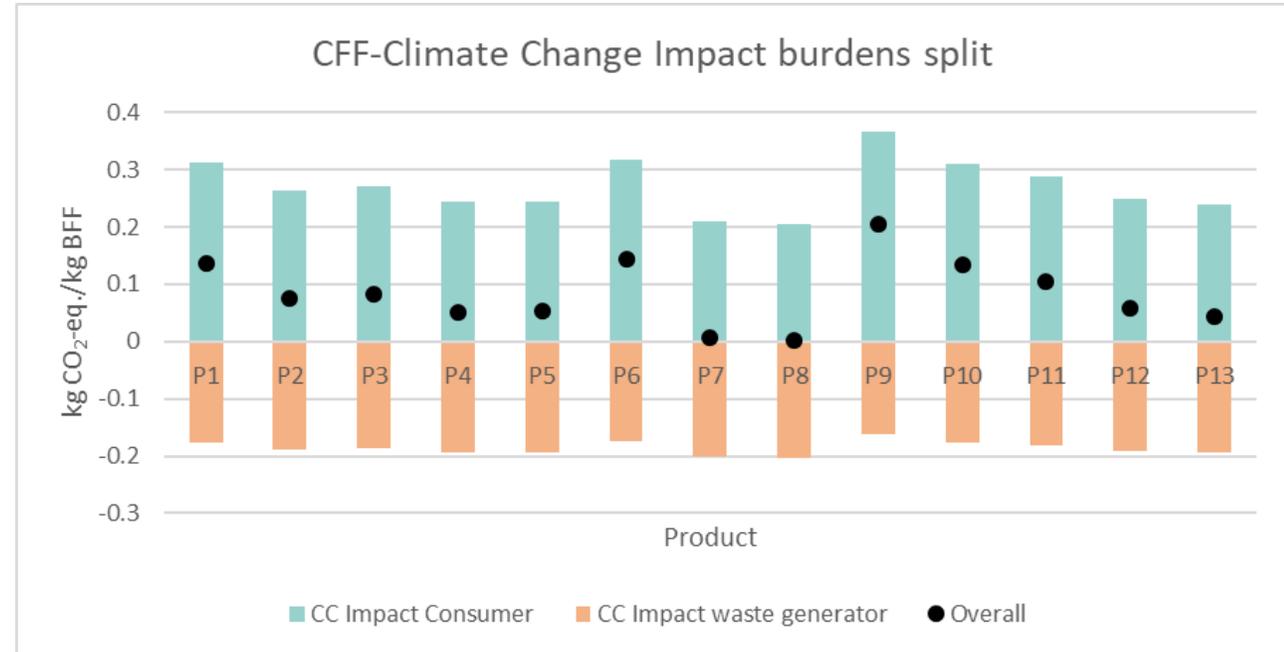
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T2.4 Validation of the methodology with real case studies (UVIC)

An adaptation of **Circular Footprint Formula (CFF)** is proposed though under discussion. This point method has been highly criticized and incoherent with the ISO standards. It was adapted to BBFs. Nutrient content was adopted and single fertilisers use for the comparison: Ammonium Nitrate, Single Phosphate and Potassium Chloride.

The use of CFF contributes to provide environmental credits to the nutrient recycler. However, for the consumers, extra impact rather than the recycling process hinders the adoption of BBFs or the decarbonisation accounting. Its use in this case and application should be further discussed (Fig 2).

There are important uncertainties in the definition of mineral counterparts and equivalences in the CFF.





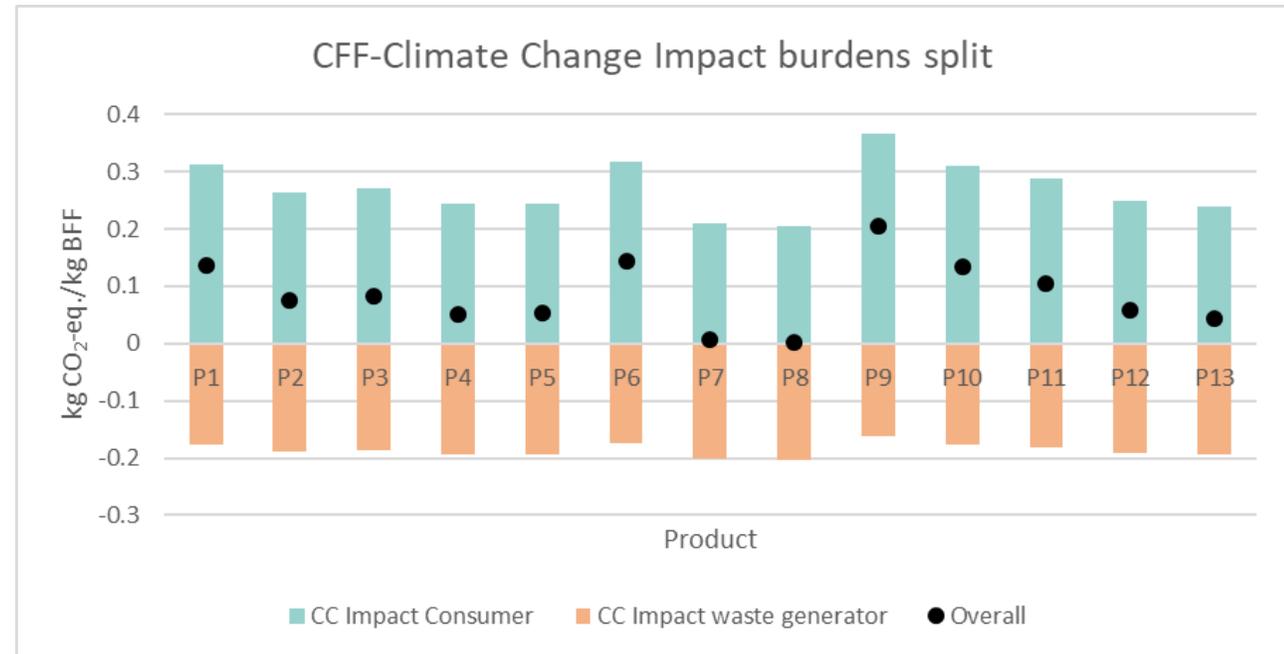
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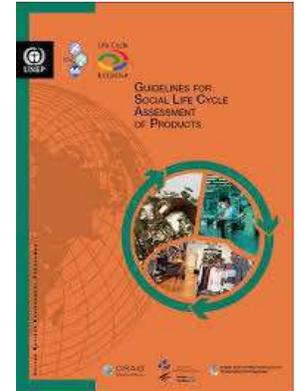
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There are important uncertainties in the definition of mineral counterparts and equivalences in the CFF.



T2.6 Social-LCA

- **Implementation of S-LCA using a dual approach:**
 - I. Qualitative approach** – organization-oriented, based on a qualitative methodology. This analysis focused on assessing social practices at the company level, including working conditions, stakeholder engagement, and ethical management.
 - II. Quantitative approach** – product-oriented, using the PSILCA database. This method enabled the identification and quantification of potential social risks throughout the supply chain of the assessed product.
- For the purpose of the analysis, **five companies** were selected. Three of them are based in Spain, one in Finland, and one in Poland.





Novafert

Results of the S-LCA:

- 🌍 **Main social and environmental benefits:**
 - I. **Job creation** in local and rural communities.
 - II. **Improved working conditions and safety standards** at most production sites.
 - III. **Support for CE** through the use of waste as raw materials.
 - IV. **Positive impact on environment and public health** by reducing the use of chemical fertilisers.

- ⚠️ **Areas for improvement:**
 - I. **Low gender diversity** in employment – most workers are men.
 - II. **Lack of formal stakeholder engagement** and limited customer satisfaction monitoring.
 - III. **Limited transparency** in communication with communities and business partners.
 - IV. **No monitoring of social responsibility** among suppliers.
 - V. **Social impacts vary strongly by country**, depending on the local economic and social context.

- 📊 **PSILCA database findings:**
 - I. Key social risks are related to: **fair wages, trade union rights, and natural resource use** (water, biomass).
 - II. **BBFs with higher chemical use (e.g. P11)** showed **greater social impact**.
 - III. **Country-specific differences** are significant:
 - Eg., Poland showed high risk for industrial water use,
 - Spain had higher risks in terms of fair salaries.

WP2 Conclusions

- NOVAFERT WP2 accomplished all the objectives established
- A discussion about the environmental impacts has been catalyzed in European Industry and Academia
- The bases for further official PEFCR of alternative fertilisers has been established to product oriented environmental footprinting
- The main methodological choices of the PEFCR-wise method were validated with 13 European case studies
- Further improvements were performed in the Social assessment of the Alternative fertilising products

Thank you!

Open to questions

Jorge Senán-Salinas, PhD
Jorge.senan@uvic.cat



Common conclusions

- **Process-oriented and product-oriented LCA analyses are complementary to reveal the impacts along the alternative fertilisers from early-stages at research towards product benchmarking in the market level.**
- However, common issues are found in the comparison of their **agronomic performance comparison and translation into LCA functionalities (functional unit)**, emissions during the application, and other non-LCA environmental issues, etc.
- Both projects highlighted the role of social assessment which revealed benefits and trade-offs in alternative fertilisers. Nonetheless, the complexity, and existence of multiple methodologies make it difficult to compare among studies. Social phenomena are complex to quantify.



Business plans and models for circular fertilizers

IPS Konzalting

Ana-Marija Špicnagel





SEA2LAND is a project based on developing and adapting technologies **to produce BBFs** from fishery and aquaculture byproducts, addressing challenges in food production, climate change, and waste reuse.

Project coordinator

NEIKER

6

Framework programme

Horizon 2020

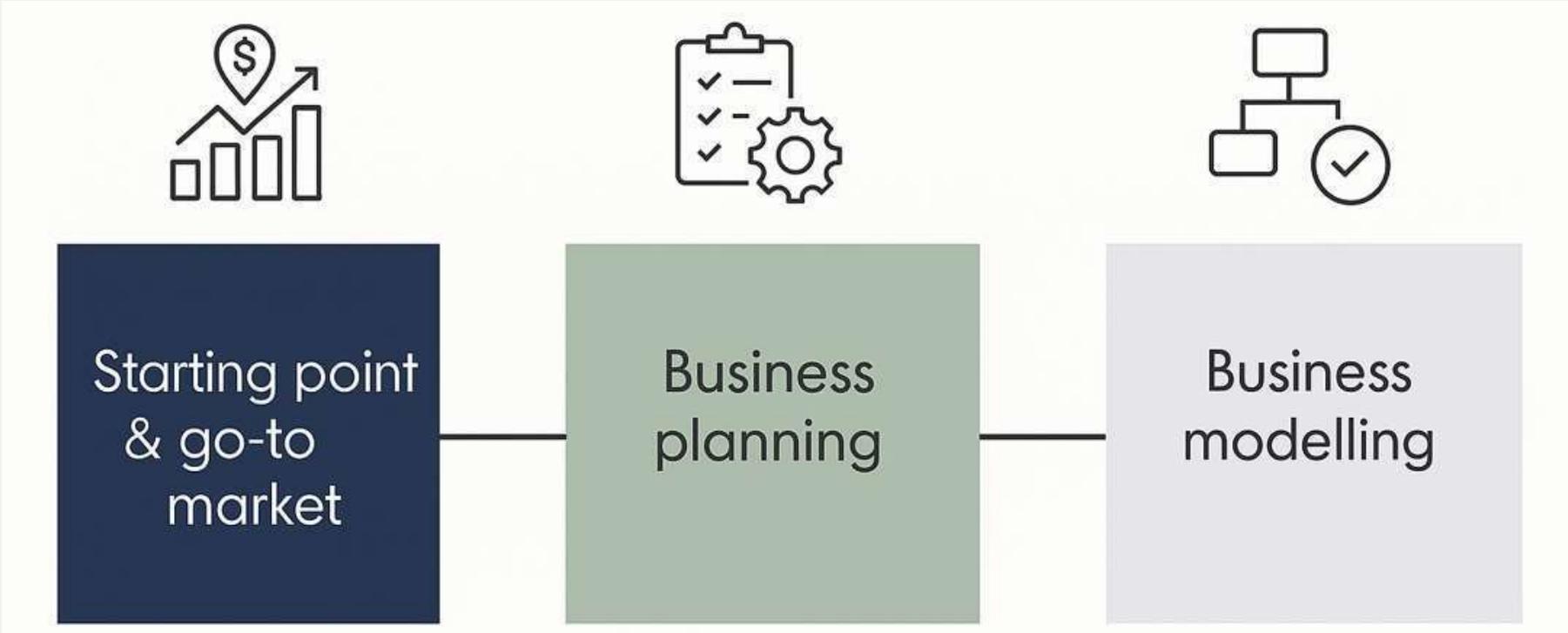
CE-RUR-08-2018-2019-2020:Closing nutrient cycles

Budget

+ 8.8 M €

Project partners

26 partners from 10 EU countries and CELAC region (Chile)





Stakeholders attitude



Stakeholders mapping
SWOT analysis

Brainstorm sessions

Choice experiment survey

Go-to-market strategy

Consultations with technical experts

Brainstorm with the fertilizing industry

Agro experts' recommendations



Business Model Canvas

Business plans

Importance of stakeholders attitude



ES FR BE IT NO EE PT MT HR CH CL

D2.3 Consumer survey – online answer collection

| | | | | | | | | | | | | |
|--|---|---|--|---|---|---|--|--|--|--|--|------|
| | X | X | | X | X | X | | | | | | 1516 |
|--|---|---|--|---|---|---|--|--|--|--|--|------|

T8.1 Implementing working sessions with main actors in business models/ T8.5 Industrial exploitation

| | | | | | | | | | | | | |
|---|----|----|----|----|----|----|---|---|----|----|---|-----|
| Brainstorm sessions | 53 | 48 | 21 | 48 | 55 | 57 | 7 | 4 | 36 | 22 | 6 | 357 |
| Survey responses (agricultural producers/fishing industry) | 26 | 9 | 5 | 6 | 46 | 3 | 3 | 2 | 33 | 8 | 5 | 146 |

Everything is connected!

| | |
|--------------|--------------|
| TOTAL | 2,019 |
|--------------|--------------|

Overview of survey implementation

- Participants are **willing to accept BBFs produced from fish waste**
- The most **important qualities of BBFs** are:
 - **nutrient ratio** that fits with crop nutrient demand,
 - **hygienically** prepared and no diseases/pests,
 - **nutrient release speed**
- **Obstacles in using BBFs:**
 - **technical equipment** for the application,
 - **legislative framework**





The performed choice experiment indicated that:

- **organic matter > form of fertilizer**
- **price > organic matter**
- **volume/fertilizer action rate > price**

Importance of stakeholders attitude

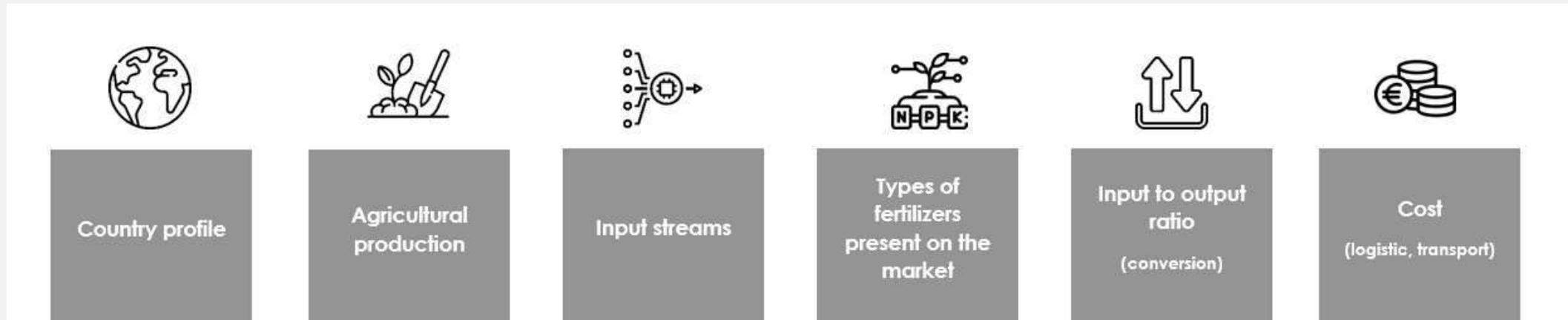
Long story short...

- There is a **growing interest** in BBFs as a sustainable agricultural solution.
- **Economic, regulatory, and logistical** barriers must be addressed.
- **Education, knowledge sharing, and collaboration are essential** for scaling up BBF adoption.

Forseen focus areas for BBFs development

- **Cost-effectiveness** - Improve production costs and affordability.
- **Regulation** - Work towards harmonised EU regulations and certification standards.
- **Education and Outreach** - Build awareness through workshops and practical field trials.
- **Collaboration** - Strengthen partnerships across sectors (fisheries, agriculture, research, policymakers).
- **Market development** - Enhance distribution channels and create tailored business models/plans for different regions.

- **8 business plans** for 3 types of end-products
 - fertiliser production for **local use**
 - fertilisers with high value and effectiveness for **specific crops** (not local)
 - **technological services**





BUSINESS MODEL

GET OUTSIDE

and talk to customers

FOCUS ON INPUT

received in validation

START LEAN

and build prototype

CHANGE INITIAL ASSUMPTIONS

to fulfil customer needs

CHASE CUSTOMERS

to get the needed validation

LAUNCH BY APPLYING

customer proven processes

BUSINESS PLAN

STAY INSIDE

and do library research

FOCUS ON OUTPUT

to create presentation

SPEND BIG

to optimize the product

FORTIFY INITIAL ASSUMPTIONS

with confirmed data

CHASE FUNDING

to get needed money

TALK ABOUT what might happen in **FUTURE**

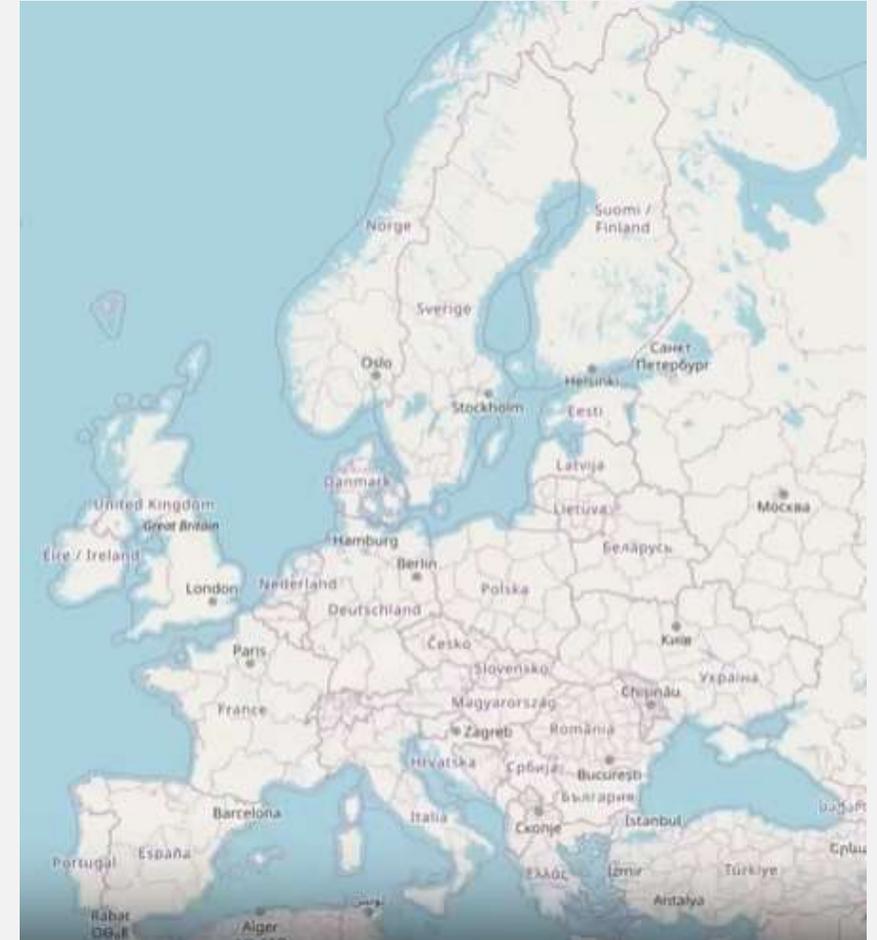
1. SUBSTITUTE NUTRIENT :

- using the price of the major nutrients found in BBF for the calculation of profitability
- **total BBF price = content of the nutrient in BBF * price single nutrient mineral fertiliser**

2. COST:

- Calculation of BBF price based on the **cost of production**, where the goal is to have a price that results in an acceptable payback period (**PP = 8 years**)
- **Costs of production** taken into account: equipment purchase cost, construction costs, operating labour, utilities, operating supplies, and administrative costs
- **Plant management** costs and **start-up costs** are the costs based on a specific percentage of the total expenses
 - ✓ **2 sub-methods:**
 - ***The cost of input of raw materials** is included and final price contains this cost*
 - *The assumption that raw material input is **cost-free** as the company owns it*

- **Two locations of production**
 - Norway
 - Italy
- to show the impact of different levels of variable costs:
 - Labour,
 - utilities (electricity, water, gas)



| | ADRIATIC | ATLANTIC | BALTIC | CANTABRIAN | NORTH | MEDITERRANEAN |
|---------------------------------|------------------------------|--|---|--|----------------------|-------------------------|
| type of input | Mollusc and fish by-products | Fish heads, fishbones/flesh (frames) and viscera | Salmon scraps, food waste, tree leaves, ash | Fish viscera | Fish sludge | Fish sludge (dewatered) |
| input quantity | 635,00 ton | 3.600 ton | 70,42 ton | 1.698.180 litre | 1.700.000,00 litre | 1.504 - 9.400 t |
| fertiliser type | Biochar compost-composite | Protein fraction and protein fraction upgraded | Bokashi pellet | Foliar fertilizer with amino acid, humic extract, organic matter | Pelleted fish sludge | Organic amendment |
| BBF quantity | 16,584 t | 2.958 t | 35,75 t | 292,28 t | 1.000,00 t | 595.94 - 3.724 t |
| CAPEX (€) | 3,456,017.50 | 10,745,000.00 | 392,497.66 | 252,507,500 | 429,800.00 | 181.517 - 757.728 |
| OPEX (€) own input | 610,973.67 | 2,152,405.68 | 297,408.67 | 646,044.78 | 60,183.63 | 61.309 - 282.986 |
| OPEX (€) purchased input | 788,773.67 | 2,512,405.68 | 313,978.80 | 985,680.78 | 264,183.63 | n.a. |



| PILOT | GROSS MARGIN_npm method - own input | GROSS MARGIN_npm method - purchased input | NPM PRICE |
|------------------|-------------------------------------|---|--------------------------------------|
| Adriatic | -176.680,96% | -228156,16% | 20,84 eur/ton |
| Atlantic | -724,33% | -862,20% | PF 156,42 eur/ton, PFu 65,00 eur/ton |
| Baltic | -24.303,41% | -25663,05% | 34,09 eur/ton |
| Cantabrian North | -8.537,60% | -13078,53% | 25,59 eur/ton |
| Mediterranean | -38,45% | -507,74% | 43,47 eur/ton |
| | 13,69% | n.a. | 43,48 eur/ton |
| | 28,66% | n.a. | 43,48 eur/ton |
| | 36,26% | n.a. | 43,48 eur/ton |

