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D9.9 Practice Abstracts M54

Table of contents

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Abstract

This deliverable contains the resume and contents of the 35 practice abstracts already developed under the Project's activity. This is the third and last batch of practice abstracts, making a total of 98 abstracts submitted.

Disclaimer

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Glossary

ABT	AQUABIOTECH LIMITED
AZTI	FUNDACION AZTI – AZTI FUNDAZIOA AZTI
BARNA	BARNA SA
CAPA	CHAMBRE D'AGRICULTURE DES PYRÉNÉES ATLANTIQUES
CATAR	CENTRE REGIONAL D'INNOVATION ET DE TRANSFERT DE TECHNOLOGIE AGRORESSOURCES
CAVIAR	PIRINEA SL CAVIAR
COPEMO	SOCIETÀ COOPERATIVA PESCATORI MOLLUSCHICOLTORI
D	Deliverable
ECRI	EESTI TAIMEKASVATUSE INSTITUUT
EIP-AGRI	European Innovation Partnership
FERTINAGRO	FERTINAGRO BIOTECH SL
FIBL-CH	FORSCHUNGSINTITUT FÜR BIOLOGISCHEN LANDBAU STIFTUNG
GRONN	GRONN GJODSEL AS
INI	INICIATIVAS INNOVADORAS SAL
INIA	INSTITUTO DE INVESTIGACIONES AGROPECUARIAS
INPT	INSTITUT NATIONAL POLYTECHNIQUE DE TOULOUSE
IPS	IPS KONZALTING DOO ZA POSLOVNE USLUGE
ISQ	INSTITUTO DE SOLDADURA E QUALIDADE
M	Month
METK	CENTRE OF ESTONIAN RURAL RESEARCH AND KNOWLEDGE
NEIKER	INSTITUTO VASCO DE INVESTIGACIÓN Y DESARROLLO AGRARIO SA
NIBIO	NIBIO – NORSK INSTITUTT FOR BIOOKONOMI
NLR	NORSK LANDBRUKSRADGIVING NORD NORGE
NUTRI	NUTRILOOP OU
PA	Practice Abstract
UGENT	UNIVERSITEIT GENT
ULB	UNIVERSITÉ LIBRE DE BRUXELLES
UMIL	UNIVERSITÀ DEGLI STUDI DI MILANO
UNIVPM	UNIVERSITA POLITECNICA DELLE MARCHE UNIVPM
UVIC-UCC	FUNDACIO UNIVERSITARIA BALMES UVIC-UCC
WP	WORK PACKAGE

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1 Introduction

The European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) was launched by the European Commission (EC) in 2012. This initiative aimed to help all EU countries to provide their citizens with a more competitive economy, better jobs, and life standards, fostering a competitive and sustainable agriculture and forestry sector that "achieves more from less". Since 2022, the EU Commission has created the **EUCAP Network** that involves the previous European Rural Networks, namely the **European Network for Rural Development (ENRD)** and the **European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI)** network.

For the Horizon 2020 projects, the EIP-AGRI adheres to the "interactive innovation model", which brings together specific actors (e.g., farmers, advisors, researchers, businesses, etc.) to work in multi-actor projects to find a solution for a specific issue or develop a concrete opportunity. In this sense, communicating about project activities and results is much easier by a common format (see Figure 1) which facilitates the knowledge flow and enables contacting farmers, researchers and all the other actors involved in innovation projects. The EIP common format consists of a set of basic elements characterising the project, including practice abstracts (PAs). The format is developed with the aim to enable contact with partners, incentivize efficient knowledge exchange and disseminating the results of the project in a concise and easily understandable way to practitioners.

All the PAs generated during the life cycle of SEA2LAND project will be periodically uploaded to the EIP-AGRI website, now called EUCAP Network, where the information is shared at the EU level, via the EUCAP Network project database, a unique repository which supports the dissemination of results of all interactive innovation projects. In addition, these PAs will be a useful dissemination tool to share the updates and outcomes of SEA2LAND with the EUCAP Network subgroup of innovation.