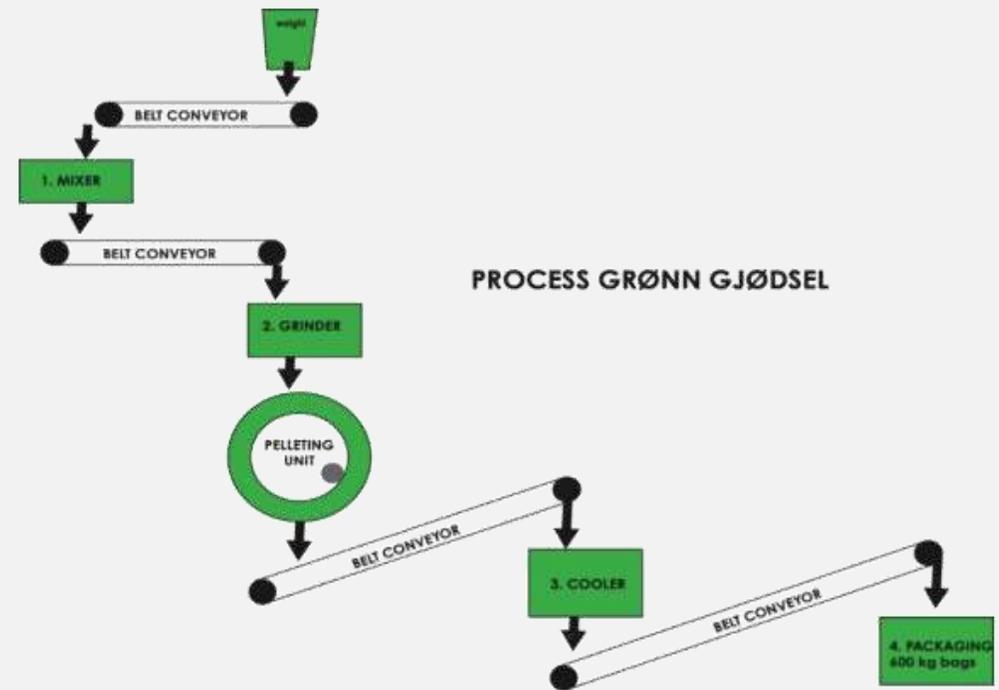
| PILOT | GROSS MARGIN_cm method - own input | GROSS MARGIN_cm method - purchased input | ROI - own input | ROI - purchased input | CM PRICE - own input | CM PRICE - purchased input |
|------------------|------------------------------------|--|-----------------|-----------------------|-----------------------------------|-----------------------------------|
| Adriatic | 41,34% | 34,85% | 12,46% | 12,21% | 62.800 eur/ton | 73.000 eur/ton |
| Atlantic | 38,23% | 34,53% | 12,40% | 12,33% | PF 2.080 eur/ton, PFu 870 eur/ton | PF 2.300 eur/ton, PFu 955 eur/ton |
| Baltic | 13,97% | 13,47% | 12,30% | 12,45% | 9.670 eur/ton | 10.150 eur/ton |
| Cantabrian North | 32,71% | 24,22% | 12,44% | 12,47% | 3.285 eur/ton | 4.550 eur/ton |
| Mediterranean | 46,74% | 16,66% | 12,29% | 12,29% | 113 eur/ton | 317 eur/ton |
| | 26,89% | n.a. | 12,42% | n.a. | 65 eur/ton | 65 eur/ton |
| | 25,22% | n.a. | 12,19% | n.a. | 38 eur/ton | 38 eur/ton |
| | 24,56% | n.a. | 12,16% | n.a. | 25 eur/ton | 25 eur/ton |





- ✓ **Input:** fish sludge
- ✓ **Output:** fish sludge pelleted fertilizer

- ✓ Calculation with **both pricing methods**
- ✓ Showing production located in **NOR** and in **ITA**
- ✓ Calculated with:
 - ✓ **own** raw materials
 - ✓ **purchased** raw materials



Business plans – NORTH pilot

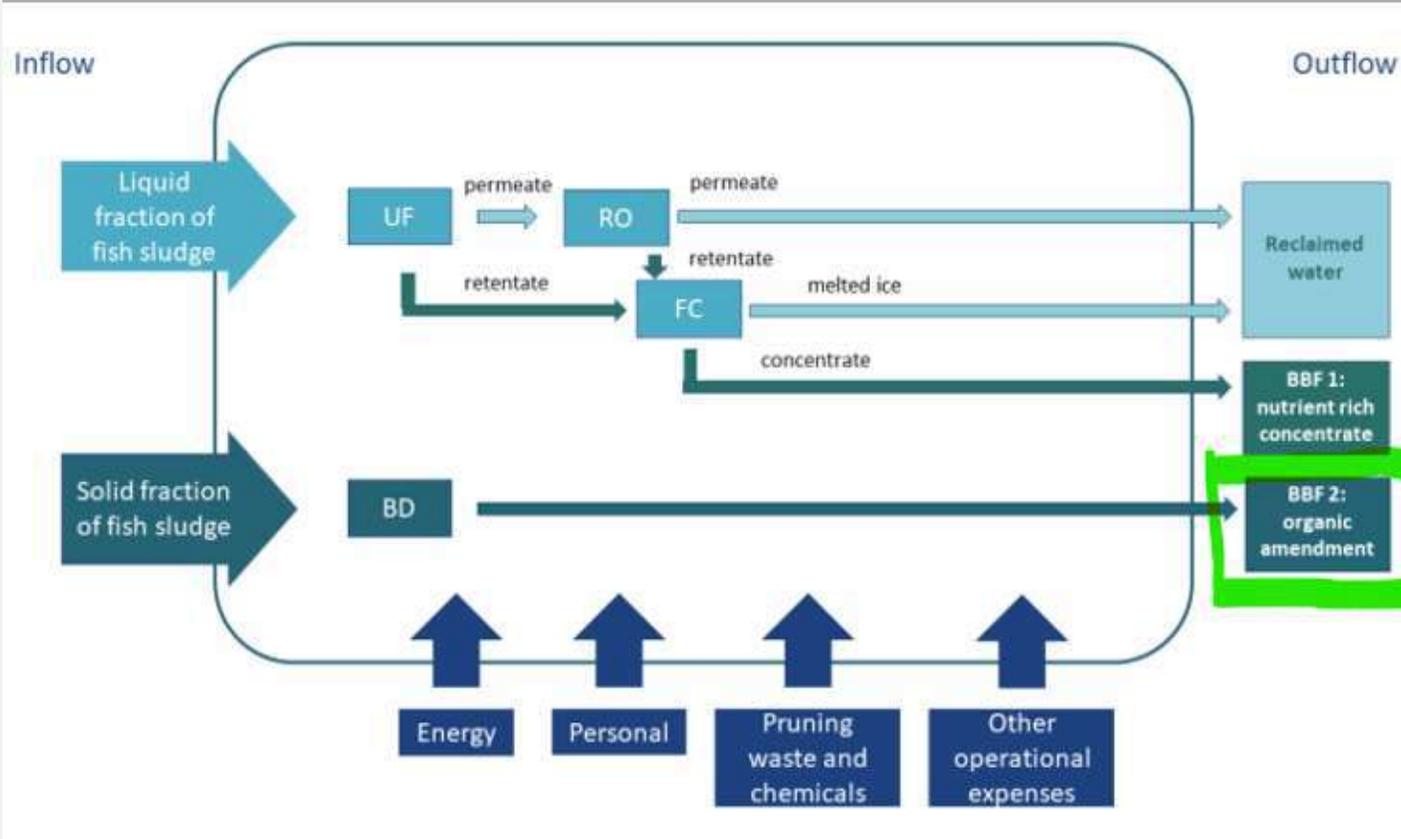
Business case results of the nutrient price method:

| | Nutrient price method | | | | | | | |
|-----------------------------------|-----------------------|-------------------|-------------------|---|-------------------|----------------------------|---------------------|-------------|
| | STREAM INPUT | BBF PRODUCED | Net profit (EBIT) | Net profit before amortization (EBITDA) | Gross margin (GM) | Return on investment (ROI) | Payback period (PP) | PRICE |
| <i>Pelleted fish sludge (FSP)</i> | | | | | | | | |
| Norway | | | | | | | | |
| purchased input | 1.700.000,00 litre | 1.000,00 ton/year | -223.604,32 | -194.979,64 | -514,39 % | -52,03 % | -1,92 years | 43,47 eur/t |
| own input | 1.700.000,00 litre | 1.000,00 ton/year | -19.604,32 | 9.020,36 | -45,10% | -4,56% | -21,29 years | 43,47 eur/t |
| Italy | | | | | | | | |
| purchased input | 1.700.000,00 litre | 1.000,00 ton/year | -220.713,63 | -192.088,95 | -507,74% | -51,35% | -1,95 years | 43,47 eur/t |
| own input | 1.700.000,00 litre | 1.000,00 ton/year | -16.713,63 | 11.911,05 | -38,45% | -3,89% | -25,72 years | 43,47 eur/t |

PP - The model calculates the payback period in a way that allows for a negative value as a mathematical result, but not as a real 'negative year' in practical terms

| | Cost method | | | | | | | |
|-----------------------------------|--------------------|-------------------|-------------------|---|-------------------|----------------------------|---------------------|-----------|
| | STREAM INPUT | BBF PRODUCED | Net profit (EBIT) | Net profit before amortization (EBITDA) | Gross margin (GM) | Return on investment (ROI) | Payback period (PP) | PRICE |
| <i>Pelleted fish sludge (FSP)</i> | | | | | | | | |
| Norway | | | | | | | | |
| purchased input | 1.700.000,00 litre | 1.000,00 ton/year | 52.925,68 | 81.550,36 | 16,54% | 12,31% | 8,12 years | 320 eur/t |
| own input | 1.700.000,00 litre | 1.000,00 ton/year | 52.925,68 | 81.550,36 | 45,63% | 12,31% | 8,12 years | 116 eur/t |
| Italy | | | | | | | | |
| purchased input | 1.700.000,00 litre | 1.000,00 ton/year | 52.816,37 | 81.441,05 | 16,66% | 12,29% | 8,14 years | 317 eur/t |
| own input | 1.700.000,00 litre | 1.000,00 ton/year | 52.816,37 | 81.441,05 | 46,74% | 12,29% | 8,14 years | 113 eur/t |

- **Nutrient price method** gives **negative results**
- By **cost method**, BBF price can be lower when production plant has its own raw material
- **BBF price 320 €/t**: gross margin 16,54% - 0,17€ of each euro of revenue is profit and 0,83€ is attributed to the cost of goods sold
- **BBF price 116 €/t**: 0,46 € of each euro of revenue is profit and 0,54€ is attributed to the cost of goods sold → because the revenue is 320 ths € vs 116 ths €
- **ROI** is same with both prices – **12%** - every invested euro pays back as a 0,12€ profit
- **Payback period – 8 years** takes to recover the cost of an investment

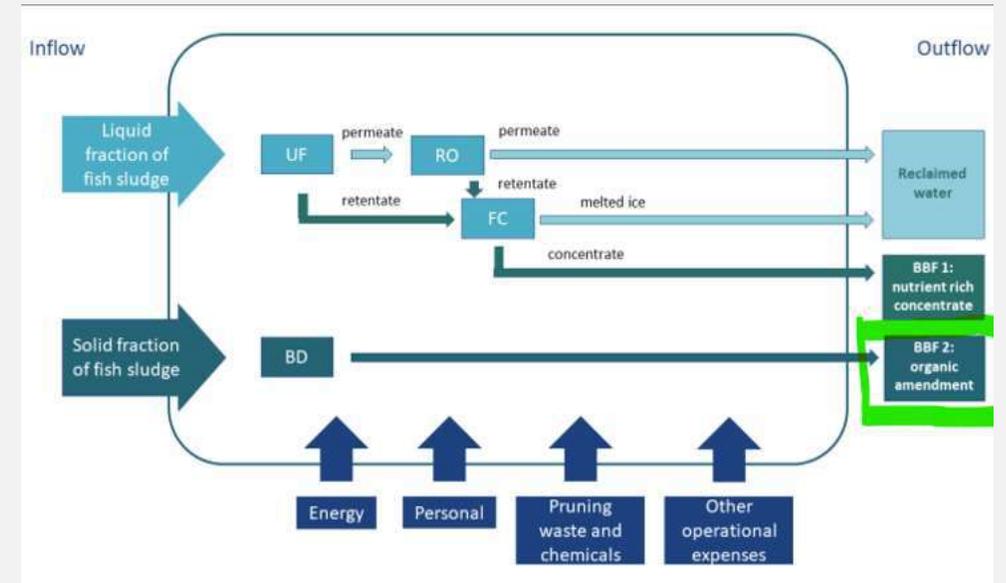


Business plans – MEDITERRANEAN pilot

- ✓ **Input:** dewatered fish sludge
- ✓ **Output:** organic amendment

- ✓ Calculation with both pricing methods
- ✓ Showing production located in **NOR** and in **ITA**

- ✓ Calculated with and without **savings** → cost of fish waste disposal → 30 €/t



Scaling up of production:

| input | output | produced BBF quantity |
|-----------------------|------------------|-----------------------|
| ✓ 800 t fish | = 1.504 t sludge | → 595,95 ton |
| ✓ 2.000 t fish | = 3.760 t sludge | → 1.489,86 ton |
| ✓ 5.000 t fish | = 9.400 t sludge | → 3.724,66 ton |

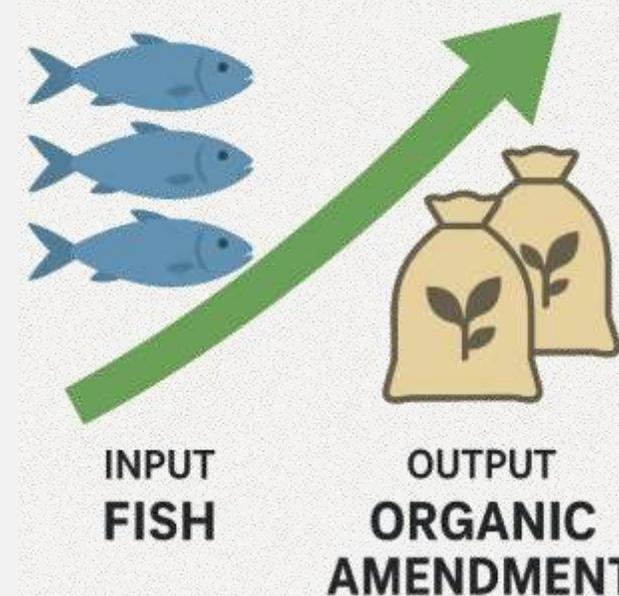
Scaling up of production

| input | CAPEX | OPEX | GM(nm price) | GM (cm price) |
|----------------|--------------|--------------|--------------|---------------|
| ✓ 800 t fish | 181.517,40 € | 66.975,30 € | 13,69 % | 26,89 % |
| ✓ 2.000 t fish | 350.391,80 € | 140.602,43 € | 28,66 % | 25,22 % |
| ✓ 5.000 t fish | 757.728,90 € | 318.585,62 € | 36,26 % | 24,56 % |

| input | ROI | payback period | price – nutrient method |
|----------------|---------|----------------|-------------------------|
| ✓ 800 t fish | 5,36 % | 18,67 years | 43,48 €/t |
| ✓ 2.000 t fish | 14,52 % | 6,89 years | 43,48 €/t |
| ✓ 5.000 t fish | 21,24 % | 4,71 years | 43,48 €/t |

| input | ROI | payback period | price – cost method |
|----------------|---------|----------------|---------------------|
| ✓ 800 t fish | 12,42 % | 8,05 years | 65,00 €/t |
| ✓ 2.000 t fish | 12,19 % | 8,20 years | 38,00 €/t |
| ✓ 5.000 t fish | 12,16 % | 8,22 years | 25,00 €/t |

SCALING UP PRODUCTION



- ✓ All **business models are only viable** under the cost-based pricing method
- ✓ Nutrient-based pricing leads to unsustainable outcomes.
- ✓ Using own inputs improves profitability, especially in Italy, by reducing production costs.
- ✓ Scaling up production improves profitability through lower unit costs, and built-in cost savings make the business financially viable even at smaller scales.
- ✓ Geographical context and **internal resource** use are critical factors for economic success.



What business **critical problems do you solve** for your customers?



Who are your **ideal customers**, and how do they make buying decisions?



What is your **unique value proposition** and **unfair advantage**?

Business Model Canvas can be broken in 3 main segments



BMC prepared on 4 levels:

- I. Business Model Canvas for **agricultural producers**
- II. Business Model Canvas for the **fisheries/aquaculture sectors**
- III. Business Model Canvas for the **fertilizing industry**
- IV. Business Model Canvas for **technology seller/supplier**



Business Model Canvas – FISHERIES/ AQUACULTURE



- BBFs from by-products offer a **sustainable, cost-effective alternative**.
- **Circular economy**: Reduces waste by reusing agricultural by-products.
- BBFs help farmers cut **production costs**.
- **Importance of workshops**, farm visits and joint projects.
- **Tailored solutions** for different farm sizes.
- **Ongoing support**
- **Production**: Costs for raw materials, infrastructure, and processing.
- **Logistics**: Distribution, packaging, and shipping.
- **Investment** in new BBF technologies.

Customer relationship

The fertilizer industry emphasizes strong customer relationships to ensure effective adoption of BBFs and maximize their benefits.

- **Close collaboration with final customers** – Direct engagement with farmers ensures proper BBF application and effectiveness.
- **Tailored nutrition plans** – Customized fertilization strategies enhance soil and crop health based on geo-climatic conditions.
- **Long-term partnerships** – Building stable relationships with farmers and food companies fosters trust and sustained adoption.

Strong customer relationships are crucial for the fertilizer industry to promote BBF adoption, optimize fertilization strategies, and ensure long-term agricultural sustainability.

Customers segments

The fertilizer industry serves diverse customer segments to ensure BBF adoption across various agricultural and horticultural sectors.

- **Farmers** – Crop producers seeking sustainable fertilization solutions.
- **Horticulture** – Fruit, vegetable, and ornamental plant growers benefiting from eco-friendly fertilizers.
- **Gardening** – Home and small-scale gardeners looking for sustainable soil enrichment.
- **Local market** – Cooperatives, nurseries, and retailers distributing BBFs to end users.

Targeting these segments ensures broad BBF adoption, supporting sustainable farming, improved soil health and a circular economy.

Revenue streams

The fertilizer industry generates revenue through key activities that support BBF adoption and sustainable fertilization practices.

SEALAND



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PARTNERS





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Business models for alternative fertilisers: experience from the cases and lighthouses

Daniel de la Nogal

EIT-Food

05/06/2025

 **RE-SOURCE**
LAB FOR BIORESOURCE RECOVERY



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NOVAFERT LH Replication - INTRODUCTION



| Demo title | TRT | Agro-typology | Country, Scale |
|--------------------------------------|-----|---|------------------------------|
| Teagasc, grassland trial | 6 | A range of manure and dairy processing residues applied at field scale to assess agronomic performance. | Ireland, National |
| Municipal water and sewerage company | 9 | Converting sewage sludge into a high DM fertiliser product which contains N, P & K for plant growth. | Poland, National |
| Pirtea porsas | 9 | Digesting pig slurry through AD and separating it into a liquid and solid fraction before applying to land. | Finland, Regional |
| Inagro | 9 | Farm-scale anaerobic digestion of agro-residues/pig manure to increase local nutrient cycling & improve nutrient use efficiency. | Belgium (Flanders), Regional |
| Axarquía Sostensible | 9 | Waste water treatment from agriculture using a water reclamation system, integrated with an irrigation system with software for the management of nutrients in reclaimed water. | Spain (Andalusia), Regional |
| Fertinagro | 9 | Design, production and marketing of organic fertilisers using recovered nutrients from organic materials of animal and plant origin (animal manure, animal by-products, plant waste etc.). Offer personalised nutrient management plans for the farmers using their products. | Spain (Aragon), National |
| OPG Dario Cenger | 9 | Treatment of plant materials and manure from livestock production in AD for biogas production. | Croatia, Regional |

As part of the project, seven flagship initiatives were selected. From these, the four most promising cases have been chosen for potential replication. Two of the discarded cases are already in the commercialization phase.

It is worth noting that the selection process has been complex, as the introduction of this type of alternative fertilizers faces significant challenges due to the strong presence of major market distributors.

The adoption of alternative fertilizers in the European Union remains relatively limited compared to conventional mineral fertilizers. As of 2025, organic fertilizers account for less than 5% of the total fertilizer market in Europe.



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NOVAFERT LH TEAGASC



1 Context and Description

Location: Co. Wexford, Ireland

Product/Service: Long-term demonstration and validation of alternative fertilisers derived from dairy processing sludge

Crops: Perennial ryegrass (for silage)

Main Driver: Need for alternatives to mineral fertilisers to improve soil health, reduce input costs, and close nutrient loops with locally available organic resources

TRL: Pilot / demonstration (applied research at farm scale)

This lighthouse project explores the practical, economic, and environmental viability of using dairy processing sludge as an alternative fertiliser to replace conventional mineral fertilisers (e.g. ammonium nitrate, superphosphate, muriate of potash)

2 Business Channels

Direct demonstration and dissemination to farmers, researchers, advisors and policymakers

Field events and knowledge transfer activities on agronomic, environmental and economic benefits

Collaborations with dairy processors for nutrient management solutions

Potential service provision model for sludge valorisation in partnership with local dairy processing plants



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NOVAFERT LH TEAGASC



3 Customer Relationship Approach

Evidence-based knowledge transfer → demonstration plots, agronomic trials, scientific studies

Participatory engagement → involving farmers and advisors in evaluation

On-farm practical demonstration → showing the application methods and effects in real-life farm settings

Technical advisory support → guidance on application, nutrient management and compliance



4 Key Partnerships

Dairy processors → source of sludge

Farmers → end users and validators

Research institutions and universities → scientific analysis and validation

Advisory services (Teagasc's advisory network) → knowledge transfer and upscaling

Regulators (Department of Agriculture, Environmental Authorities) → policy alignment and regulatory acceptance



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NOVAFERT LH TEAGASC



5 Supporting Activities

Management: planning and operation of trials, stakeholder coordination

Research and development: nutrient analysis, soil health monitoring, product optimisation

Marketing and dissemination: farmer events, publications, training.

Infrastructure management: application machinery, plots, analysis facilities

Policy and regulatory engagement: compliance with fertiliser and waste regulations



6 Market Penetration Strategies

Targeting localised systems close to dairy processors → due to transport cost limitations

Promoting cost savings and soil health benefits → documented €164/ha savings vs mineral fertilisers

Providing long-term data on agronomic performance and environmental impact

Engagement with policymakers → aligning with climate action plans and nutrient management regulations



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7 IP Strategy

Patents: Not applicable (generic concept and practice)

Trademarks: Not likely relevant

Design protection: Possible for bespoke spreading/application systems or decision-support tools

The lighthouse model focuses more on knowledge generation, demonstration and scaling through adoption rather than proprietary product development



8 Scalability and Replicability

Conditions for replication:

Access to a local source of nutrient-rich organic materials

Suitable agronomic systems (e.g. grasslands, forage production) where nutrients can be efficiently utilised

Availability of spreading technology adapted for low-emission and targeted application

Willingness of farmers and local advisors to participate in demonstration activities

Key stakeholders for replication:

Dairy processors

Farmers and farm advisors

Research and extension organisations

Regulatory bodies

Infrastructure needs:

Real-life farming sites

Machinery for fertiliser application and crop harvesting

Laboratory capacity for nutrient and soil health analysis



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NOVAFERT Integration with EIT Food Acceleration Programmes (Seedbed & FAN)



Seedbed Incubator

The **EIT Food Seedbed Incubator** is a 6-month, equity-free programme designed to validate the commercial potential of Europe's most promising IP-backed innovations.

•**Applicability to TEAGASC Model:** While the TEAGASC demonstration is not a startup per se, the programme's focus on bridging the gap between academic research and practical applications aligns well with TEAGASC's objectives. Participation could facilitate market validation and stakeholder engagement for the alternative fertiliser model.



Food Accelerator Network (FAN)

The **EIT Food Accelerator Network (FAN)** is a 2-3 month, theme-based programme delivered through six innovation hubs across Europe. It supports startups and innovators in scaling their solutions and accessing a broad network of industry partners.

•**Applicability to TEAGASC Model:** Engagement with FAN could provide TEAGASC with opportunities to collaborate with startups focusing on nutrient recycling and sustainable agriculture, potentially leading to joint ventures or technology transfers that enhance the scalability of the alternative fertiliser model.



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Preliminary replicability analysis across Europe

The potential for replicating the TEAGASC alternative fertiliser model varies across European regions, influenced by factors such as dairy industry presence, regulatory frameworks, and agricultural practices



High Replicability Regions

Ireland: As the origin of the TEAGASC model, Ireland's strong dairy industry and supportive regulatory environment make it an ideal candidate for replication and further development

Netherlands: With a significant dairy sector and advanced agricultural practices, the Netherlands presents a conducive environment for adopting alternative fertiliser models. The country's focus on circular economy initiatives further supports this potential

Denmark: Denmark's commitment to sustainable agriculture and its robust dairy industry make it a promising region for implementing the TEAGASC model



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Preliminary replicability analysis across Europe



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Moderate Replicability Regions

Germany: While Germany has a substantial dairy sector, regional variations in regulations and agricultural practices may influence the replicability of the model

France: France's diverse agricultural landscape offers opportunities for adoption, particularly in regions with intensive dairy farming

Low Replicability Regions

Southern Europe (e.g., Spain, Italy, Greece): These regions have less intensive dairy industries and different climatic conditions, which may limit the applicability of the TEAGASC model without significant adaptations.



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TEAGASC conclusion



The TEAGASC lighthouse demonstration is a replicable and adaptable model aimed at validating and promoting alternative fertilisers from local organic sources. By combining scientific research, demonstration and farmer engagement, the model facilitates market adoption while generating essential knowledge for upscaling circular nutrient use solutions in agriculture.



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NOVAFERT LH Axarquía Sostenible (BIOAZUL)



1 Context and Description

Location: Algarrobo, Málaga, Andalusia, Spain

Products/Service: Reclaimed water used for fertigation (nutrient-rich municipal wastewater effluent)

Main crops: Avocado, Mango, Passion Fruit, Dragon Fruit

Main driver: Water scarcity + Fertiliser use reduction + Environmental protection

TRL: 9 (market-ready technology)

2 Business Channels

Direct provision of reclaimed water for fertigation to local farms.

Partnerships with irrigation communities.

Pilot and demonstration services to showcase benefits for potential adopters.

Public-private collaborations with municipalities and WWTP operators.

Potential future channel: sale of "ready-to-use" fertiliser-enriched reclaimed water or service bundles.



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3 Customer Relationship Approach

Trust and safety focused → addressing public concerns about reclaimed water

Demonstration and communication → guided visits, technical datasheets, showcasing food safety and crop benefits

Co-creation and participative monitoring → involving farmers and other stakeholders directly in testing

Technical support → irrigation system advice, monitoring solutions



4 Key Partnerships

Municipal authorities and wastewater treatment plants (WWTP) → source of raw material

Farmers and irrigation communities → end-users and co-developers

Technology providers (e.g. sensors, DSS) → smart irrigation management, energy savers...

Regulatory bodies and health authorities → compliance and risk management

R&D and EU-funded projects (NOVAFERT, P2Green) → innovation and dissemination



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5 Supporting Activities

Management: project and stakeholder coordination, regulatory compliance management

Marketing: raising awareness, public acceptance campaigns, benefits communication

R&D: nutrient management optimisation, fertigation impact assessment

Technical services: design, installation and operation of tertiary treatments and irrigation infrastructure

Policy engagement: contribute to regulations harmonisation and local policy development

6 Market Penetration Strategies

Policy leverage: Using new EU Directives and national legislation (RD 1085/2024) as market enablers

Target water-stressed areas → replicability where water scarcity is severe

Promotion of economic and environmental benefits → lower fertiliser cost, secure water source

Pilot & scale approach → local demonstration + gradual scale-up

Cooperative schemes → through irrigation communities and municipal partnerships

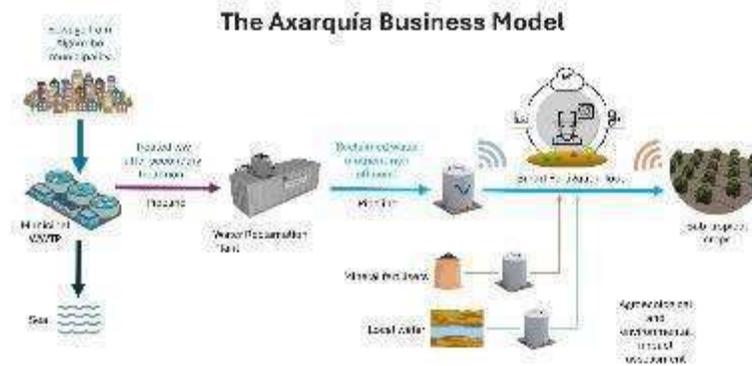


7 IP Strategy

Patents: Not a priority (process and concept mainly public and replicable)

Trademarks: Possible for commercialised reclaimed water services or nutrient water product

Design protection: For decision-support tools or bespoke fertigation system design



8 Scalability and Replicability

Conditions:

Proximity to WWTP

Investment in tertiary treatment and distribution

Willingness of farmers and irrigation communities

Supportive regulatory environment

Key stakeholders for replication:

Municipalities

WWTP operators

Farmer associations

Regional authorities



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NOVAFERT Integration with EIT Food Acceleration Programmes (Seedbed & FAN)



📍 Seedbed Incubator (pre-seed stage)

Fit for BIOAZUL / Axarquía Sostenible model: **PARTIAL** (at early replication stage)

Seedbed focuses on turning innovative ideas into market-validated propositions. Since BIOAZUL already has a mature lighthouse and operational system (TRL 9), the core model itself is **beyond Seedbed scope**.

However, Seedbed **could be highly useful in regions where replication is at ideation/early stage**:

- New stakeholders (e.g., WWTP operators + farmer groups) could jointly develop business cases in new regions.
- Startups could emerge around local service provision (e.g., nutrient water management as a service, tech add-ons).

Seedbed relevance → for new market entry, localisation and tailoring to specific geographies.

🚀 Suggested pathway:

- **Seedbed (where new areas need localised models and stakeholder engagement)** → e.g. regions in Northern Europe with no reclaimed water services yet.
- **FAN (where mature solutions can be commercialised and scaled up)** → e.g. Southern Europe + other water-scarce areas.

📍 Food Accelerator Network (FAN) (growth/scale stage)

Fit for BIOAZUL / Axarquía Sostenible model: **STRONG** (for scaling in water-scarce regions)

FAN is ideal to scale validated businesses with market traction:

• BIOAZUL could use FAN to:

- Develop a **pan-European commercialisation and scaling plan**.
- Establish **strategic partnerships with food sector players and municipalities**.
- Build capacity and get mentorship on scaling up reclaimed water solutions in food production.
- **Address public perception, regulatory marketing and scaling challenges** (key barriers identified).

FAN relevance → for scale-up, market reach and business consolidation in multiple EU markets.



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Preliminary replicability analysis across Europe



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1 Southern Europe (VERY HIGH replicability)

Countries: Spain (other regions), Italy, Greece, Portugal

Why:

- High water scarcity
- Sub-tropical and Mediterranean crops
- Growing pressure on freshwater resources
- Farmers familiar with fertigation

Replication enablers:

- Existing WWTP infrastructure
- Need for circular water reuse policies (EU alignment)



2 Eastern Europe (MEDIUM replicability)

Countries: Bulgaria, Romania, Hungary

Why:

- Agriculture + water stress combination (summer droughts)
- Lower acceptance and limited tertiary treatment capacity

Replication enablers:

- EU funding possibilities
- Growing need for sustainable water use in agriculture

Barriers:

- Less developed water reuse culture



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Preliminary replicability analysis across Europe



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3 Northern and Western Europe (LOW to MEDIUM replicability)

Countries: Netherlands, Belgium, Denmark, Germany, UK

Why:

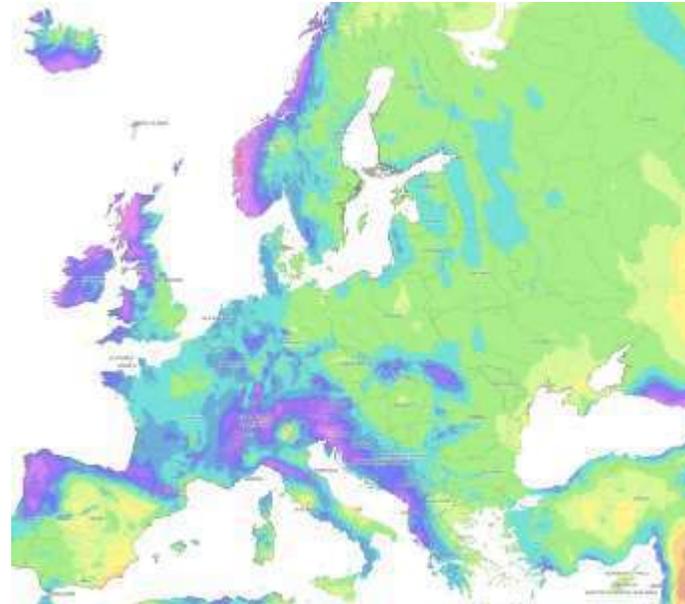
Generally higher water availability → lower immediate need
Strong environmental regulations → possible niche adoption in specific areas (e.g. greenhouse horticulture, dry summers)

Replication enablers:

Innovation-friendly markets
Strong public and private cooperation models

Barriers:

Public perception
Regulatory and market acceptance



4 South-Eastern and Mediterranean border regions (HIGH replicability in the mid-term)

Countries: Cyprus, Malta, Southern France, coastal Croatia

Why:

Extreme water stress + growing pressure for alternative water sources

EU support and legislation (reuse targets)

Replication enablers:

EU Water Reuse regulation + national policies
High need for diversification of water sources



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AXARQUIA conclusion



The Axarquía Sostenible model demonstrates **high potential for replication**, particularly in **Southern Europe** where water scarcity and agricultural demands align closely with the model's benefits. Eastern Europe presents opportunities with appropriate investments in infrastructure. Western and Central Europe can adopt the model in regions facing localized water stress, leveraging existing facilities. Northern Europe, while less in need, may consider implementation for environmental sustainability goals.



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NOVAFERT LH UVIC and FERTINAGRO (Blood Hydrolysate Fertilisers)



1 Context and Description

Location: Spain (Catalonia)

Products/Service:

Production and application of blood hydrolysate-based fertilisers (Superbia, Superaminopot, Superaminophos-K) derived from animal by-products (industrial waste from the meat industry) in liquid and solid formulations.

Application:

Can be used across all crop types via fertigation. Demonstrated reduction of mineral fertiliser use and improved crop performance.

Main driver:

Valorisation of animal by-products, reduction of mineral fertiliser dependence, improved soil health and increased crop productivity/quality.

TRL: 8–9 (Products commercially available in Spain, pending EU recognition for CMC inclusion)



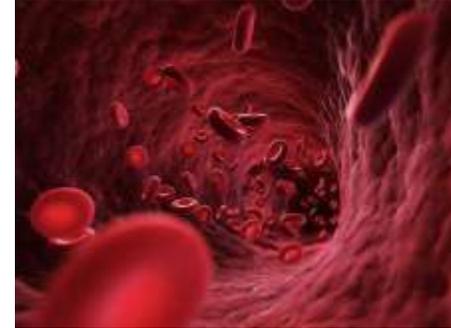
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NOVAFERT LH UVIC and FERTINAGRO (Blood Hydrolysate Fertilisers)



2 Business Channels

- **Direct sale of fertilisers (liquid and solid)** → to farmers, cooperatives, and distributors.
- **Integration with mineral fertilisers** → hybrid formulations.
- **Partnerships with irrigation and fertigation solution providers** → integrated use.
- **Demonstration projects and trials** → to validate performance and raise awareness.
- **Agro-retail distribution and agronomy advisory channels.**



3 Customer Relationship Approach

- **Technical support and agronomic advisory services** → dosage, application timing and crop adaptation.
- **Demonstration and trials** → to prove benefits in productivity and harvest quality.
- **Training and awareness raising** → to overcome regulatory and acceptance challenges (especially use of animal by-products).
- **Relationship with distributors and cooperatives** → trusted local intermediaries.



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NOVAFERT LH UVIC and FERTINAGRO (Blood Hydrolysate Fertilisers)



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4 Key Partnerships

Meat processing industry → source of raw material (blood)

Farmers and cooperatives → end users

Agricultural distributors and retailers → sales channel

R&D partners (UVIC and others) → for validation and development

Regulatory authorities → to ensure compliance and support CMC inclusion process

5 Supporting Activities

Management: Sourcing, processing and logistics of blood hydrolysate fertilisers

Marketing and awareness: Promotion to end users and intermediaries.

R&D: Optimization of formulations and validation across crops and regions

Infrastructure management: Operating ABP (Animal By Product) processing facilities

Policy and regulatory engagement: CMC (Component Material Categories) recognition and market acceptance



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NOVAFERT LH UVIC and FERTINAGRO (Blood Hydrolysate Fertilisers)



5 Supporting Activities

Management: Sourcing, processing and logistics of blood hydrolysate fertilisers

Marketing and awareness: Promotion to end users and intermediaries

R&D: Optimisation of formulations and validation across crops and regions

Infrastructure management: Operating ABP processing facilities

Policy and regulatory engagement: CMC recognition and market acceptance

6 Market Penetration Strategies

Policy leverage: Inclusion of blood hydrolysate in EU Fertilising Products Regulation (CMC 10 processing ongoing)

Promotion of economic and agronomic benefits:

- Fertiliser cost savings

- Yield increases and improved harvest quality.

Targeting intensive and high-value crop segments:

- Where quality impacts and premium categories bring higher returns

Building farmer trust and acceptance:

- Addressing concerns on ABP use through trials and food safety demonstrations



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NOVAFERT LH UVIC and FERTINAGRO (Blood Hydrolysate Fertilisers)



7 Scalability and Replicability

Conditions for replication:

Proximity to meat processing facilities → fresh blood cannot be stored or transported long distances

Sufficient supply of raw material → industrial scale operation needed for profitability

Suitable agronomic and market conditions → high-value crops benefit most

Regulatory alignment → ABP acceptance and safety demonstration

Key stakeholders:

Meat processors

Farmers and cooperatives

Fertiliser distributors

Regulators and policy makers

Infrastructure needs:

ABP processing facility with acid handling, reactors and heat supply

Qualified technical staff

Distribution and sales infrastructure



8 IP Strategy

Patents: Not specified. Possible for processing technologies

Trademarks: Product brands (Superbia, Superaminopot, Superaminophos-K)

Design protection: Possible for product formulations and combined products



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NOVAFERT Integration with EIT Food Acceleration Programmes (Seedbed & FAN)

Seedbed Incubator (pre-seed / early stage)

Suitability: Moderate to high (for new regional markets and regulatory readiness)

The product and model are already commercialised in Spain but are **not yet fully validated across Europe** due to regulatory restrictions on the use of blood-based fertilisers (not yet part of EU recognised CMCs)

Seedbed is relevant in new EU countries and regions to:

Validate market needs and acceptance in different agricultural systems

Work with stakeholders (farmers, cooperatives, distributors) to co-design suitable fertilisation strategies

Navigate local/national regulatory and market frameworks in preparation for the full EU CMC approval

Seedbed relevance → Early market validation and regulatory readiness for new EU markets

Food Accelerator Network (FAN) (growth/scale stage)

Suitability: Very High (for scale-up post regulatory approval)

Once EU-wide regulatory approval is granted (when blood hydrolysate is officially recognised as a CMC), this model becomes a **ready-to-scale business**

FAN can support:

Pan-European market entry strategy across high-value crop sectors

Building commercial partnerships with fertiliser distributors, cooperatives and retailers

Large scale demonstration and awareness-raising campaigns

Overcoming public and buyer acceptance challenges (linked to ABP origin) through education and agronomic evidence

FAN relevance → Scale-up, market expansion and demand generation across Europe



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Preliminary replicability analysis across Europe

High Replicability Potential

Spain, France, Germany, Netherlands

- All have significant meat processing industries and existing ABP handling infrastructure.
- Modern agricultural sectors with intensive farming and fertigation practices.
- Circular economy and nutrient recycling are priorities in agricultural policy.

Drivers:

- ✓ Strong supply of raw material (blood).
- ✓ High-value crop segments.
- ✓ Good regulatory alignment (once CMC recognition is granted).
- ✓ Advanced fertilisation markets open to innovative solutions.

Moderate Replicability Potential

Poland, Denmark, Italy

Presence of meat processing sector but:

- More fragmented supply chains
- Possible challenges linked to ABP perception
- In Italy, variability in farm structure and practices (northern intensive vs southern less intensive farming)

Drivers and Barriers:

- ✓ Possible local raw material availability
- ✓ Advanced horticulture in parts (e.g. Denmark, Northern Italy)
- ✗ Potential resistance to ABP use in fresh produce sectors
- ✗ Distance from slaughterhouses to application sites may be limiting



Low Replicability Potential

Eastern and Southern Europe (e.g. Greece, Bulgaria, Romania)

- Smaller meat processing industries
- Less advanced fertigation and intensive agriculture sectors
- Regulatory and public acceptance barriers likely higher

Drivers and Barriers:

- ✗ Limited raw material
- ✗ Lower intensity agriculture
- ✗ Greater acceptance challenges



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NOVAFERT LH UVIC and FERTINAGRO conclusion



The UVIC & FERTINAGRO model has **strong scale-up potential in countries with intensive agriculture and strong meat industries.**

EITFOOD and their programs as FAN will be key post-regulatory approval for rapid European scaling, while Seedbed can support market validation in regions with more complex acceptance or logistical challenges.



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NOVAFERT LH LUKE - Pirteä Porsas



1 Context and Description

Location: Vehmaa, Southwest Finland

Climatic zone: Boreal — avg. temp 6.2 °C, rainfall 675 mm

Model: On-farm anaerobic digestion (AD) of pig slurry; separation of solid and liquid fractions. Liquid fraction is used as a **replacement for mineral nitrogen fertilisers**, applied via a low-emission pipeline-based umbilical slurry spreading system.