This document presents **35 PAs** that have been mainly developed based on the outcomes of the deliverables and results obtained during the last period of the project. It is the third and last batch of practice abstracts, bringing the total number of summaries to 98. Despite not having reached the total of 100 abstracts, the project has focused on preparing many more scientific publications than it had as a Key Performance Indicator. These publications are presented **in 9.8 Communication and Dissemination Report (M54).**

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2 Methodology

PAs are short summaries of around 1000 - 1500 characters (word count – no spaces) which describe the main information/recommendations and serve end users in their daily practice. All PAs have been prepared following the guidance and Common Format of EIP-AGRI (see Figure 1) in the shape of an Excel template. Every PA must be accompanied by a short title of no more than 150 characters.

This deliverable presents the abstract practices with another design that has been prepared in order to publish them on the project website. However, this design contains the main information as required in the EIP-AGRI format (see Figure 2):

- Main results/outcomes of the activity (expected or final).
- Main practical recommendations such as the main added value/benefit/opportunities to the end user.

Both the summary and the title may be also provided in the native language of the coordinator or one of the partners. However, an English version of PAs must always be available. In addition to the PAs, the Excel template contains general information about the project, including keywords, list of partners and contacts, website and audio-visual material.

Please note that the following practice abstracts have not yet been validated by EIP-AGRI.

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EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR AGRICULTURE AND RURAL DEVELOPMENT

Directorate H. Sustainability and Quality of Agriculture and Rural Development
H.5. Research and Innovation

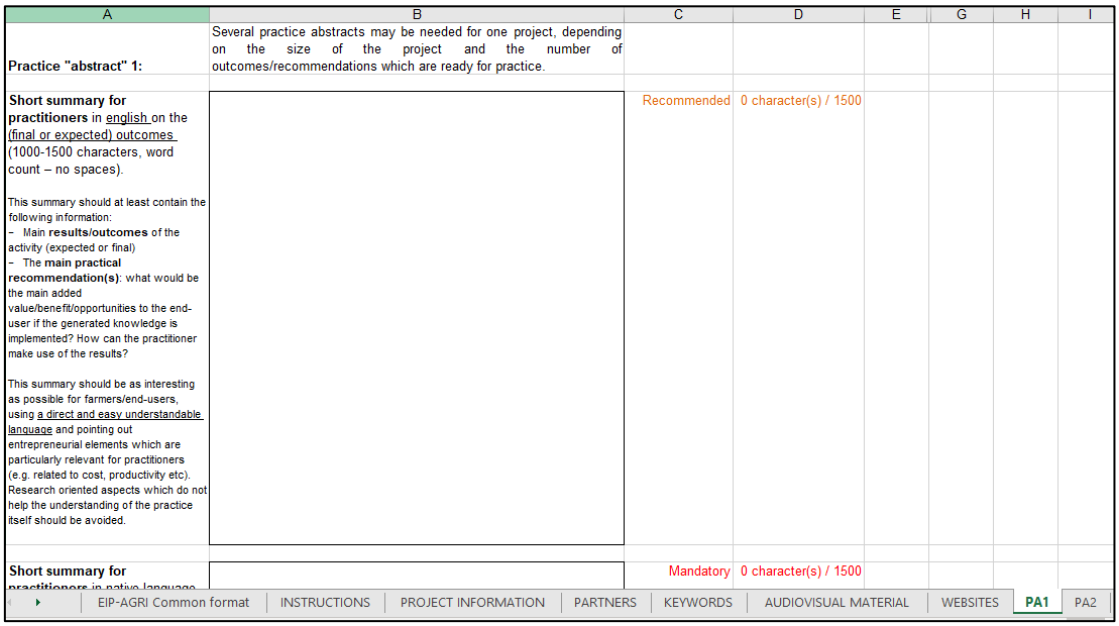
EIP-AGRI Common format for interactive innovation projects

The interactive innovation approach under the European Innovation Partnership Agricultural Productivity and Sustainability (EIP-AGRI)[1] fosters the development of demand-driven innovation, turning creative new ideas into practical applications thanks to interactions between partners, the sharing of knowledge and effective intermediation and dissemination.