Crops: Mainly cereals (barley, spring wheat, rye, winter wheat)

TRL: 8–9 (mature implementation, operating at scale with logistical infrastructure)

2 Business Channels

Direct use on shareholder fields (400–500 ha via slurry pipelines)

Umbilical slurry spreading technology replacing heavy machinery

Future potential: provision of fertiliser services to neighbouring farms (if permitted)



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NOVAFERT LH LUKE - Pirteä Porsas



3 Customer Relationship Approach

Internal use model: manure is valorised on fields owned by shareholders

Efficient logistics: reduced need for tankers; integrated infrastructure

Transparency and trust: enabled by traceable manure management and environmental benefit

4 Key Partnerships

Farm shareholders → own the land and benefit from nutrient application

Technology providers → digesters, slurry separators, pipelines, methane recovery

Municipalities and landowners → pipeline access permissions

Policy makers and environmental regulators → nitrate directive compliance and CAP support schemes



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5 Supporting Activities

Manure separation and treatment: digester, storage tanks, pumps

Infrastructure management: deep-buried pipelines, outlets, methane recovery

Nutrient application logistics: optimised via fixed infrastructure

R&D and optimisation: improving separation ratios, nutrient efficiency

Sustainability monitoring: tracking GHG savings and fertiliser substitution

6 Market Penetration Strategies

Optimise logistics and infrastructure for low-traffic, low-loss nutrient delivery

Promote methane recovery and substitution of fossil energy

Highlight compliance with nitrate limits through nutrient management precision

Extend services to nearby farms or cooperatives, contingent on access rights and regulations

Use sustainability and fuel savings as a selling point for replication

7 IP Strategy

This is more an infrastructure and operations model than a product innovation. Therefore:

Patents: Not directly applicable

Know-how: Valuable operational knowledge (separation, slurry handling, pipeline logistics)

Design protection: Could apply to bespoke spreading system layouts



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8 Scalability and Replicability

Conditions for replication:

Access to sufficient manure and methane usage on-site

Availability of land for pipelines or agreement with neighbours/municipalities

Capital investment ability (pipeline: €50,000/km)

Medium to large-scale operations (economies of scale needed)

Key stakeholders for replication:

Farmers or cooperatives with significant livestock

Municipalities (permits for pipeline crossing)

Technology suppliers and agricultural engineers

Environmental authorities (regulation of nitrate, GHG credits, CAP alignment)

Infrastructure requirements:

Anaerobic digester and storage tanks

Manure separation system

Subsurface slurry pipeline with multiple outlets

Methane utilisation system (CHP, heating, or fuel)



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NOVAFERT Integration with EIT Food Acceleration Programmes (Seedbed & FAN)



Seedbed Incubator (Pre-seed / Early Stage)

Suitability: Moderate to High

While the core infrastructure of Pirteä Porsas Ltd is already established, the Seedbed Incubator can support:

Validation of market need: Assessing the demand for similar manure valorisation systems in other regions

Stakeholder engagement: Engaging with local farmers, municipalities, and regulators to understand regional needs and constraints

Business model adaptation: Tailoring the existing model to fit different regional contexts, considering variations in livestock density, land availability, and regulatory environments



Food Accelerator Network (FAN) (Growth/Scale Stage)

Suitability: Very High

The FAN programme can facilitate:

Scaling up operations: Expanding the model to other regions or countries with similar agricultural profiles

Commercial partnerships: Connecting with technology providers, agricultural cooperatives, and energy companies for collaborative ventures

Policy advocacy: Engaging with policymakers to promote supportive regulations for circular economy initiatives in agriculture



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Preliminary replicability analysis across Europe



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High Replicability:

• **Denmark, Netherlands, Germany:** These countries have intensive livestock farming, existing biogas infrastructure, and supportive policies for renewable energy and nutrient recycling.

Moderate Replicability:

• **France, Poland, Belgium:** Regions with significant livestock sectors but may require additional investment in infrastructure and regulatory adjustments.

Low Replicability:

• **Southern and Eastern Europe (e.g., Greece, Romania, Bulgaria):** Challenges include lower livestock densities, limited infrastructure, and varying regulatory frameworks.

Key Factors Influencing Replicability:

- **Availability of feedstock:** Sufficient quantities of manure or organic waste are essential.
- **Infrastructure investment:** Capital for anaerobic digesters, separation units, and pipeline systems.
- **Regulatory environment:** Policies supporting nutrient recycling, renewable energy, and sustainable agriculture.
- **Stakeholder engagement:** Collaboration with farmers, municipalities, and technology providers.



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NOVAFERT LH LUKE – Pirteä Porsas conclusion



Pirteä Porsas Ltd offers a mature, **climate-resilient circular business model** built around manure valorisation, nutrient efficiency, and emission reduction. While the model requires **significant infrastructure** investment and logistical coordination, it demonstrates strong benefits in terms of compliance, GHG reduction and operational sustainability — particularly in livestock-intensive regions.



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WEEK

EU Green Week Partner Event

ADVANCING CIRCULAR FERTILISERS: SOLUTIONS FOR A SUSTAINABLE AGRICULTURE



ADVANCING CIRCULAR FERTILISERS: SOLUTIONS FOR A SUSTAINABLE AGRICULTURE

Thank you for joining us!





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Advancing circular fertilisers: solutions for a sustainable agriculture

Pilar Zapata Aranda
BIOAZUL S.L.

Engaging stakeholders for regional action: overcoming barriers to circular fertilisers adoption

5th June 2025, The Square, Brussels



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Stakeholder engagement

What does the term “stakeholder engagement” refer to?

A structured and inclusive process to involve all relevant actors—researchers, practitioners, policymakers, industry, and civil society—across the project lifecycle, ensuring that diverse perspectives enhance the relevance, uptake, and long-term impact of the project outcomes.





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Stakeholder engagement

What does “stakeholder engagement” refer to in the context of NOVAFERT project?



Objective:

Build lasting, cross-sectoral connections to promote the use and uptake of alternative fertilisers.



Key Actions:

- **Create a Multi-Actor Network**

Farmers, experts, producers, water operators, advisors, consumers, authorities, researchers, and NGOs.

- **Establish Regional Working Groups**

Consortium members collaborate locally to implement and disseminate project activities.

- **Promote Cross-Border Exchange**

Meetings between regional actors from different countries to share lessons learned and success stories.

- **Encourage Long-Term Knowledge Flow**

Sustained interaction between research, innovation, civil society, and public authorities—beyond the project duration.



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Stakeholder engagement

Activities foreseen in NOVAFERT project



Overall Objectives:

- Foster uptake of alternative fertilisers by engaging key stakeholders (local to EU level).
- Create synergies with Operational Groups, Thematic Networks, Focus Groups, and other EU/national initiatives.
- Ensure sustainable exploitation of project outcomes beyond its duration.
- Promote NOVAFERT during its full lifespan and widely disseminate results.



Expected Outcomes:

- Increased adoption of alternative fertilising products.
- Strengthened regional and EU-wide networks.
- Replicable co-creation methodologies.
- Greater visibility and usability of NOVAFERT results.
- Long-term sustainability through synergy-building and knowledge transfer.



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Stakeholder engagement

Activities foreseen in NOVAFERT project



Key Activities:

- **Stakeholder Mapping and consultation:**
 - Map and analyse stakeholders: farmers, advisors, industry, authorities, civil society, etc.
 - Define tailored engagement strategies.
- **Regional Working Groups (RWGs):**
 - Establish 7 RWGs (1 RWG/region) across Europe to support the Regional Action Plan co-creation.
 - Establish links with existing initiatives.
- **Participatory regional workshops:**
 - Organise 3 workshops/region.
 - Raise awareness, build knowledge, co-create solutions.
- **International workshops**
 - Organise 4 workshops on key themes (LCA, policy, innovation, etc.).
 - Leverage platforms like ESNI, ManuREsource, ESPC.



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Stakeholder engagement

Regional Working Groups



A **Regional Working Group (RWG)** is a collaborative team, comprised of different types of stakeholders, that focuses on addressing issues within a specific geographic area. These groups aim to share information, develop strategies, and coordinate actions related to a particular topic or project.

Key Features:

- **Collaboration:** They bring together diverse perspectives and expertise to tackle regional challenges.
- **Coordination:** They facilitate communication and alignment among different stakeholders.
- **Action-Oriented:** They aim to translate discussions and plans into concrete actions.

RWG structure and composition:

Based on the **Quadruple Helix Model:**

 *Science* |  *Policy* |  *Industry* |  *Society*

This approach ensures co-creation with end-users and boosts innovation acceptance.

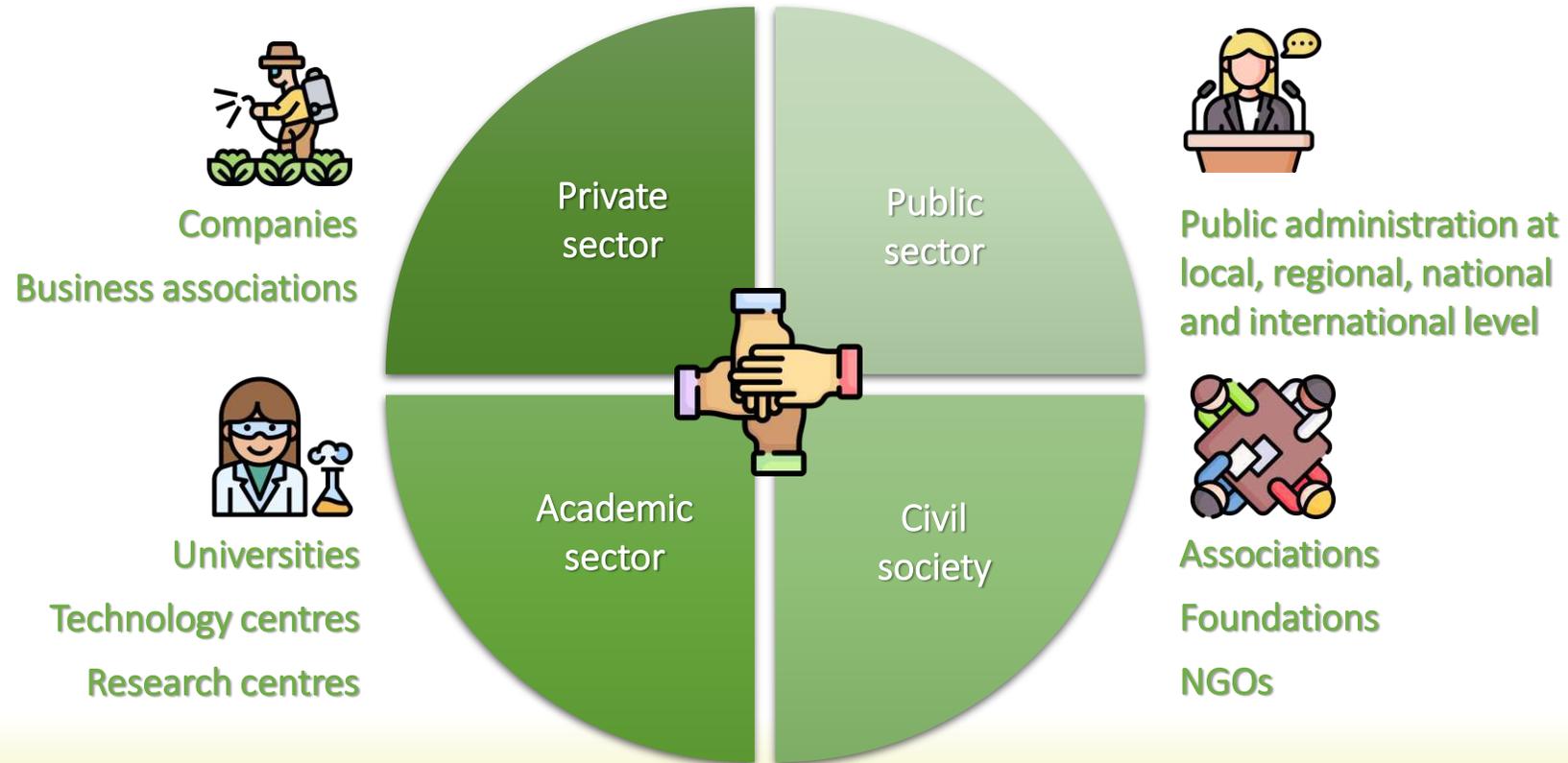
Each RWG tailors participation to local contexts and relevant nutrient sources, ensuring balanced representation across the four helixes.



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Stakeholder engagement

Quadruple Helix Model of Innovation





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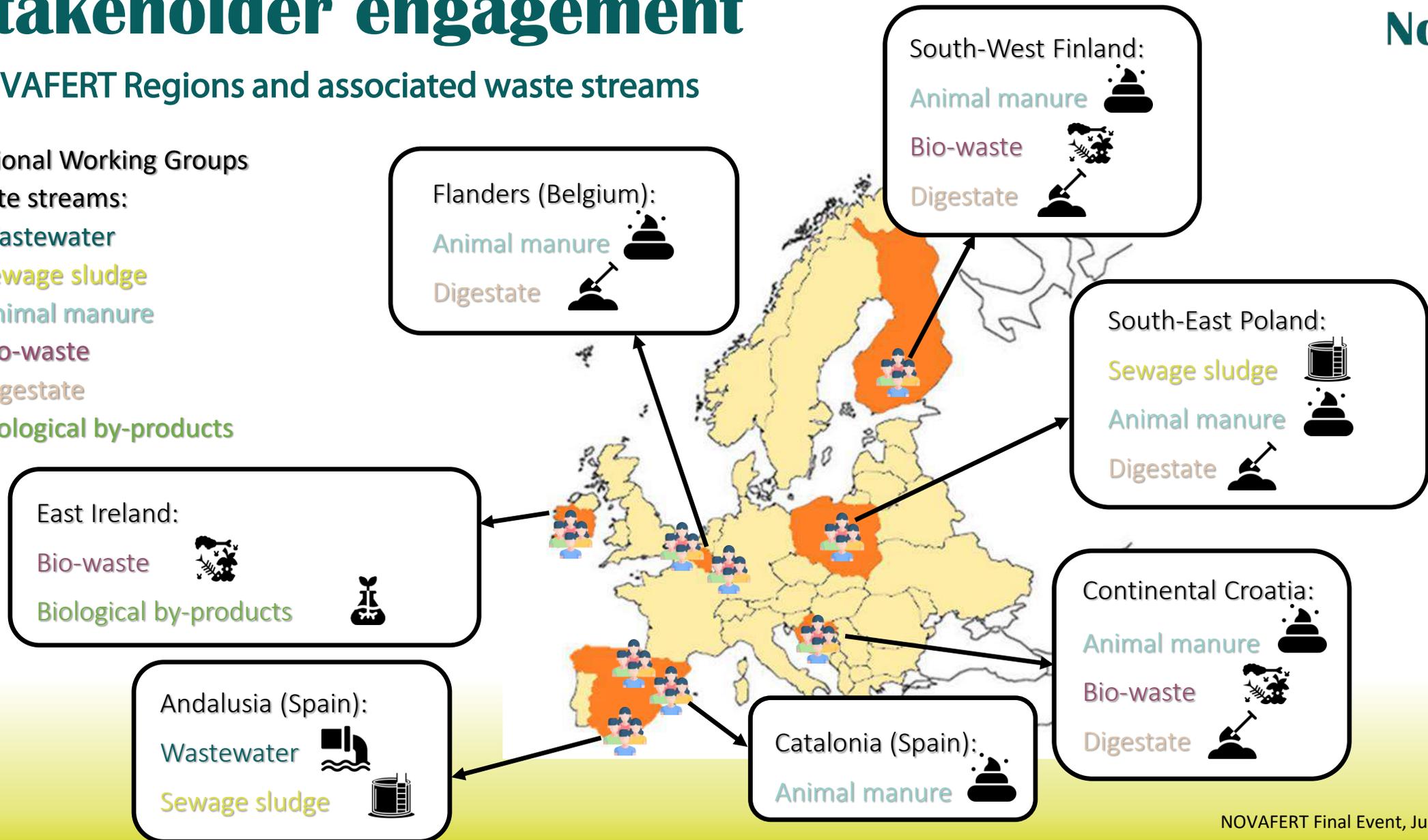
Stakeholder engagement

NOVAFERT Regions and associated waste streams

7 Regional Working Groups

6 waste streams:

- Wastewater
- Sewage sludge
- Animal manure
- Bio-waste
- Digestate
- Biological by-products





Stakeholder engagement

Main activities with the RWG: SWOT and PEST

What is a SWOT Analysis?

SWOT stands for **Strengths, Weaknesses, Opportunities, and Threats**.

It is a strategic planning tool used to:

- **Identify internal and external factors** that can impact a project, business, or initiative.
- **Support decision-making** by highlighting areas of advantage, potential improvement, external opportunities, and possible risks.





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Stakeholder engagement

Main activities with the RWG: SWOT and PEST



In the context of **NOVAFERT**, the **SWOT Analysis** is a strategic tool used to evaluate **regional conditions** for the development and implementation of **alternative fertilising products**.

It helps identify:

Internal factors: related to the regional capacities, actors, and structures.

External factors: linked to the regulatory, economic, social, and technological environment.

Internal Factors:

- **Strengths:** Regional advantages that support the adoption of alternative fertilisers.
- **Weaknesses:** Internal limitations or gaps within the region that hinder implementation.

External Factors:

- **Opportunities:** External drivers that can accelerate innovation and market uptake.
- **Threats:** Risks or barriers from the broader context (e.g. regulation, market resistance).

SWOT results feed into the **Regional Strategic Action Plans (RSAPs)** and support **stakeholder engagement** through the **Regional Working Groups (RWGs)**.



Stakeholder engagement

Main activities with the RWG: SWOT and PEST

Objective:

To identify regional success factors and barriers for the adoption of alternative fertilising products, focusing on:

- Economic context.
- Research & innovation potential.
- Market readiness and uptake.

Approach:

- Based on **regional analyses** covering legal, economic, social, environmental, and technological aspects.
- Combined with a **PEST analysis** (Political, Economic, Social, Technological) to assess external conditions.

Process:

- Attributes for each SWOT quadrant were co-developed with RWG members.
- Each attribute was **scored from 1 to 5** based on relevance.
- Results were visualised using **radar (spider) charts** for each region and SRM (Secondary Raw Material).
- Tool developed to ensure consistency and comparability across regions.

Added Value:

- Mix of **qualitative and quantitative** evaluation.
- Promotes **evidence-based strategic planning** for RSAPs.
- Ensures inclusion of **local perspectives** through RWG participation.



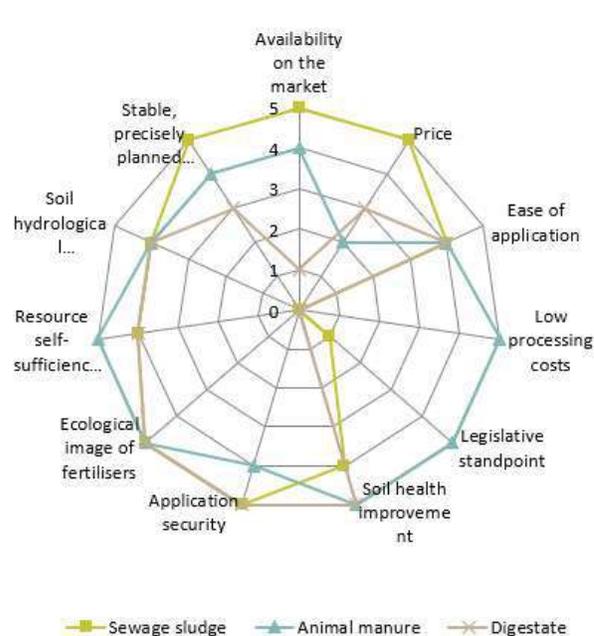
Stakeholder engagement

Main activities with the RWG: SWOT and PEST

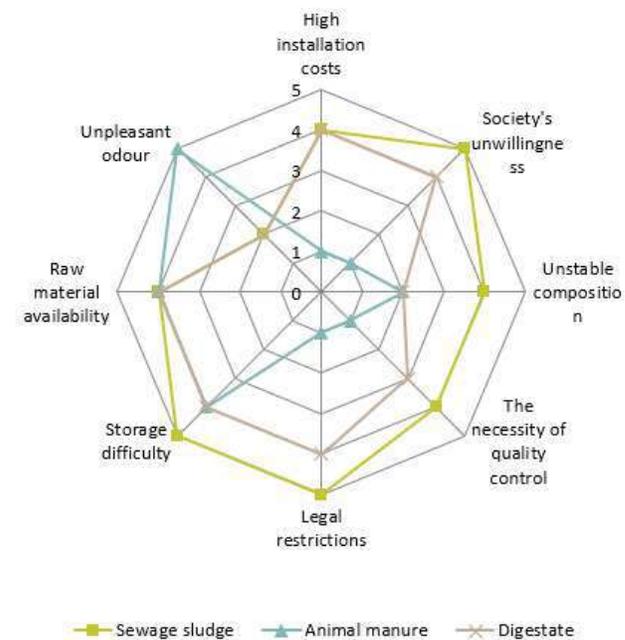
| No | Strengths Item | Explanation | Scoring for sewage sludge | Scoring for animal manure | Scoring for digestate |
|----|----------------------------|--|---------------------------|---------------------------|-----------------------|
| 1 | Availability on the market | In Poland, sewage sludge, digestate, and animal manure are available in the market. Poland has a well-developed wastewater treatment sector, which translates into the availability of sewage sludge. Animal manure is commonly used in agriculture in Poland, particularly in cereal crops and animal husbandry. Digestate, is also available in Poland, but on a smaller scale | 5 | 4 | 1 |
| 2 | Price | The price of fertilisers from secondary sources such as sewage sludge, animal manure and digestate in Poland is relatively low. The most expensive is fertiliser made from animal manure, followed by digestate and sewage sludge | 5 | 2 | 3 |
| 3 | Ease of application | The application of fertilisers derived from sewage sludge, digestate and animal manure is relatively easy in Poland and does not require advanced technology | 4 | 4 | 4 |
| 4 | Low processing costs | Processing costs are low for manure as opposed to sewage sludge and digestate | 1 | 5 | 1 |
| 5 | Legislative standpoint | From a legislative standpoint, the application of fertilisers derived from sewage animal manure is straightforward in Poland, unlike digestate and sewage sludge, where the procedures are complicated | 1 | 5 | 1 |
| 6 | Soil health improvement | Fertilisers from sewage sludge, digestate and animal manure enrich the soil by enhancing its nutrient content and improving microbial activity. They contain beneficial microorganisms, increase nutrient availability, and enhance soil structure | 4 | 5 | 5 |

Strengths matrix for South-East Poland region

Strengths



Weaknesses



Strengths and weaknesses radar diagrams for South-East Poland region



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Stakeholder engagement

Main activities with the RWG: SWOT and PEST

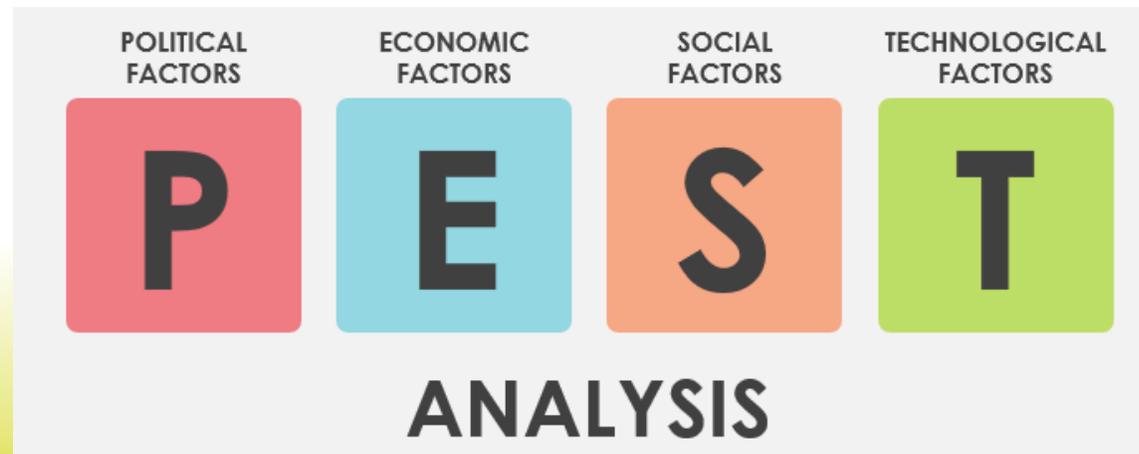
What is a PEST Analysis?

PEST stands for **Political, Economic, Social, and Technological** factors.

It is a widely used tool to assess **external macro-environmental factors** that can influence the success of innovations — in this case, **alternative fertilisers in agriculture**.

It complements **SWOT** analysis and supports **strategic planning** in each region.

The PEST analysis was developed in collaboration with RWGs and tailored to each region's context to support Region Specific Action Plan (RSAP) development.





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Stakeholder engagement

Link between SWOT and PEST analyses

In order to develop the PEST analysis, the **SWOT attributes** were grouped into two main categories:



Barriers to alternative fertilisers production and usage, described based on the weaknesses and threats from the SWOT.



Drivers of alternative fertilisers production and usage, described based on the strengths and opportunities from the SWOT.

These **Barriers and Drivers** were then further **classified** into four categories (the PEST dimensions):

- **P – Political:** Regulations, policies, trade laws, and political stability.
- **E – Economic:** Growth rates, inflation, unemployment, market trends.
- **S – Social:** Cultural factors, education, lifestyle, consumer behaviour.
- **T – Technological:** Innovation, R&D activity, access to and adoption of new technologies.

This process allowed the construction of the **PEST analysis** based on real, regional insights gathered through the SWOT.



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Stakeholder engagement

Main activities with the RWG: Regional Specific Action Plan (RSAP)

What is an Action Plan?

A structured document defining **objectives, results, and actions** to foster, in the case of NOVAFERT project, the use of **alternative fertilisers from 6 waste streams in 7 EU regions**.



7 Regional Specific Action Plans have been developed (one per target EU region).

They include **concrete, region-specific actions** to overcome barriers and **promote the use of alternative fertilisers** in agriculture.

Based on:

- NOVAFERT regional analyses.
- Collaboration within the NOVAFERT consortium.
- Work of the Regional Working Groups.
- Participatory workshops.

Aim to **transfer lessons learned across regions to boost the uptake of alternative fertilisers EU-wide**.



Stakeholder engagement

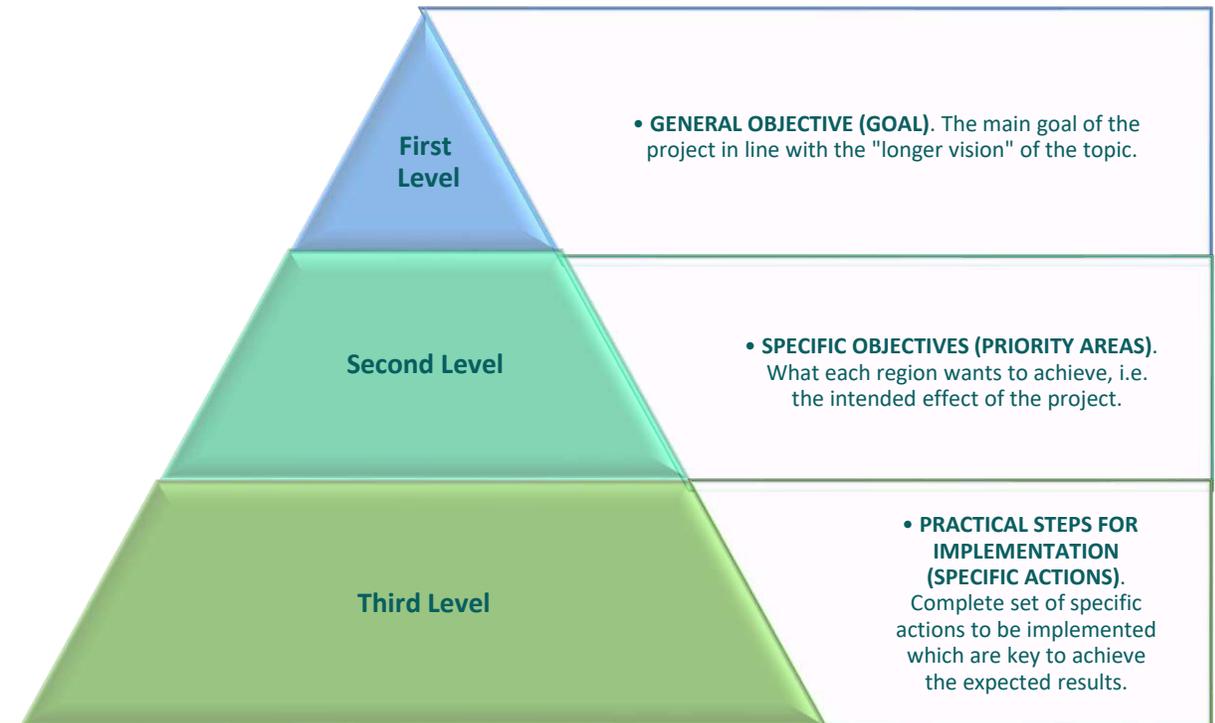
Main activities with the RWG: Regional Specific Action Plan (RSAP)

The RSAPs are structured according to the priority areas set out in the General Action Plan (GAP).

The GAP is structured in 3 different levels:

- 1. General Goal:** Demonstrate the technical, economic, and environmental feasibility and safe use of a broad range of alternative fertilising products made from recovered nutrients.
- 2. Priority Areas:** Define specific objectives to guide each region in developing its RSAP.
- 3. Implementation Steps:** Include concrete actions to be carried out in the short, medium, and long term.

This structure ensures that each RSAP is aligned with overall project goals while tailored to regional needs.



Levels for the development of a Regional Specific Action Plan



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Stakeholder engagement

Main activities with the RWG: Regional Specific Action Plan (RSAP)



Priority areas identified in the GAP:

These are the main areas/fields of the implementation strategy to achieve the general objective (first level). The priority areas selected are:

1. Legal Framework.
2. Political willingness.
3. Research and technological development.
4. New business models.
5. Financial incentives.
6. Self-sufficiency.
7. Public acceptance.
8. Environmental protection.



Stakeholder engagement

Main activities with the RWG: Regional Specific Action Plan (RSAP)

Defining Actions Within GAP Priority Areas

For each **priority area** identified in the General Action Plan (GAP), regions were asked to define **concrete actions** to be implemented. This process involved outlining **potential activities** and the **steps for implementation**, guided by the following questions:

- **What will we do?**

List of specific actions to be carried out. Actions should involve all relevant stakeholders.

- **How will we do it?**

Brief description of the steps required to implement each action.

- **When will it happen?**

Timeline for each step or action.

- **Who is responsible?**

Ideally, a specific individual or organization in charge of implementation.

- **Status of the action**

Indicate whether the action is *Completed*, *In Process*, or *Awaiting*.

- **Possible funding sources**

Identify internal or external resources available to support implementation.



Stakeholder engagement

Main activities with the RWG: Regional Specific Action Plan (RSAP)

| What we will do? <i>(This is a list of the actions you will take)</i> <i>Note: Actions should be identified for all users.</i> | How we will do it? <i>(This is a short description of the steps required to deliver the action)</i> | When is it being proposed? <i>(This is when each step will be taken)</i> | Who will be responsible? <i>(A named individual would ideally be responsible for the delivery of each action)</i> | Status <i>(The current point of contact.)</i> <i>Note: Completed / in Process / Awaiting</i> | Possible Funding Sources <i>(obtaining resources internally / externally)</i> |
|--|--|---|--|--|--|
| 1. Legal Framework | | | | | |
| National legislation complies with the European legislation on the use of Alternative Fertilisers | Step 1: Mapping of key national and European legislation. Step 2: Legal harmonisation of the national and regional framework. Step 3: Coordination within national and regional administrations. | Month/Year | XXXX | | Simple application new recycling bins from local authority. Time costs of talking to supply chain. |
| 3. Research and technical development | | | | | |
| 4. New business models | | | | | |
| 5. Financial incentives | | | | | |
| Public administration provides economic incentives to farmers that use alternative fertilisers | Step 1: Developing awareness campaigns to promote alternative fertilisers, contributing to the EU strategy "Farm to Fork" at the local and regional levels. Step 2: Creating a set of National, regional, and/or local taxes bonification/exemptions. Step 3: Developing preferential financing options for alternative fertiliser infrastructure. | Month/Year | XXXX | | Simple application new recycling bins from local authority. Time costs of talking to supply chain. |
| 6. Self sufficiency | | | | | |
| 8. Environmental protection | | | | | |



Stakeholder engagement

Main activities with the RWG: Regional Specific Action Plan (RSAP)

| What will we do? | How will we do it | When is it being proposed? | Who will be responsible? | Status <i>(Completed / In Process / Awaiting)</i> | Possible Funding Sources |
|---|---|----------------------------|---|--|--|
|  Priority area 1: Legal Framework | | | | | |
| Uptake of nutrient recycling subsidy for enhancing the use of manure-based nutrients. | <ol style="list-style-type: none"> 1. Mapping of nutrient sources in the region for producing the alternative fertilisers. 2. Producing tailor made alternative fertilisers according to regional crop requirement. 3. Demonstrating the use of alternative fertilisers and showcasing their efficiency for the whole value chain. | From 2025. | Policy makers, farmers union and farmers. | <i>In Process</i> | H2020 and HORIZON EU projects. |
|  Priority area 2: Political Willingness | | | | | |
| Demonstrating environmental benefits when substituting mineral fertilisers with alternative ones. | <ol style="list-style-type: none"> 1. Collaboration with policy makers to provide information about soil P status in agricultural fields and consequence for P losses. 2. Demonstrate agronomic efficiency of alternative fertilisers. 3. Disseminate results of alternative fertilisers for different stakeholders. | 2024-2025. | Researchers (mainly LUKE). | <i>In Process</i> | National funding schemes, H2020 and HORIZON EU projects. |



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Stakeholder engagement

Main activities with the RWG: Participatory workshops

As part of the NOVAFERT initiative, **three participatory workshops** have been held in **each of the 7 target EU regions** to:

- **Engage and consult stakeholders.**
- **Present the project and its objectives.**
- **Gather feedback and foster collaboration.**
- **Build a broader Community of Practice** around alternative fertilisers.



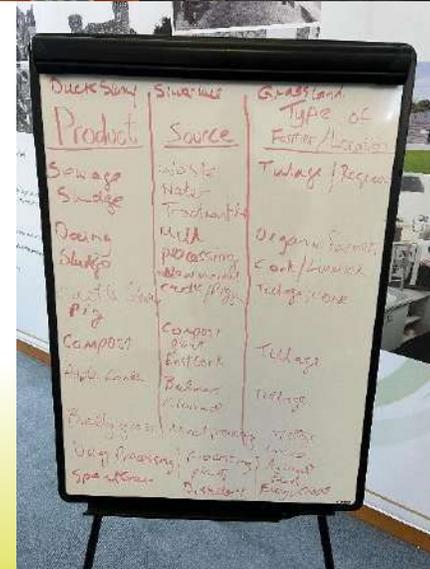
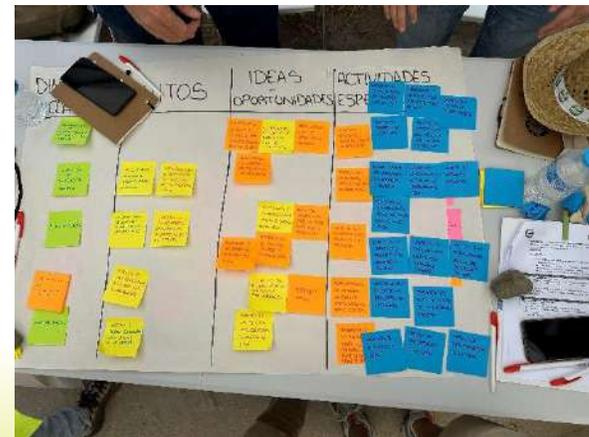
Organised by regional partners and attended by the RWG members, as well as other relevant actors, these workshops were tailored to each region's specific waste streams and aimed to attract a **multidisciplinary audience** (target: ≥ 50 participants per event). In the long term, the communities created are aimed to serve as platforms for **co-creation, dialogue, and exchange of best practices** on nutrient recovery and reuse.



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Stakeholder engagement

Main activities with the RWG: Participatory workshops





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Stakeholder engagement

Main conclusions

The activities carried out—such as the **SWOT and PEST analyses**, the creation of **RWGs**, and the organisation of **participatory workshops**—have played a **fundamental role** in shaping a strategic, inclusive, and regionally grounded approach to foster the use of alternative fertilisers.

These actions have:

- **Identified key barriers and drivers** at both local and systemic levels.
- Enabled **stakeholder engagement** and co-creation of knowledge.
- Informed the development of **tailored Regional Specific Action Plans (RSAPs)**.
- Promoted a **shared vision and commitment** among regions and actors.

Together, they lay a solid foundation for advancing sustainable fertiliser practices, enhancing circularity in agriculture, and contributing to long-term environmental, social, and economic resilience across Europe.



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Thank you for your attention

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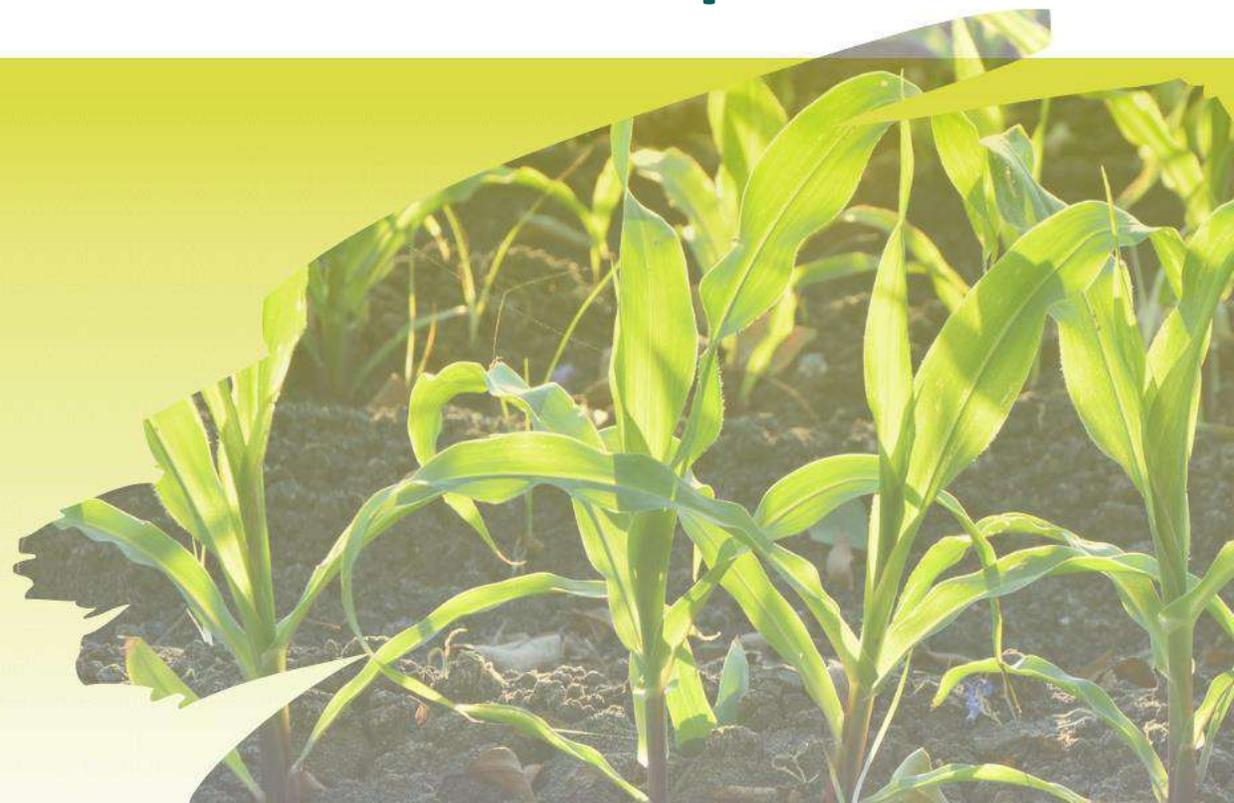
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Recommendations to enhance market adoption

Ana-Marija Špicnagel

IPS Konzalting

05/06/2025



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Introduction



Conventional fertilisers

- Rely on **finite**, often imported raw materials
- Production processes are resource and **energy-intensive**
- **Rapid nutrient release** can mismatch with plant uptake timing
- Environmental issues like **runoff and nutrient loss**

Why are alternative fertilisers important?

- Alternative fertilisers **support sustainable agriculture** by utilising locally available secondary raw materials, thereby reducing dependence on imports.
- They contribute to **nutrient loop closure** and the reduction of greenhouse gas emissions.
- Their application **improves** soil quality, enhances water retention, and reduces nutrient losses.

Key challenges for Market Adoption



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- **Lack of knowledge and trust** in the efficiency of BBFs compared to mineral fertilizers
- **Incomplete logistics networks** and limited product availability in local markets
- **Non-existent or inconsistent regulation** and product standardization within the EU.



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T4.1 Industry analysis of the fertiliser market

| BBFs in Sustainable Agriculture | EU Fertilizers Market Analysis | Alternative Fertilizers | Industry Dynamics | Customer Segmentation & Strategies | Business Model Canvas |
|---------------------------------|--------------------------------|-------------------------|-------------------|------------------------------------|-----------------------|
|---------------------------------|--------------------------------|-------------------------|-------------------|------------------------------------|-----------------------|

- | | | | | | |
|--|---|--|--|--|---|
| ✓ Importance in addressing environmental and agricultural challenges | ✓ Current trends and challenges ✓ Impact of regulations on business operations | ✓ Market needs and demand ✓ Pros and cons of alternative fertilisers in agriculture | ✓ Identification of key players ✓ Competitive landscape and market concentration analysis | ✓ Behavioural analysis based on survey ✓ Effective marketing and product development strategies | ✓ Focus on customer relationships ✓ Strategies for building long-term partnerships |
|--|---|--|--|--|---|

✓ **A comprehensive analysis of the bio-based fertiliser industry** was carried out, focusing on both market dynamics and regulatory frameworks across Europe.

✓ **Surveys and stakeholder engagement** helped identify the preferences, barriers, and expectations of farmers, producers, and consumers regarding BBFs (6 countries, 150 responses)



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Behavioral analysis – two surveys



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What do farmers think about alternative fertilisers?

Take 2 minutes of your time to complete the survey, which is part of a European research project on new types of fertilizers in agriculture.

In return, you'll be among the first to know about new technologies for alternative fertiliser production.



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What do consumers think about alternative fertilisers?

Take 2 minutes of your time to complete the survey, which is part of a European research project on new types of fertilizers in agriculture.

In return, you'll be among the first to know about new technologies for alternative fertiliser production.





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What do farmers think about alternative fertilisers?

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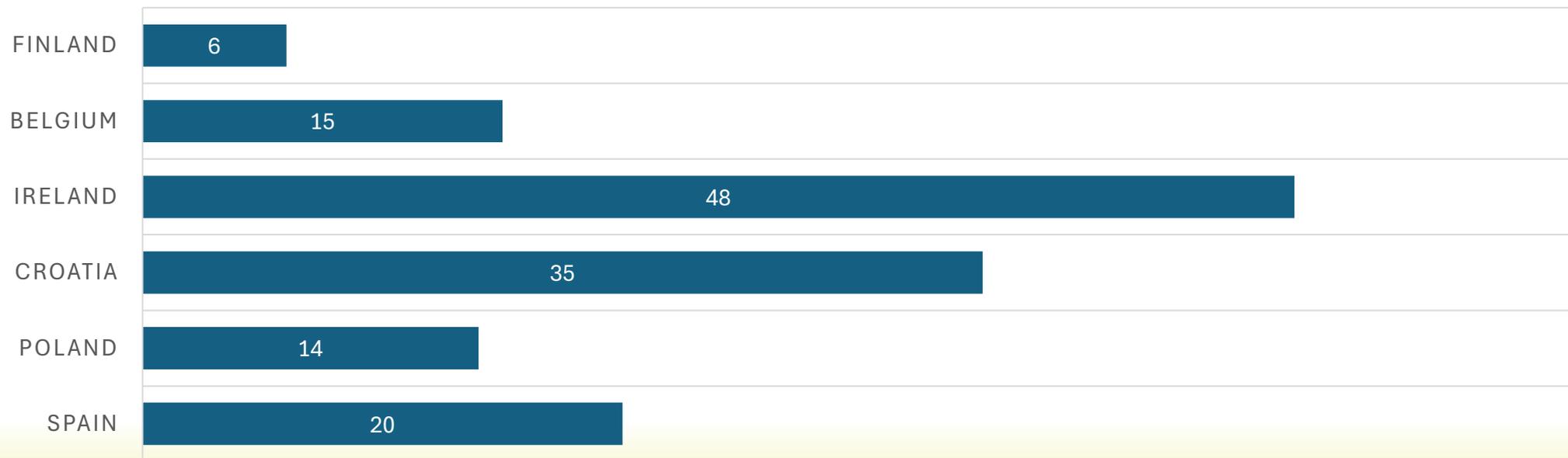
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„What FARMERS seek to find in novel fertilisers?“



Distribution of the survey along with our dedicated partners during communication activities (workshops, seminars) to collect as many responses as possible

RESPONSES COLLECTED



Survey results - FARMERS



What is the dominant sector in agricultural production on the farm?