The EIP **common format** consists of a set of basic elements characterising the project and **includes one (or more) "practice abstract"(s)**. The format was developed with two main objectives:
(1) to enable contacting partners and incentivise efficient knowledge exchange, and
(2) to disseminate the results of the project in a concise and easy understandable way to practitioners.
The common format allows providing information all along the life-cycle of the project. The **content of the common format can be updated at any moment** when useful, for instance in an intermediate phase of the project. Project information should at least be available at the beginning (describing the situation at the start of the project, including project title and objectives) and at the end of the project (describing the results/recommendations resulting from the project, including a final project report and one or more practice abstracts).

EIP-AGRI Common format | INSTRUCTIONS | PROJECT INFORMATION | PARTNERS | KEYWORDS | AUD

Figure 1. *EIP-AGRI Common format*



A	B	C	D	E	G	H	I
Practice "abstract" 1:	Several practice abstracts may be needed for one project, depending on the size of the project and the number of outcomes/recommendations which are ready for practice.						
Short summary for practitioners in english on the (final or expected) outcomes (1000-1500 characters, word count – no spaces). This summary should at least contain the following information: – Main **results/outcomes** of the activity (expected or final) – The **main practical recommendation(s)**: what would be the main added value/benefit/opportunities to the end-user if the generated knowledge is implemented? How can the practitioner make use of the results? This summary should be as interesting as possible for farmers/end-users, using a direct and easy understandable language and pointing out entrepreneurial elements which are particularly relevant for practitioners (e.g. related to cost, productivity etc). Research oriented aspects which do not help the understanding of the practice itself should be avoided.		Recommended	0 character(s) / 1500				
Short summary for practitioners in native language		Mandatory	0 character(s) / 1500				

EIP-AGRI Common format | INSTRUCTIONS | PROJECT INFORMATION | PARTNERS | KEYWORDS | AUDIOVISUAL MATERIAL | WEBSITES | PA1 | PA2

Figure 2. *EIP-AGRI template for PA*

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3 Summary of Practice Abstracts

Nº	Title of the Practice Abstract	Partner	Language
1	Obtaining reclaimed water for industrial reuse from aquaculture sludge	UVIC	English / Spanish
2	Phosphorus extraction strategies from P-rich ashes coming from fish sludge-derived organic amendments	UVIC	English / Spanish
3	Nitrogen fate following use of biobased fertilisers	NIBIO	English / Norwegian
4	Greenhouse gas emissions from biobased fertilizers derived from fishery waste and by-products	UGENT	English / Dutch
5	Nitrogen mineralization patterns of biobased fertilizers: field trial in Belgium	UGENT	English / Dutch
6	Microplastics	UGENT	English / Dutch
7	Soil health assessment using bio-indicators in an Estonian field trial with bio-based fertilizers	METK	English / Estonian
8	Biofertilizers and organic farming	FIBL EU	English / French
9	Potential and needs of such fertilizers when being applied in organic	FIBL EU	English / French
10	Social life cycle assessment of fishery-based bio-fertilisers (BBF)	INPT	English / French
11	Testing the amending efficacy of compost-biochar composite from fish waste	UMIL / UNIVPM	English / Italian
12	Assessing the Economic Viability of Biochar-compost Composite Production as an Innovative Bio-Based Fertiliser	IPS	English / Croatian
13	Assessing the Economic Viability of Biostimulant Production as an Innovative Bio-Based Fertiliser	IPS	English / Croatian
14	Business Model Canvas for agricultural producers	IPS	English / Croatian
15	Business Model Canvas for fertilizing industry	IPS	English / Croatian
16	Business Model Canvas for fisheries, aquaculture sectors	IPS	English / Croatian
17	Business Model Canvas for technology sellers, suppliers	IPS	English / Croatian
18	Assesing the economic viability of Bokashi pellet production as an innovative bio-based fertilizer	IPS	English / Croatian