Ireland: Crop production for livestock feed production (27,55 %)
Croatia: Crop production for livestock feed production (24,14 %)
Poland: Crop production for human consumption(55,00 %)
Finland: Crop production for human consumption(75,00 %)
Belgium: Crop production for livestock feed production (67,56 %)
Spain: Crop production for human consumption (66,67 %)

Are you interested in producing/using alternative fertilisers?

Ireland: interested in using (41,67 %)
Croatia: interested in using (34,29 %)
Poland: interested in using (36,67 %)
Finland: interested in producing (33,33 %)
Belgium: interested in producing (33,33 %)
Spain: Need more information (45,00 %)

Survey results - FARMERS



How much are you spending on fertilising products?

Ireland: 200-500 €/ha/year (41,67 %)
Croatia: < 200 €/ha/year (34,48 %)
Poland: < 200 €/ha/year (55,00 %)
Finland: 200-500 €/ha/year (75,00 %)
Belgium: 200-500 €/ha/year (52,35 %)
Spain: 200-500 €/ha/year (33,33 %)

What are the main factors that would help you decide to try out alternative fertilisers?

Ireland: Cost (87,56 %)
Croatia: Cost (65,52 %)
Poland: Cost (85,00 %)
Finland: Cost (89,55 %)
Belgium: Type of fertiliser (86,23 %)
Spain: Type of fertiliser (66,67 %)



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What do consumers think about alternative fertilisers?

Take 2 minutes of your time to complete the survey, which is part of a European research project on new types of fertilizers in agriculture.

In return, you'll be among the first to know about new technologies for alternative fertiliser production.



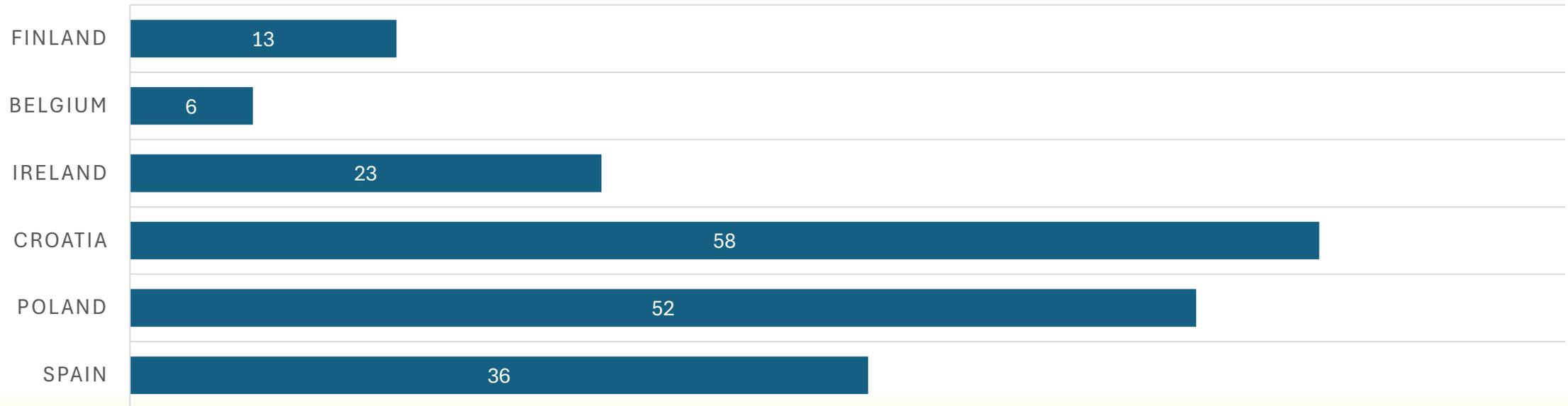
Novafert

Consumer survey: fertiliser market analysis



Distribution of the survey along with our dedicated partners during communication activities (workshops, seminars) to collect as many responses as possible

RESPONSES COLLECTED



Survey results - CONSUMERS



Where do you usually buy fertilisers?

Ireland: from a farm or cooperative (66,67 %)
Croatia: local stores (91,49 %)
Poland: local stores (79,92 %)
Finland: local stores (100 %)
Belgium: local stores (75,00 %)
Spain: local stores (75,00 %)

What is the most important factor when choosing a fertiliser?

Ireland: price (94,47 %)
Croatia: price (57,45 %)
Poland: price (70,83%)
Finland: nutrient composition (80,00 %)
Belgium: nutrient composition (75,00 %)
Spain: nutrient composition (64,29 %)

Survey results - CONSUMERS



Novafert

How much do you spend annually on organic fertilizer?

Ireland: 0-50 EUR (55,56 %)

Croatia: 0-50 EUR (57,45 %)

Poland: 50-100 EUR (33,33 %)

Finland: 0-50 EUR (90,00 %)

Belgium: 0-50 EUR (50,00 %)

Spain: 0-50 EUR (25,00 %)

Would you be willing to pay more for organic fertilizer if it comes from renewable sources?

Ireland: No (72,22 %)

Croatia: Yes (72,34 %)

Poland: Yes (64,58 %)

Finland: Yes (90,00 %)

Belgium: Yes (75,00 %)

Spain: Yes (85,71 %)

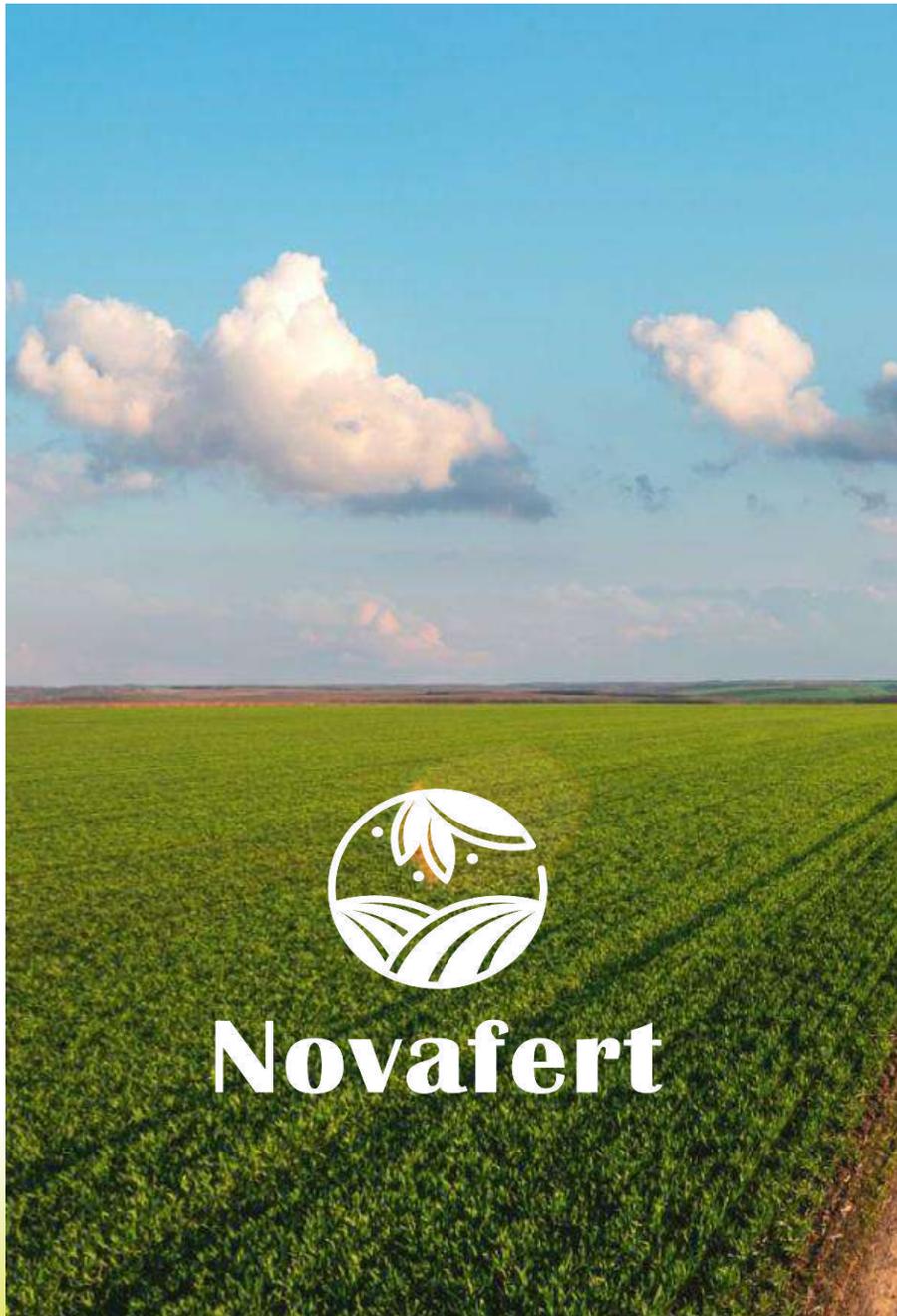


RECOMMENDATIONS

- ✓ **EDUCATION & AWARENESS**
- ✓ **REGULATORY SUPPORT**
- ✓ **DISTRIBUTION**
- ✓ **SEGMENTED APPROACH**
- ✓ **FOSTERING INNOVATION**

Education and awareness

- ✓ Launch well-structured, **multilingual communication campaigns** targeting different user groups (farmers, advisors, consumers).
- ✓ Use **demonstration farms** (Living Labs) to showcase real-world BBF application, effectiveness, and ease of use.
- ✓ Provide accessible and **evidence-based materials** (e.g., manuals, videos, digital tools) tailored to regional contexts.
- ✓ Highlight economic, agronomic, and environmental **benefits of BBFs in comparison to mineral fertilisers.**



Regulatory support

- ✓ Create a **central EU database** of approved BBFs and their specifications, accessible to producers and users.
- ✓ Integrate BBFs into the **Common Agricultural Policy (CAP)** eco-schemes and agri-environmental programs.
- ✓ **Harmonise standards and certifications** across the EU to reduce regulatory fragmentation and facilitate cross-border trade.
- ✓ **Promote collaboration** among regulatory authorities, research institutions, and industry to ensure policies are aligned with innovation.



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Distribution & accessibility

- ✓ Strengthen **cooperation with agricultural cooperatives** and local distributors to embed BBFs into existing input supply chains.
- ✓ Develop **short supply chain models** that reduce costs and improve product traceability from producer to farmer.
- ✓ Support the establishment of **regional distribution and storage centres for BBFs** to ensure consistent supply across rural areas.



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Segmented approach

- ✓ Tailor **strategies for different user groups**, recognising the diverse needs (smallholders, medium-sized farms, cooperatives, large agribusinesses).
- ✓ **Customise messaging to resonate with each group: emphasise** cost savings for large farms, soil health and sustainability for organic producers, and ease of use for smaller farms.
- ✓ Use segmentation insights from behavioural analysis to **prioritise outreach and living labs** where adoption potential is highest.
- ✓ Provide **practical use cases**, testimonials, and locally validated success stories for each user segment.



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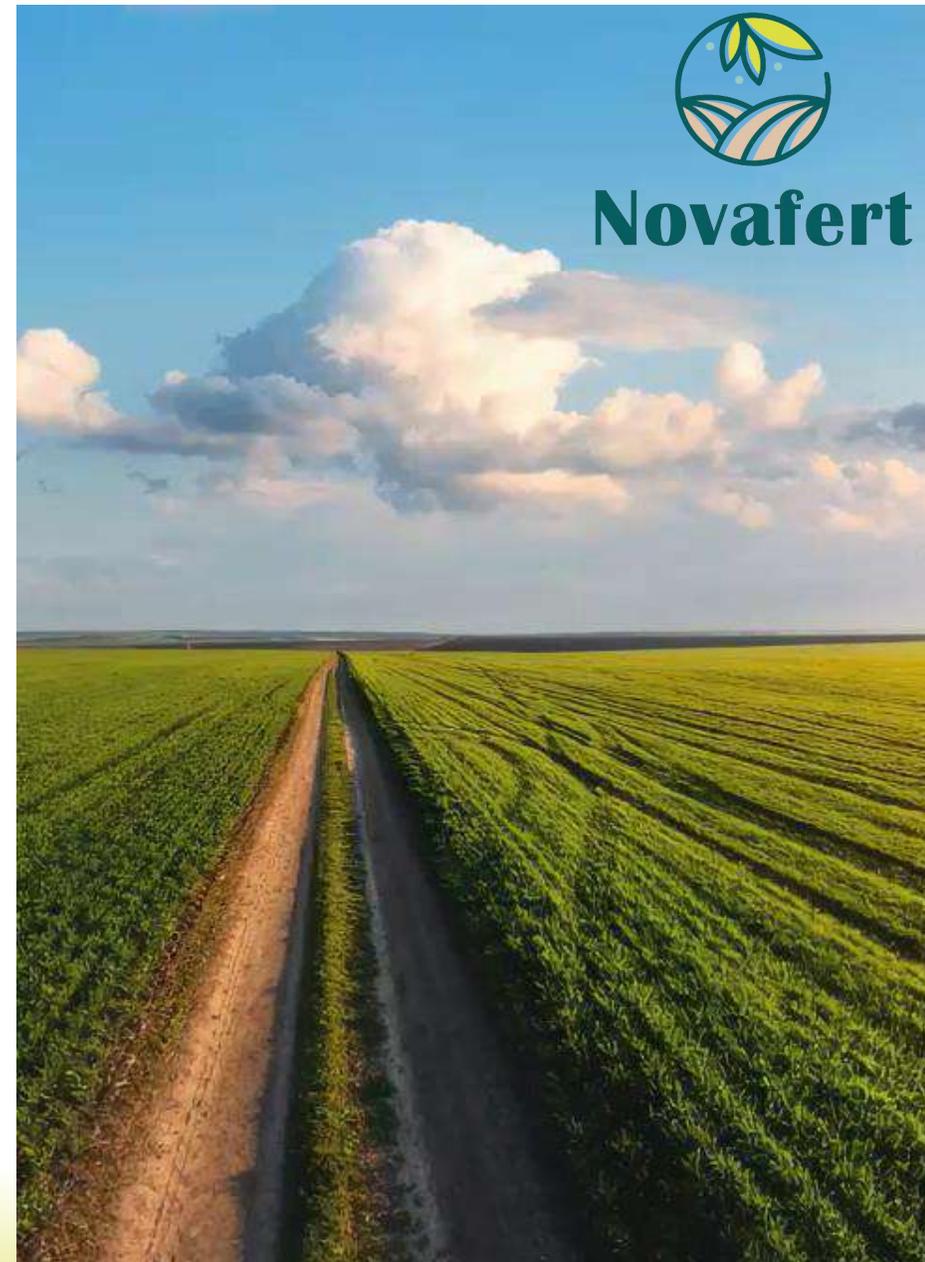
Long story short...

✓ **Key adoption factors:**

- ✓ product performance,
- ✓ affordability,
- ✓ certification

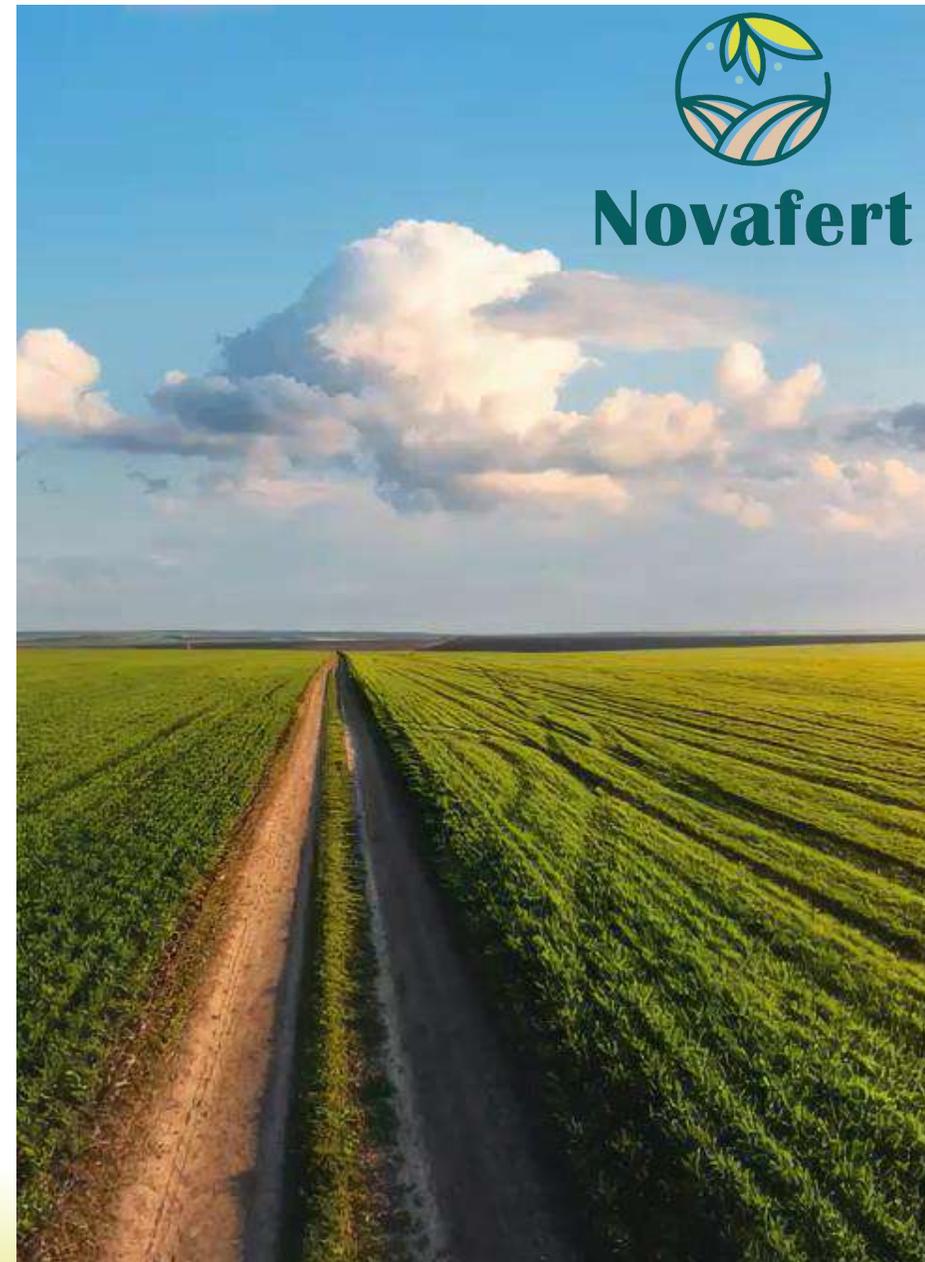
✓ **Main barriers:**

- ✓ fragmented supply,
- ✓ lack of regulation,
- ✓ limited field validation

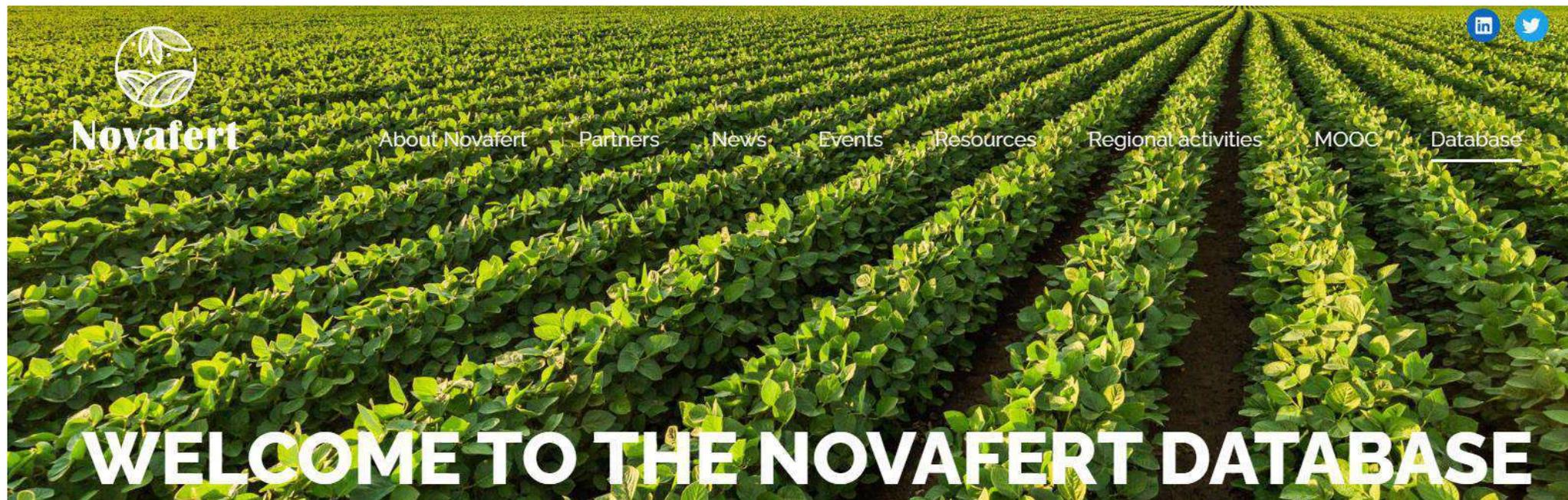


Long story short...

- ✓ **High interest** in BBFs among professionals and consumers shows strong adoption potential
- ✓ Many users are open to trying BBFs if **supported by advisors and incentives**
- ✓ **Targeted actions can accelerate adoption!**
 - ✓ education,
 - ✓ support,
 - ✓ availability



How NOVAFERT contributes?



The NOVAFERT [database](#) provides an extensive portrayal of the current state of affairs for several alternative fertiliser products.

The database includes data from 76 value chains derived from six secondary raw materials: treated manure, digestate, sewage sludge, wastewater, bio waste, and biological byproduct.

How NOVAFERT contributes?



NOVAFERT Massive Open Online Course

Discover the MOOC modules!





Novafert

Website: Novafert

Contact: ams@ips-konzalting.hr



Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.