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19	Assessing the Economic Viability of Fish Sludge Pelleted Fertiliser Production as an Innovative Bio-Based Fertiliser	IPS	English / Croatian
20	Assessing the Economic Viability of Organic Amendment Production as an Innovative Bio-Based Fertiliser	IPS	English / Croatian
21	Business Case Assessment of Protein Fraction Production Technology for Bio-Based Fertilisers at Industrial Scale	IPS	English / Croatian
22	Assessing the Economic Viability of Protein Fraction Production as an Innovative Bio-Based Fertiliser	IPS	English / Croatian
23	Production of ingredients for the formulation of biostimulants by autolysis of rainbow trout viscera	AZTI	English / Spanish
24	Production of an ingredient for the formulation of biostimulants by enzymatic hydrolysis of rainbow trout viscera	AZTI	English / Spanish
25	Production of an ingredient for the formulation of biostimulants by silage of rainbow trout viscera	AZTI	English / Spanish
26	Industrial exploitation and replicability in EU countries	FERTINAGRO	English / Spanish
27	The economics of fishery-based by-products	FERTINAGRO	English / Spanish
28	Optimized technical datasheets	FERTINAGRO	English / Spanish
29	Bio-based fertilisers for the food of the future From fishery waste to growing organic broccoli in the year 2095	ULIEGE	English / French, Dutch, German
30	Environmental hotspots of bio-based fertilisers	FIBL CH	English / German
31	How to assess the environmental impacts of fishery-based bio fertilisers	FIBL CH	English / German
32	Phosphorus use efficiency of alfalfa fertilized with aquaculture derived bio-based fertilizers in an Andisol	INIA	English / Spanish
33	A Decision Support System framework for using fishery-based bio fertilizers	ISQ	English / Portuguese
34	Inventory of stakeholders	NEIKER	English / Spanish
35	Future evolution of the produced fertilisers effectiveness	NIBIO	English / Norwegian

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PRACTICE ABSTRACT NO. 1

SEA2LAND

UVIC
UNIVERSITAT DE VIC
UNIVERSITAT CENTRAL DE CATALUNYA

Beta
Biodiversitat, Ecologia, Tecnologia Ambiental i Alimentària

Obtaining reclaimed water for industrial reuse from aquaculture sludge

Main results / outcomes

Aquaculture sludge has been demonstrated to be a valuable source of nutrients for agricultural applications (especially in N). Raw wastewater sludge can be separated with some technologies such as centrifugation or screw-press in two fractions (liquid and solid) for enhancing the nutrient content of the solid phase. The resulting liquid fraction can be treated for obtaining a useful reclaimed water which can help aquaculture industries to increase water savings. An ultrafiltration filtration (UF) coupled to a reverse osmosis (RO) system was shown to be effectively reduce the solid content (UF) and the nutrients content (RO) of the liquid fraction. The reclaimed water resulted in a high-quality water with low values regarding the turbidity (< 2 FNU), TSS (< 5 mg/L), COD (< 5 mg/L) or TP (< 1 mg/L). This fulfils the requirements established in the new Spanish Regulation (RD 1085/2024) for the water reuse in refrigeration processes and for the cleaning of surfaces without food contact.

Practical recommendations

A good flocculation during the separation phase helps to reduce the solid concentration in the liquid phase, enhancing the UF+RO effectiveness. We recommend using polymer-type flocculants to avoid damaging the membranes. Then, reducing the N-content of the liquid phase should be the target in the RO. By operating the RO to obtain a 50% of the permeate, a reduction of 80% of the incoming N could be achieved, resulting in a final concentration of less than 15 mg/L.

Figure 1. Pilot scale ultrafiltration module (in green) and reverse osmosis system (in purple).

Figure 2. Screw-press pilot system for the raw wastewater sludge separation.

About this abstract

Authors: Miguel Martínez, Nagore Guerra – BETA-Technological Center (UVic-UCC), Diego Mendiola (CAVIAR PIRINEA S.L)

Date: May 2025

SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe. The project is running from January 2021 to June 2025.