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Showcasing the Novafert Atlas and database

Dónal Kinsella

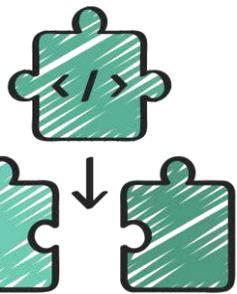
Teagasc

05/06/2025



Funded by the
European Union

Challenges and project motivation



Conventional fertilisers



- Finite, often imported, resources + energy-intensive
- Fast release of nutrients
- Crop nutrient uptake
- Soil leaching



Nutrients recovered from locally sourced secondary raw materials

- Biobased fertilizers are seeing as an alternative to replace mineral fertilizers
- Opportunity to reduce the environmental impact of fertilisers



Project aims

- To demonstrate **technical, economic, and environmental** feasibility and safe use of a wide portfolio of alternative fertilising products from different waste streams

To promote their use and increase the awareness of their benefits

Close the loop



NOVAFERT methodology- 1



Novafert

WP
1

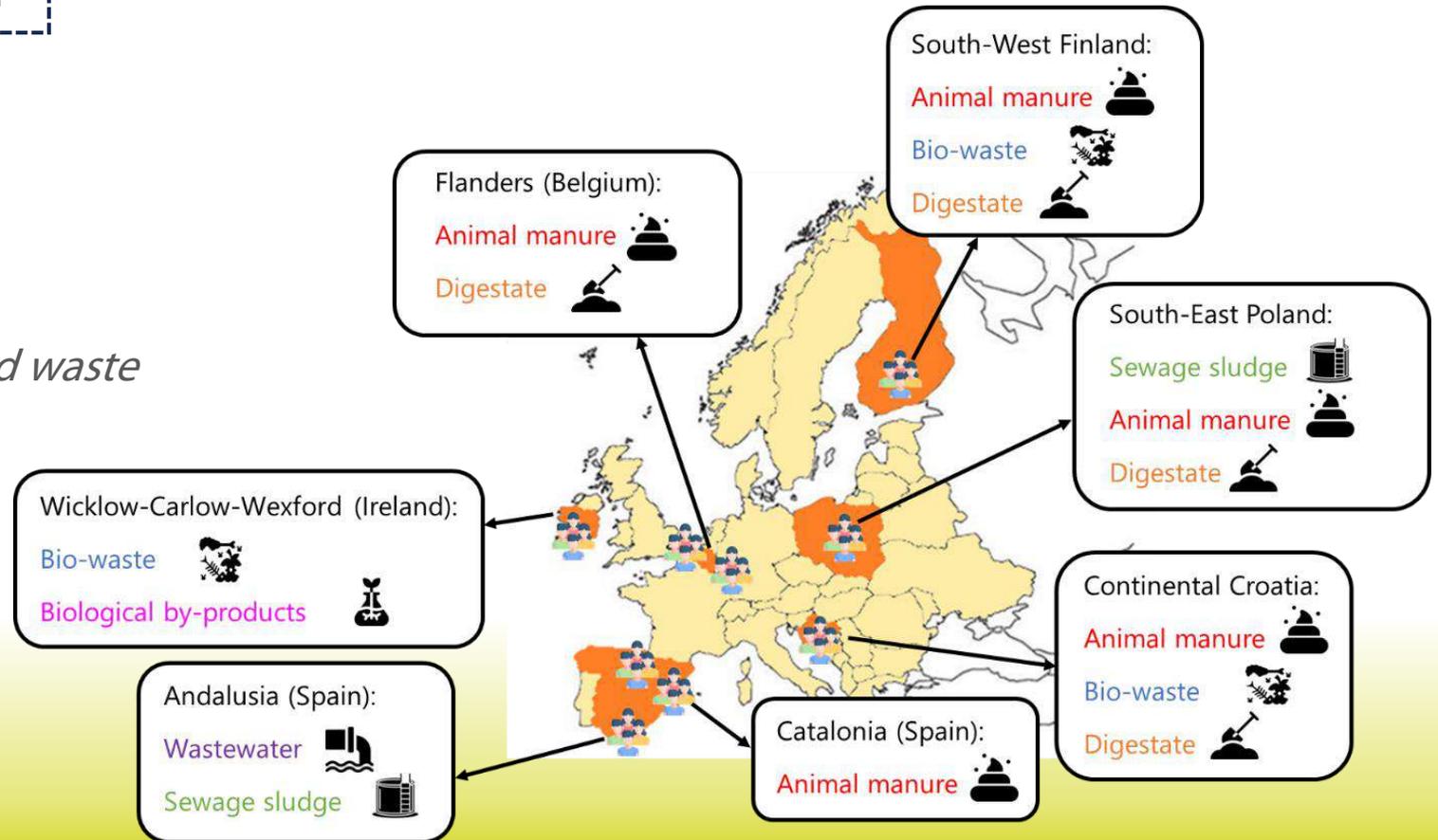
Products & technologies
mapping



Living labs
mapping



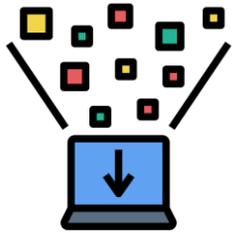
NOVAFERT regions and their associated waste streams



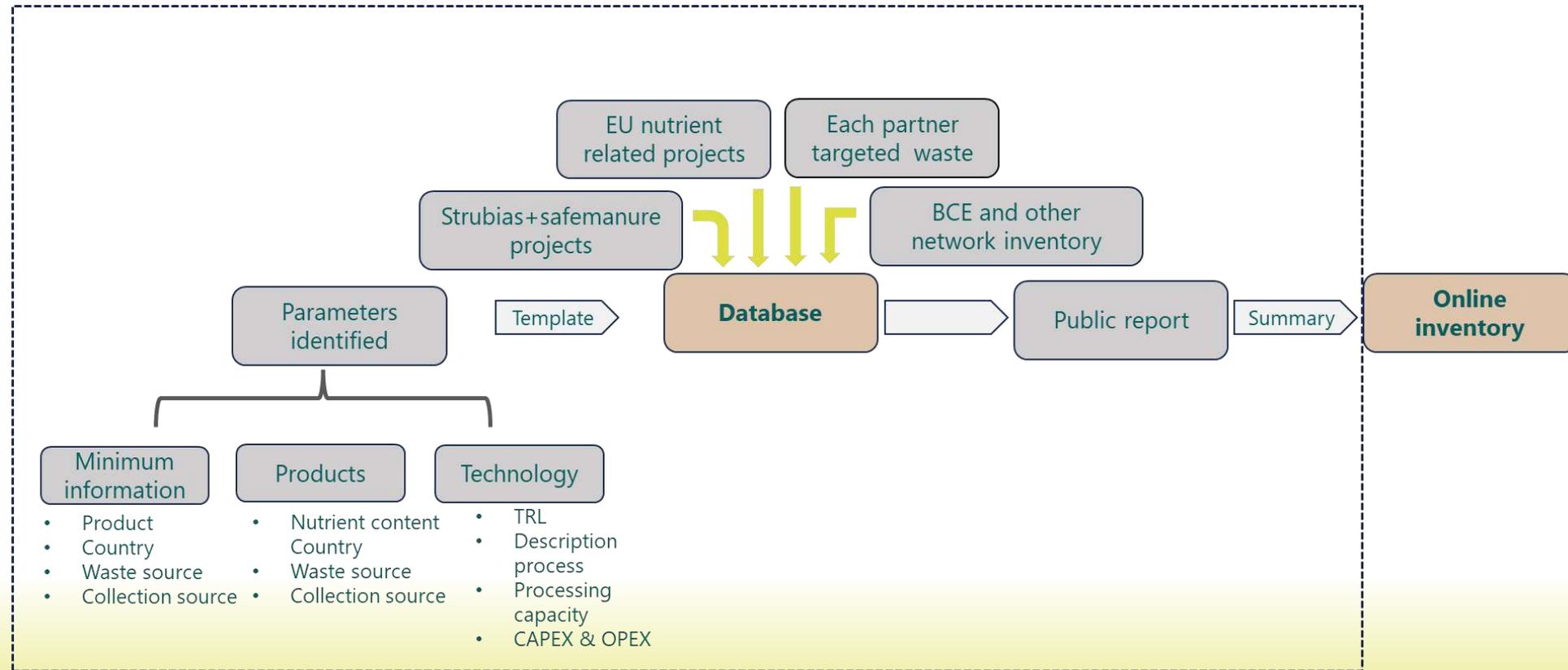


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NOVAFERT specific goals



- ✓ To map existing alternative fertilising products and technologies across Europe

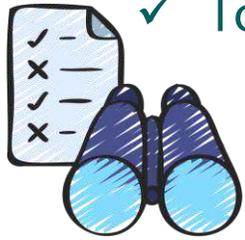


- treated manure**
- digestate**
- sewage sludge**
- wastewater**
- bio waste**
- biological byproduct.**



Novafert

NOVAFERT specific goals



✓ To map existing alternative fertilising products and technologies across Europe

Data collection of fertilising products derived from secondary raw materials

- ✓ Technology maturity and readiness level.
- ✓ Output material (product),
- ✓ Processing conditions
- ✓ Available CAPEX and OPEX: production costs
- ✓ Available legal status (regional/national/EU).



The NOVAFERT [database](#) provides an extensive portrayal of the current state of affairs for several alternative fertiliser products.

The database includes data from 76 value chains derived from six secondary raw materials: treated manure, digestate, sewage sludge, wastewater, bio waste, and biological byproduct.

The categorisation of the database takes following parameters into account:

The following primary categories were analysed:

- thermochemical nutrient recovery
- P precipitation
- physical-chemical nitrogen recovery
- biological nutrient recovery methods such as composting and anaerobic digestion

| Search | | Choose Product main category | Choose Technology main category | Choose Raw Material | 137 results | | | | | | | | |
|--------------------------|-------------------------------------|--|---------------------------------|------------------------|---------------|---|---|---------------------|--|-----------|-----------------------------|--|-----------------------------|
| Technology main category | Technology sub category | Product main category | Product sub category | Secondary raw material | Country | Production data | | | | Cost | | Considered as fertiliser in the national regulatory framework? | |
| | | | | | | Input material | Technology maturity and readiness level | Processing capacity | Process description | CAPEX | OPEX | | Market |
| 1 | Physical-chemical nutrient recovery | Compost, digestate & other bi. (See all) | Bio dried solid fraction | Treated manure | Spain | Pig slurry, solid fraction, post. (See all) | 2 | 0.5 - 0.5 t/year | The solid fraction of pig slat. (See all) | | | | Considered as animal manure |
| 2 | Physical-chemical nutrient recovery | Scrubber solution & mineral col. (See all) | Nutrient-rich concentrate | Treated manure | Spain | manure, Liquid fraction pig sl. (See all) | 2 | 1-2 t/year | The reverse osmosis products (See all) | | | | |
| 3 | Physical-chemical nutrient recovery | Scrubber solution & mineral col. (See all) | Mineral concentrate | Treated manure | Belgium | Pig manure, col. product | 9 | | Mineral concentrate's producer. (See all) | € 660 000 | 570 €/m ³ slurry | | Seen as animal manure |
| 4 | Thermochemical nutrient recovery | Biogas, Hydrochar & Ash | Ash | Treated manure | Spain/Finland | pig slurry, biokied solid fra. (See all) | 9 | 0.6 - 1.5 t/year | Biothermal drying (compostings). (See all) | | | | |



Available:



Novafert

Technology mapping

Primary technology categories

Physical- chemical nutrient recovery

- Physical separation
- Stripping + Scrubbing
- Membrane filtration

Biological nutrient recovery

- Composting
- Anaerobic digestion
- Microalgae technology

P precipitation

- Struvite precipitation
- CaP precipitation

Thermochemical nutrient recovery

- Pyrolysis
- Combustion
- Thermal drying
- Hydrothermal carbonisation

TECHNOLOGY

PHYSICAL - CHEMICAL NUTRIENT RECOVERY

BIOLOGICAL NUTRIENT RECOVERY

P PRECIPITATION

THERMOCHEMICAL NUTRIENT RECOVERY

PRODUCT

Ammonium salt, scrubber water & mineral nitrogen concentrates

Compost and digestate

Struvite, K-Struvite, Ca Phosphate, vivianite

Ash, biochar and bio-phosphate
Granular / pelletised & powder

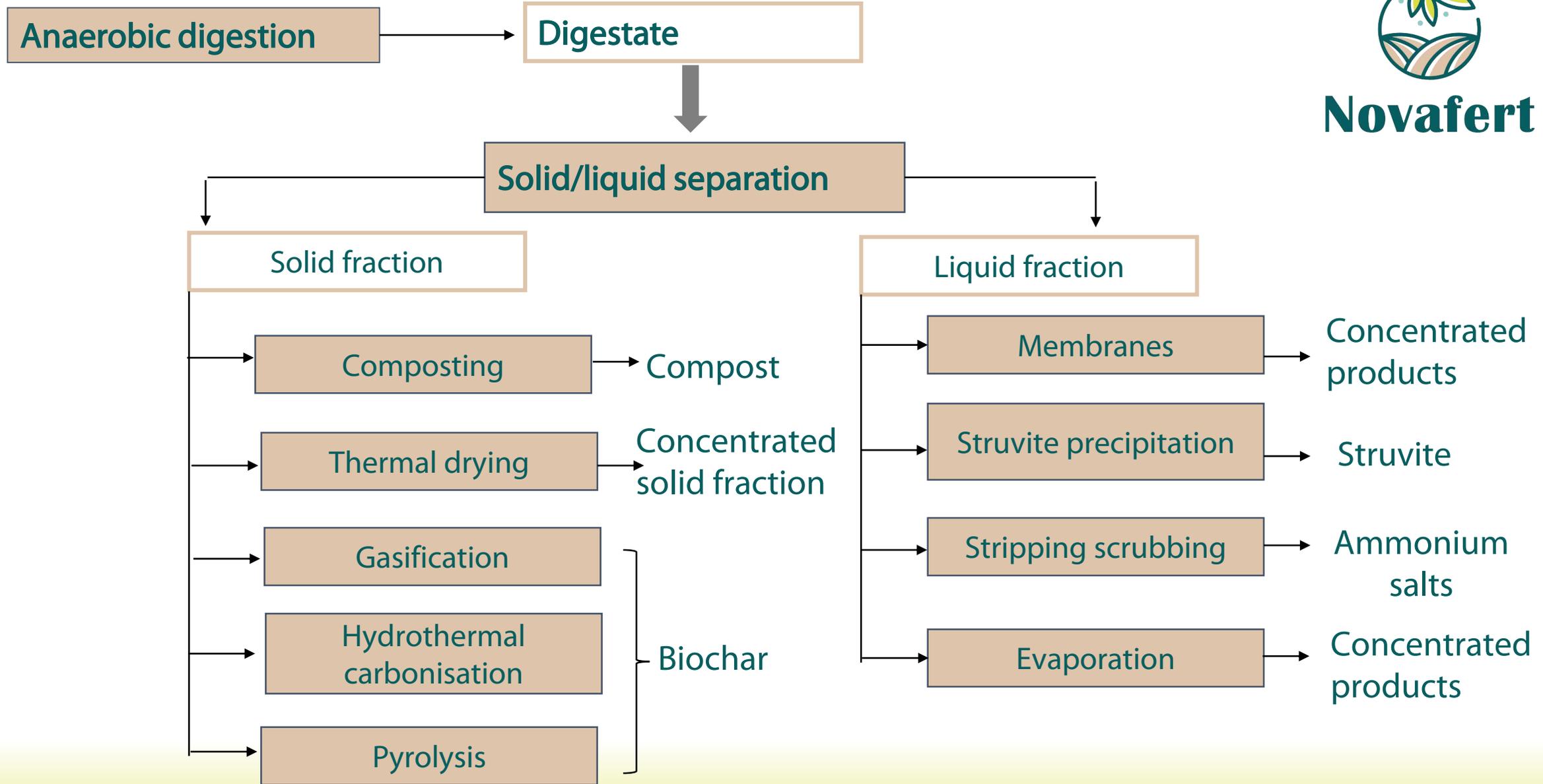


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Technology mapping



Novafert



Separator – produce liquid and solid fraction of slurry

Product



Digestate – Valuable source of fertiliser, can be sourced in solid and liquid fractions



GRASSA mobile biorefinery – Located in the southwest of Ireland

Product



Whey & press cake – The whey is used as a valuable source of fertiliser which is comparable with slurry and the press cake is used as a feedstock for ruminants.

Technology mapping



Novafert



Waste water treatment plant – plants located across the EU

Product



Struvite – Contains a range of nutrient value depending on input source of material



Dairy wastewater treatment plant – plants located in Ireland and across the EU

Product



Dairy sludge

Technology mapping



Novafert



Mechanical slurry separator

Product



Solid fraction of cattle slurry – Concentrated product for transport over longer distance



Raw broiler manure

Product



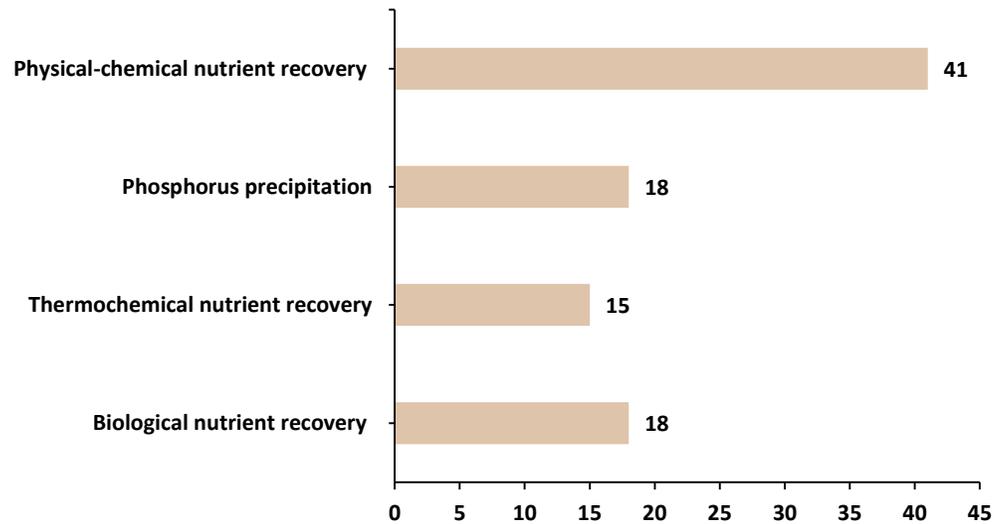
Pelletized broiler manure – A safe concentrated product for easier use and transport



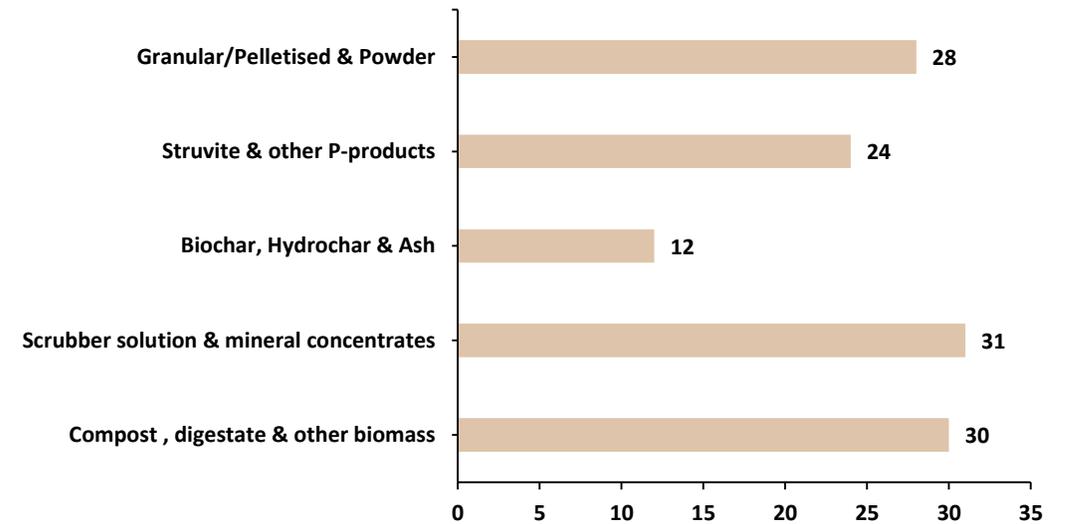
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Available technologies and products- NOVAFERT Inventory

Available nutrient recovery technologies



Product being currently used





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Western EU- Physical-chemical nutrient recovery

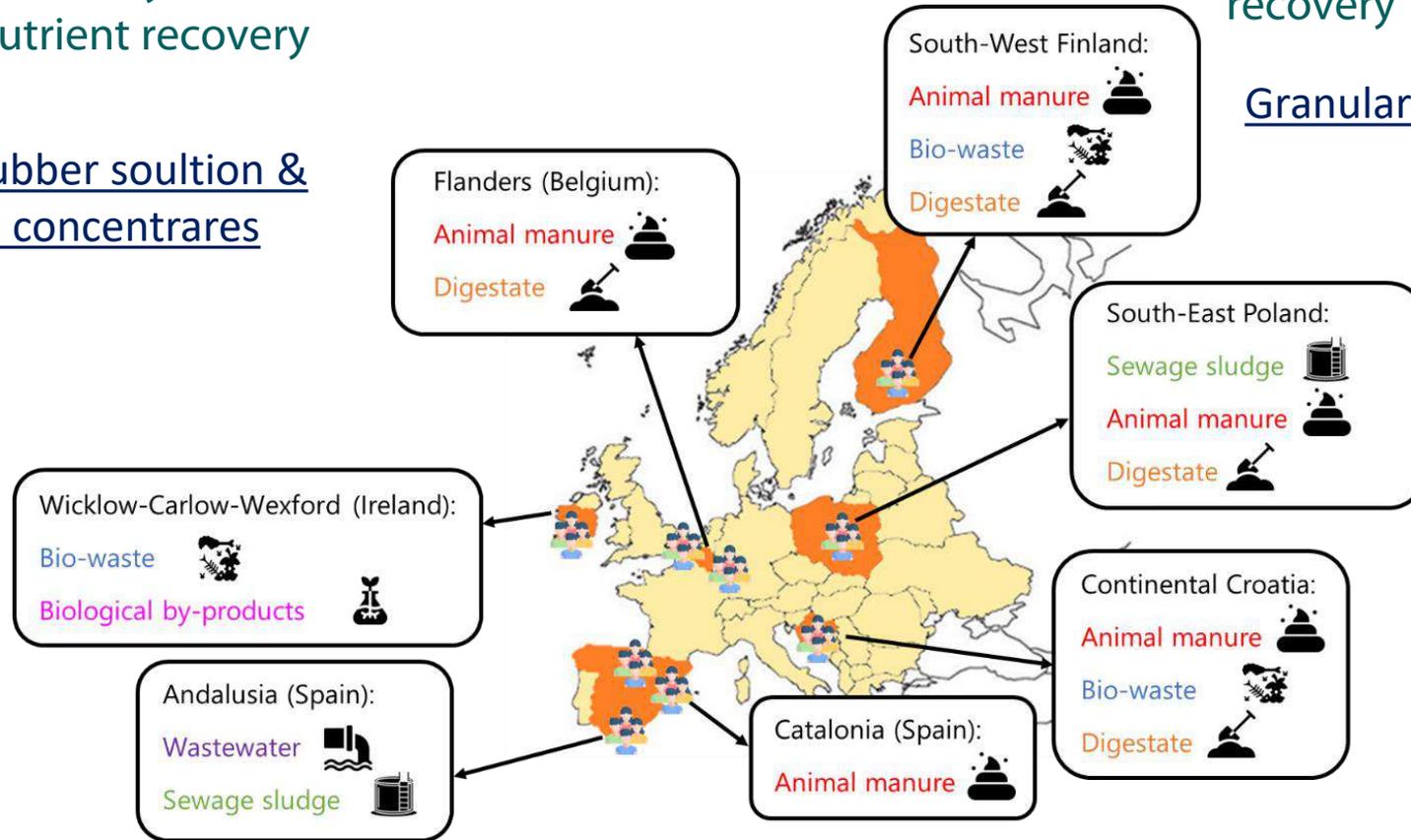
AS, Scrubber solution & mineral concentrates

Northern EU- Physical- chemical nutrient recovery

Granular/Pelletised & Powder

Eastern EU- Thermochemical nutrient recovery

Biochar, Hydrochar & Ash



Southern EU- Biological nutrient recovery & Physical-chemical nutrient recovery

Compost, digestate & other biomass

NOVAFERT methodology- 2



Novafert



WP
1

Products & technologies
mapping



Living labs
mapping



Definition – Collaborative initiatives between multiple partners to co-create, test, monitor and evaluate solutions to a common problem

Type of system (Farmers, research institutes etc.)