Website: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 1

SEA2LAND

UVIC
UNIVERSITAT DE VIC
UNIVERSITAT CENTRAL DE CATALUNYA

Beta
Biodiversitat, Ecologia, Tecnologia Ambiental i Alimentària

Obtención de agua reciclada para reutilización industrial a partir de lodos de acuicultura

Resultados principales

Se ha demostrado que los lodos de acuicultura son una fuente valiosa de nutrientes para aplicaciones agrícolas (especialmente en nitrógeno). Los lodos de aguas residuales sin tratar pueden separarse mediante algunas tecnologías, como la centrifugación o el prensado por tornillo, en dos fracciones (líquida y sólida) para mejorar el contenido de nutrientes de la fase sólida. La fracción líquida resultante puede tratarse para obtener agua reciclada útil, lo cual puede ayudar a las industrias acuícolas a aumentar el ahorro de agua. Un sistema de ultrafiltración (UF) acoplado a un sistema de ósmosis inversa (RO) ha demostrado ser eficaz para reducir el contenido de sólidos (UF) y el contenido de nutrientes (RO) de la fracción líquida. El agua reciclada obtenida fue de alta calidad, con valores bajos de turbidez (< 2 FNU), sólidos en suspensión totales (< 5 mg/L), demanda química de oxígeno (< 5 mg/L) o fósforo total (< 1 mg/L). Esto cumple con los requisitos establecidos en el nuevo Reglamento español (RD 1085/2024) para la reutilización del agua en procesos de refrigeración y en la limpieza de superficies sin contacto con alimentos.

Recomendaciones prácticas

Una buena floculación durante la fase de separación ayuda a reducir la concentración de sólidos en la fase líquida, mejorando la eficacia del sistema UF+RO. Recomendamos el uso de floculantes de tipo polimérico para evitar dañar las membranas. Posteriormente, la reducción del contenido de nitrógeno (N) en la fase líquida debe ser el objetivo del proceso de ósmosis inversa. Al operar el sistema de RO para obtener un 50 % de permeado, se puede lograr una reducción del

Figura 1. Módulo de ultrafiltración a escala piloto (en verde) y sistema de ósmosis inversa (en morado).

Figura 2. Sistema piloto de prensado por tornillo para la separación de lodos de aguas residuales sin tratar.

Acerca de este resumen

Authors: Miguel Martínez, Nagore Guerra – BETA-Technological Center (UVic-UCC), Diego Mendiola (CAVIAR PIRINEA S.L)
Date: May 2025
SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe. The project is running from January 2021 to June 2025.
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PRACTICE ABSTRACT NO. 2

SEA2LAND

UVIC
UNIVERSITAT DE VIC
UNIVERSITAT CENTRAL DE CATALUNYA

Beta
Biodiversitat, Ecologia, Tecnologia Ambiental i Alimentària

Phosphorus extraction strategies from P-rich ashes coming from fish sludge-derived organic amendments

Main results / outcomes

Organic amendments coming from marine aquaculture sludge were demonstrated to be rich in phosphorus. Since the current regulation does not allow to use them as fertilizers, the thermal valorization could be an interesting option for aquaculture industry in terms of energy savings. Different strategies were followed to extract the P in the resulting ashes after the organic amendment combustion. First, a screening of different acids (sulfuric and citric acid) at different concentrations was conducted. Sulfuric acid at 1 M with a low acid-to-ash ratio (10 to 1) led to the maximum extraction efficiency of the P in the ashes (up to 85%). A cumulative two-round P extraction was then tested using 1 M H_2SO_4, which resulted in a very concentrated P product (4.57% of P_2O_5). Finally, alkaline-driven precipitation of the P-rich H_2SO_4 was performed to obtain two precipitates with a P-content up to 15% mainly in the form of calcium phosphates.

Practical recommendations

Cumulative extraction of the P from ashes is a good way to increase the P concentration in the final solution, despite decreasing the extraction efficiency in the second extraction round. The pH of the H_2SO_4 solution can be used as indicator of the capacity of the acid to continue extracting P from the ashes. If the pH is higher than 2.0, a decrease in the extraction efficiency is observed. Finally, despite alkaline-driven precipitation results in high concentrated P precipitates, the mass balance efficiency is very low, being able to recover as precipitated salt a minor part of the phosphorus in the extract. Further research in maximizing precipitation efficiency is needed. In the meantime, commercialization of the acidic P-rich extract obtained in a cumulative process would be recommended.

Figure 1. Lab-scale extraction of P with sulfuric acid from ashes

Figure 2. Alkaline-driven precipitation from P-rich sulfuric acid solution.

About this abstract

Authors: Miguel Martínez, Nagore Guerra – BETA-Technological Center (UVic-UCC)
Date: May 2025
SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe. The project is running from January 2021 to June 2025.
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PRACTICE ABSTRACT NO. 2

SEA2LAND

UVIC
UNIVERSITAT DE VIC
UNIVERSITAT CENTRAL DE CATALUNYA

Beta
Biodiversitat, Ecologia, Tecnologia Ambiental i Alimentària

Estrategias de extracción de fósforo a partir de cenizas ricas en P provenientes de enmiendas orgánicas derivadas de lodos de pescado

Principales resultados

Las enmiendas orgánicas derivadas de lodos de acuicultura marina son ricas en fósforo, pero la normativa actual impide su uso directo como fertilizantes. La valorización térmica surge como una opción energética interesante para la industria acuícola. Tras la combustión de estas enmiendas, se evaluaron distintas estrategias para extraer el fósforo de las cenizas resultantes. Se compararon ácidos como el sulfúrico y cítrico a varias concentraciones, destacando el ácido sulfúrico 1 M con una relación ácido/ceniza de 10:1, que alcanzó hasta un 85% de eficiencia en la extracción. Además, se implementó una extracción acumulativa en dos etapas con H_2SO_4 1 M, logrando un extracto con alta concentración de fósforo (4,57% P_2O_5). Posteriormente, la precipitación alcalina del extracto permitió obtener precipitados con hasta un 15% de fósforo, principalmente como fosfatos cálcicos.

Recomendaciones prácticas

Aunque la extracción acumulativa aumenta la concentración de fósforo, la eficiencia disminuye en la segunda ronda y un pH superior a 2.0 indica menor capacidad extractiva. La precipitación alcalina, pese a producir concentrados ricos, tiene baja eficiencia en el balance de masa, recuperando solo una fracción del fósforo. Por ello, se recomienda profundizar en mejorar esta etapa, y mientras tanto, comercializar el extracto ácido acumulativo como producto rico en fósforo.

Figure 1. Lab-scale extraction of P with sulfuric acid from ashes

Figure 2. Alkaline-driven precipitation from P-rich sulfuric acid solution.

Acerca de este resumen

Authors: Miguel Martínez, Nagore Guerra – BETA-Technological Center (UVic-UCC)
Date: May 2025
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PRACTICE ABSTRACT NO. 3

Nitrogen fate following use of biobased fertilisers

Main results / outcomes

In BBFs, nitrogen is partly available to plants. The remainer is bound in organic compounds and may become available to plants with time. During a trial at Apelsvoll research station, Norway, broccolis between 11 and 33 % of the nitrogen applied with BBFs. Soil samples revealed that the BBFs providing the highest broccoli yield and nitrogen uptake also provided a higher amount of plant available soil nitrogen early in the season. After broccoli cultivation, winter wheat were grown without further fertilization to assess the slow release of nitrogen from the BBFs. The protein content were higher in wheat cultivated on previously BBF fertilized land (11.7-11.9 %) than in crops cultivated on unfertilized land (10.9 %).

Practical recommendations

Use of BBFs requires specific knowledge on plant available nitrogen and the release of nitrogen with time. Low nitrogen plant availability in the early growth season may be amended with an addition of the required amount of mineral nitrogen. BBFs gives the benefit of improved soil health due to the organic material and may provide nitrogen also for the coming crops.