Selection criteria: Scale, Goals, Activities, Participants, Context

ATLAS- 53 Nutrient oriented living labs, focus on nutrient recycling



Selection of 7 living labs demonstrating the best environmental performances and practices in the selected regions will be considered as lighthouse demos



**ATLAS
OF THE
EU
NUTRIENT
ORIENTED
LIVING LABS**



Available:



Living labs & demonstration - Ireland



Novafert

- Features a mix of research-based field trials
- Includes industry scale projects
- Farmer initiatives



Teagasc sustainable nutrient use trials – Long-term living lab and demonstration displacing synthetic fertiliser with alternative nutrient sources in grassland and arable systems



Groups of farmers visiting the Teagasc lighthouse demonstration farm

Ireland

Teagasc grassland trial

Name: Teagasc
Location: Wexford
Type of system: Research
Geographical scale: National
Living Lab manager/promoter/coordinator: Donal Kinsella & Patrick Forristal

Partners involved in the LL:
Teagasc, semi-state body

Overall concept of the activities to be implemented

Teagasc established a grassland sister trial to the arable trial and is also in its 5th year. The purpose of the demo trial is to assess agronomic benefits of different bio-based recycling derived fertilisers at a field-scale level. The primary goal is to determine how these fertilisers can enhance soil fertility by increasing carbon and major nutrient levels in the soil. Progress is being monitored by analysing crop yield and quality. The aim of this living lab is to promote nutrient recovery and recycling from different agricultural processing waste resources. Additionally, the focus is on helping farmers understand and adopt these bio-based recycled fertilisers as options for their own grassland system.

The grassland trial consists of a perennial ryegrass sward. The trial consists of nine fertiliser treatments with five replicates of each, along with three zero fertiliser plots. The nine fertiliser treatments consists of main stream fertiliser and eight alternative sources of fertiliser including cattle slurry, pig slurry solids, aluminum precipitated dairy processing sludge, calcium precipitated dairy processing sludge, strawite from potato processing wastewater, strawite from municipal wastewater, incinerated poultry litter and incinerated sewage sludge. The alternative sources of fertiliser did not provide all the crops N, P, K and S requirements, these treatments were balanced with main stream fertiliser to ensure all plots received the same amount of nutrients for optimal yield.

The demo plot trials are considered to be at TILL 6. Funded under EU Horizon 2020 project NutriZoyla.

Existing LCA analyses: N/A

Available:



Living labs & demonstration - Poland



Novafert

- Demonstrates a strong focus on the industrial production of diverse fertilisers and soil improvers
- Feedstocks include municipal sewage sludge, chicken and horse manure
- Includes production of fertiliser from digestate



Municipal water and sewerage company – utilization of sewage sludge into Glebex+



Groups of farmers visiting the Polish lighthouse demonstration farm

Poland

Ekotechnologie S.C.

Name: Ekotechnologie S.C. (Biorol Technology)
 Location: Wroclaw 57-09-115 (Cieszyn, Poland)
 Type of system: In-house
 Leading Lab: manager@ekotechnologie.pl
 Coordinator: Beata Chmielna, Jarosław Korndorf

Partners involved in the LL: N/A

Overall concept of the activities to be implemented

The Biorol Technology is a process used to produce a natural fertilizer (Biorol) from waste. The process is implemented using an innovative method that simultaneously processes specialized municipal sewage sludge and sewage produced from biomass combustion.

- Capacity: 0.2-2 Mtpa waste mixture with the option of increasing the efficiency of the installation to 3 Mtpa
- Productivity: from 150-500 t/ha of organic fertilizer or soil improver with a structure similar to peat or compost
- Installed electric power: from 50kW-100kW
- Capacity: 1 operator/shift (with help on the first change)
- Main waste type: treated sewage sludge and/or from biomass combustion

Technical description

The Biorol Technology is a process used to produce a product that is a natural fertilizer - Biorol from waste. The process is carried out using an innovative method of simultaneous processing of stabilized municipal sewage sludge and waste resulting from biomass combustion. The technological line consists of the following modules:

1. Preparation of the mixture for drying with warehouses for raw materials and transmission.
2. Drying of a standardized mixture of waste.
3. Packaging of the final product - biofertilizer.
4. Purification of gases and dust from the drying process and loading the dryer.

3. Control and measurement equipment. Available on the market (PL 6)

The Biorol Technology was developed as a part of a project funded by the National Fund for Environmental Protection and Waste Management titled "Development of innovative and environmentally friendly technology for production of natural fertilizer from waste".

The Biorol Technology enables the processing of municipal sewage sludge and biogenic waste into fully-fledged organic fertilizers, organic-mineral fertilizers or soil improvers, agents, all while simultaneously eliminating pathogens and reducing the environmental risks to the natural ecosystem, human health, and the well-being of animals.

3.1. Biorol fertilizer production process

The Biorol fertilizer is a granular form with dimensions ranging from 2-4 mm and a moisture content below 15%.

Chemical composition of Biorol fertilizer in dry matter:

- N: 12.0
- Phosphate: 2.5%
- Potassium: 1.0%

3.2. Biorol fertilizer

The Biorol fertilizer has a rich and diverse composition, making it unnecessary to enhance or improve its quality further. Biorol also acts as a soil acidifier, thereby facilitating water absorption of nutrients by plants. It enhances soil structure and properties and improves plant resistance to drought. Biorol is an ecological fertilizer with a carefully selected composition in terms of quality and nutrient properties, enabling proper growth and rapid development of plants. Biorol meets all the quality criteria required for commercial trade and is permitted for use in agriculture. Biorol fertilizer qualifies as a biofertilizer for use in organic farming, home gardens, agricultural and energy crops, soil reclamation, green roofs, lawns, and more.

In Biorol Technology, the composition of the waste mixture for the process has been standardized to achieve the best quality characteristics of the resulting natural fertilizer - Biorol. For Biorol Technology, a dosing program has been developed for the quantitative addition of waste to the process, considering the variable morphology of the raw materials. The entire process is monitored for process parameters such as temperature, pressure, moisture content of the mixture and product, granule size, and efficiency. For safety reasons, the heating medium of the installation does not come into direct contact with the drying material.

One of the significant advantages of Biorol Technology is the innovative design of the dryer. Special blade constructions inside the dryer prevent the occurrence of the "sticky phase" during the drying process of the sewage sludge and ashes mixture. This solution reduces the demand for thermal energy during the reduction of moisture in the mixture. The dryer's design is aimed at minimizing the accumulation of dust on full equipment or technological devices and preventing noise issues. Optimizing the production of Biorol fertilizer allows for safe transport, storage and easy control of its application to the soil.

Available:



Living labs & demonstration - Finland



Novafert

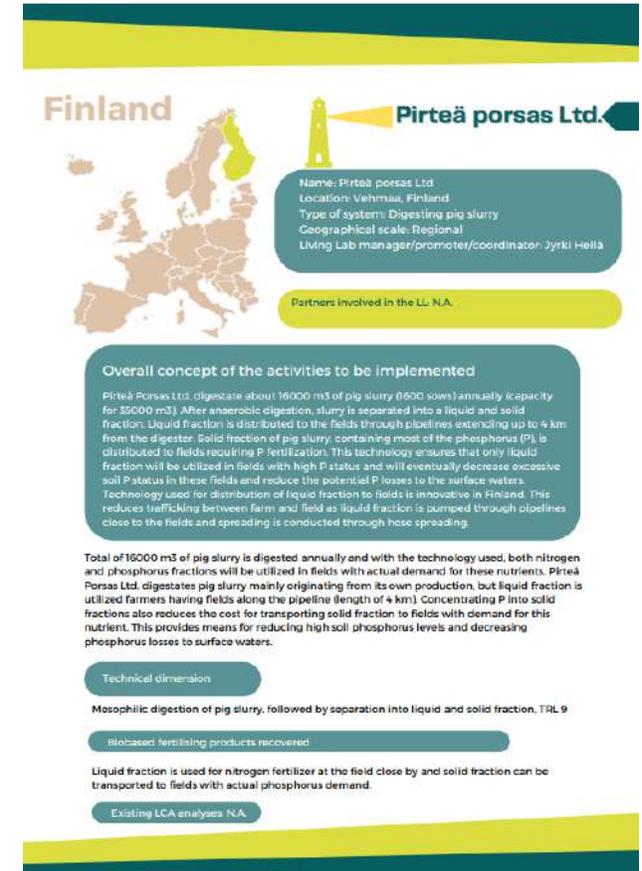
- Research initiatives involving field scale experiments
- Farmer led initiatives utilising recycled fertilisers
- Industry scale production including AD, granulation and pelletising



Pirtea porsas Ltd – Anaerobic digestion of pig slurry and digestate separated into liquid and solid fraction



Groups of farmers visiting the Finish lighthouse demonstration farm



Available:



Living labs & demonstration - Croatia



Novafert

- Systems primarily involve farmers and industry
- AD and digestate from plant materials and manure for application in large-scale orchards



OPG Dario Cenger - Anaerobic digestion of plant materials and manure from livestock production



Groups of farmers visiting the Croatian lighthouse demonstration farm

Croatia

OPG Dario Cenger

Name: OPG Dario Cenger (Bioel d.o.o. - Ecodig)
Location: M. A. Relkovića 6/a, 43290 Grubišno Polje, Croatia
Type of system: Industry/farmer
Geographical scale: Regional
Living Lab manager/promoter/coordinator: Dario Cenger, Matijan Cenger

Partners involved in the LLNA:

Overall concept of the activities to be implemented

OPG Dario Cenger started in 2005. It encompasses five thriving business entities under the umbrella of Grupa Cenger. Each company within the group has a unique specialised task but all of them have common objective - contribution to the development of ecological agriculture in Croatia.

Bioel d.o.o. provides green energy with its 1MW Biogas power plant, while PZ Zimo organizes cooperation and transportation. Biodem takes care of distribution and sales, while OPG Jerko Cenger works intensively in the sector of ecological livestock farming, crop production and medicinal plant cultivation, and OPG Dario Cenger produces high-quality Ecodig organic fertilizer.

Ecodig fertilizer feature a well-balanced nutrient composition devoid of any animal-based residues.

All business entities within Cenger Group operate on a group model, where the initial founder and producer of Ecodig, OPG Dario Cenger, plays a central role. This interconnectiveness of the group companies enables the creation of the innovative solutions for the agricultural sector.

Long-term goal is to create a circular economy in which production and distribution of organic fertilizers is integrated into local community.

The data for the BIOEL facility for the year 2021 is as follows:

- The produced electrical energy (E_{el}) amounts to 9.258.500 MWh (33.258.600 MJ).
- The useful thermal energy (E_{th}) amounts to 4.040.552 MWh (14.545.997 MJ).
- The primary fuel energy (E_q) amounts to 22.010.472 MWh (79.237.699 MJ).

Main waste type treated are plant materials and manure from livestock production.

Available:



Andalusia

- Systems primarily involve companies, irrigator communities and research centers
- Water regeneration and reuse for agriculture from treated urban and slaughterhouse wastewater



Axarquía Sostensible – Management of fertigation with regenerated water for better management of water and nutrients



Groups of farmers visiting the lighthouse demonstration farm in Andalusia



Novafert

Spain

Axarquía Sostensible

Name: Axarquía Sostensible
Location: La Axarquía, Andalusia, Spain
Type of system: Waste water from agriculture
Geographical scale: Spain
Living Lab manager/promoter/ordinator: Biozzul

Partners involved in the LL:

- Biozzul, S.L. SME (water technology)
- Trope S.A.T. 2805, large company (fruit producer and distributor)
- Comunidad de regantes de Algarrabo, Irrigators community
- CSIC-IRSEM La Mayora, Research centre

Overall concept of the activities to be implemented

The mission of the Operational Group (GO) 'AXARQUÍA SOSTENSIBLE' is to promote, through the innovative project, the use of regenerated water in the different areas of zones of each of the members of the group, and to promote the transfer of knowledge and innovation to the agricultural sector of Axarquía. The aim is to pass the way for regenerated water to be a real alternative that has the trust of water managers, authorities, farmers and consumers. From a multidisciplinary approach, the management of fertigation with regenerated water will be addressed using ICT technologies. In order to achieve better management of water and nutrients, which in turn will reduce the environmental impact of agricultural activity on soils and lower water tables.

The GO arises mainly from the need to guarantee access to water for irrigators of subtropical crops in the region of La Axarquía (Málaga), which represent a large percentage of the total irrigated agricultural area (close to 40%). The state of the wastes impounded in the Vinuela reservoir - which supplies water for irrigation to the region - has reached only 47.41 hm³, 28.66% of its capacity (reading of 7/6/2020), 9.7% of its capacity (2/6/2023).

This innovative project is based on the previous work carried out in the project funded by the European Horizon 2020 program, RichWater, during which results were generated on the water treatment and regeneration process and the management of this resource in agricultural irrigation that gave rise to a transfer of very useful knowledge for the agricultural sector of our region.

Available:



Catalonia

- Systems involve industry, farmer cooperatives and research centers
- Technologies include AD using livestock manure and other organic waste from the food industry as the feedstock
- Further processing of the digestate including separation, composting, ultrafiltration, reverse osmosis, stripping/ scrubbing and evaporation



Fertinagro – System include AD, fermentation, vacuum evaporation, hydrothermal conversion and composting of organic materials from animal and plant origin



Group of farmers visiting the lighthouse demonstration farm in Catalonia

Spain Fertinagro

Name: Fertinagro Biotech
 Location: C/ Les Enllobes, 74, +4002 Teruel, (Espana)
 Type of system: Industry
 Geographical scale: National/International
 Living Lab manager/promotor/ordinator: Ignasi Saez/ Ana Robles

Partners involved in the LL:
 • Fertinagro Company
 • BETA technological center

Overall concept of the activities to be implemented
 Development of innovative technologies to recover nutrients from livestock manure and include them in their commercial fertilizer production chain

Fertinagro Biotech is the head of the Plant Nutrition Division of Grupo Tereviva, a business group dependent on the Inversalla Patrimonio holding, which operates in the agri-food and renewable sectors. For almost 40 years they have been working to achieve a more competitive, valuable and sustainable agriculture, with a dynamic growth policy and a strong commitment to research which has allowed them to adapt to the new needs of farmers and markets. Organic also belongs to the Tereviva group, and it's the branch dedicated to the design, production and marketing of organic fertilizers since 1986. They are pioneers in using different types of raw materials to produce fertilizers, transforming them into products of high agronomic value. The whole group produces 1300/000 tonnes of all types of technological and sustainable fertilizer marketed worldwide.

Type of waste: Organic materials of animal and plant origin (animal manure, animal by-products, plant waste etc.)
 Biogas reactor and development of new nutrient recovery technologies, including composting or hydrothermal conversion (TR, E-7)
 Fertinagro was already the pilot for the project Fertimanure, where they produced on-farm tailor-made fertilizer (TMF) with a combination of pig slurry, synthetic mineral fertilizers, biostimulants and humic acids and applied them to a potato field trial in Spain (TR, 7). They are also involved in the development of R&D: leading centred at the C.I.B.A. located in Utiel/Teruel, where we have a physical-chemical analysis laboratory and a molecular biology laboratory where our latest acquisitions represent an important revolution in the field of biotechnology. In it we carry out metagenomic studies with which we are able to sequence the genome of the different microorganisms present in the soil and, therefore, see the characteristics of their microbiological composition.

Technical dimension

- Anaerobic digestion
- Solid State Fermentation
- Vacuum evaporation
- Hydrothermal conversion
- Composting

Biobased fertilising products recovered

- Nutrient-rich organic amendments
- Biostimulants
- Liquid nutrient-rich concentrates
- Tailor Made Fertilizers

Existing LCA analyses: N/A

Available:



Belgium



Novafert

- Systems involve research, farms and industry
- Technologies include farm scale AD, stripping and scrubbing, advanced digestate treatment (separation, drying)



Inagro – Farm scale AD of agro-residues/pig manure



Group of farmers visiting the lighthouse demonstration farm in Flanders

Belgium

Inagro

Name: Inagro
Location: Ghent, Rumbek-Beitem, BELGIUM
Type of system: Research Institute
Geographical scale: Regional
Living Lab manager/promoter/coordinator: Sander Vandendriessche

Partners involved in the LL:
• UGhent University
• European Biogas Association (EBA) Association

Overall concept of the activities to be implemented
Farm scale anaerobic digestion of agro-residues/pig manure to increase local nutrient cycling & improve nutrient use efficiency.

This small-scale AD plant is a classical CSTR reactor with a total volume of 200 m³ and a nominal volume of 150 m³. The installation has an electrical power of 31 kW and is operated at mesophilic (± 40°C) or thermophilic (± 50-60°C) temperatures. The biomass is being mixed by a Peters Fermento Mixer (11 kW), adjustable in height and width. Prior to burning the biogas in a CHP unit, water vapour and sulphur are removed from the biogas by a condensation step and biological desulphurization, respectively. To date, this technology occurs almost exclusively on dairy farms in Flanders, while Inagro digests mainly local agro-residues and/or manure. The AD plant can be visited for demonstration purposes and serves as a pilot scale research facility for anaerobic digestion, pre- and post-treatment, as well as biogas upgrading.

Technical dimension

This demo/pilot is operational at TRL 9 and has been set up through a biogas installation at Inagro with a 31 kW pocket (farm scale) anaerobic digester, making it directly comparable to other pocket digesters and thus very relevant for farmers. The pocket digester can be fed with different input streams to assess co-digestion conditions for small scale anaerobic digestion, has the possibility to implement pre- or post-treatment techniques and/or biogas upgrading. This demo/pilot solution is linked to Nutri2Cycle EU Project, Biogas-MAMBO SWO and Horizon Europe project Value4Farm.

Bio-based fertilising products recovered:
Digestate: the characteristics of the digestate are variable and largely depend on the input streams used, as well as on any pre- and/or post-treatment present.

Existing LCA analyses: N.A.

Available:

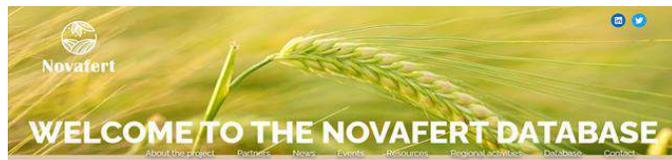


Final remarks



Novafert

- The outputs from NOVAFERT aligns with the EU Green Deal's farm-to-fork-strategy goals, particularly the reduction of chemical fertiliser use and nutrient losses
- The mapping of available technologies and products along with identification of living labs are crucial to accelerate the uptake of alternative fertilisers on farms across Europe
- Geographical spread showcases the diverse approaches and technologies for nutrient recovery



The NOVAFERT database provides an extensive portrayal of the current state of affairs for several alternative fertiliser products.

The database includes data from 76 value chains derived from six secondary raw materials: treated manure, digestate, sewage sludge, wastewater, bio waste, and biological byproduct.

The categorisation of the database takes following parameters into account:

The following primary categories were analysed:

- thermochemical nutrient recovery
- P precipitation
- physical-chemical nitrogen recovery
- biological nutrient recovery methods such as composting and anaerobic digestion

| Technology main category | Technology sub-category | Product main category | Product sub-category | Secondary raw material | Country | Input material | Pre-treatment | Process description | Process description |
|--------------------------|-------------------------|---------------------------|---------------------------|------------------------|---------------|---|---------------|---------------------|---|
| Phosphate recovery | Stripping | Digestate | Biogas and solid fraction | Heat-treated | Spain | Big slurry with Reciprocating Separator | 1 | 1.1-1.2 t/ton | The main fraction (Big slurry) is 1.1-1.2 t/ton |
| Phosphate recovery | Membrane systems | Biogas and solid fraction | Nutrient-rich concentrate | Heat-treated | Spain | manure (COW) | 1 | 1.1-1.2 t/ton | The main fraction (Big slurry) is 1.1-1.2 t/ton |
| Phosphate recovery | Membrane systems | Biogas and solid fraction | Nutrient-rich concentrate | Heat-treated | Belgium | Big manure on product | 1 | 1.1-1.2 t/ton | The main fraction (Big slurry) is 1.1-1.2 t/ton |
| Phosphate recovery | Composting | Biogas and solid fraction | Biogas | Heat-treated | Spain, Poland | Big manure (liquid) | 1 | 1.1-1.2 t/ton | The main fraction (Big slurry) is 1.1-1.2 t/ton |

Atlas of nutrient orientated living labs

Map of our Lighthouse demos





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Novafert



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