Figure 1: Applied BBFs

Figure 2: Broccoli field, Norway 2024

Further information

The results will be available in Deliverable 5.1, published on sea2landproject.eu

About this abstract

Authors: Astrid Solvåg Nesse and Mette Thomsen, NIBIO
Date: May 2025
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PRACTICE ABSTRACT NO. 3

Agronomisk virkning og miljøpåvirkning av organiske gjødselvarer (BBF)

Hovedresultat

I organiske gjødselvarer er nitrogenet kun delvis tilgengelig for plantene som minerals nitrogen. Resten er bundet i organiske forbindelser og kan bli plantetilgjengelig med tid. I et forsøk på Apelsvoll forsøksstasjon, tok brokkoli opp mellom 11 og 33 % av nitrogenet som ble tilført med organiske gjødselvarer. Analyser av jordprøver viste at de gjødselvarene som gav den høyeste avlingen og nitrogenopptaket, også hadde den høyeste mengden mineralsk nitrogen tidlig I vekstsesongen. Etter brokkolidyrkningen ble vinterhvete dyrket uten videre gjødsling. Formålet var å se om det organiske nitrogenet ville omdannes til plantetilgjengelig nitrogen og bidra til plantevekst. Proteininnholdet i hveten var høyere i hvete som var dyrket på areal tidligere tilført organiske gjødselvarer (11.7 – 11.9 %), enn i hvete dyrket på ugjødslet jord (10.9 %).

Praktiske anbefalinger

Bruk av organiske gjødselvarer krever spesifikk kunnskap om plantetilgjengelig nitrogen ved start, og omdanning over tid. Gjødselvarer som tilfører lite plantetilgjengelig nitrogen tidlig i sesongen kan evt. blandes med mineralsk nitrogen for å øke planteveksten. Til forskjell fra mineralgjødsel har organiske gjødselvarer fordelen at de tilfører organiske materiale til jord, og dermed forbedrer jordhelsen, og at produktet kan tilføre plantetilgjengelig nitrogen over lenger tid.

Figure 1: Applied BBFs

Figure 2: Broccoli field, Norway 2024

Mer informasjon

Resultatene blir tilgjengelige i Deliverable 5.1, publisert på sea2landproject.eu

Om sammendraget

Authors: Astrid Solvåg Nesse and Mette Thomsen, NIBIO
Date: May 2025
SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe. The project is running from January 2021 to June 2025.
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PRACTICE ABSTRACT NO. 4

Nitrogen mineralization patterns of biobased fertilizers: field trial in Belgium

Main results / outcomes

Soil mineral nitrogen (SMN) and mineralization were monitored throughout the field trials to assess nitrogen dynamics and availability under different fertilizer treatments. Soil samples were collected from the field trial in Upigny, Belgium, where broccoli was grown on clay loam soil. Four biobased fertilizers (BBFs) were tested: an NPK solution with amino acids (FER3), fish sludge pellets (FSP), a protein-rich fraction from fish waste after twin-screw extrusion (CAT1), and a hydrolysate from shellfish waste. Samples were taken from 0–90 cm depths at key stages: before (T1) and after fertilization (T2), during growth (T3: BBCH 25, T4: BBCH 51), post-harvest (T5), and after winter crop planting (T6). Fertilizer rates aimed for 120 kg N ha-^{1}; the control (CON) received none and the refence fertilization (REF) was done with chicken manure. By T4, SMN concentration increased in all treatments, mostly composed of nitrate N in the topsoil, most likely due to the mineralization of organic residues and fast nitrification under moist condition, with FER3 showing the highest concentration (49 mg/kg at T4, 0–10 cm). The SMN levels of the treatments show the potential plant available N pool of the soil during study period. After harvesting, the FER3 treatment (32 kg ha^{-1}) again maintained significant higher SMN level in the topsoil, followed by the CAT1 treatment (13 kg ha^{-1}). By T6, no significant differences were observed from both layers. The field's long history of organic farming may have led to ongoing mineral N release from residual organic matter. Mineral N concentrations showed little variation across treatments and time points. Rainfall and moist soil conditions also affected N leaching and movement, which is why the usual decline in mineral N with soil depth was not observed as typically seen in other fields.

Practical recommendations

Regularly measuring SMN levels before and during field trials allows for precise adjustment of N applications, helping to prevent over- or under-fertilization. This supports the efficient use of liquid fertilizers – which are more likely to leach – by aligning application rates and timing with crop needs, thereby improving nitrogen use efficiency and reducing the risk of nitrate leaching into groundwater.

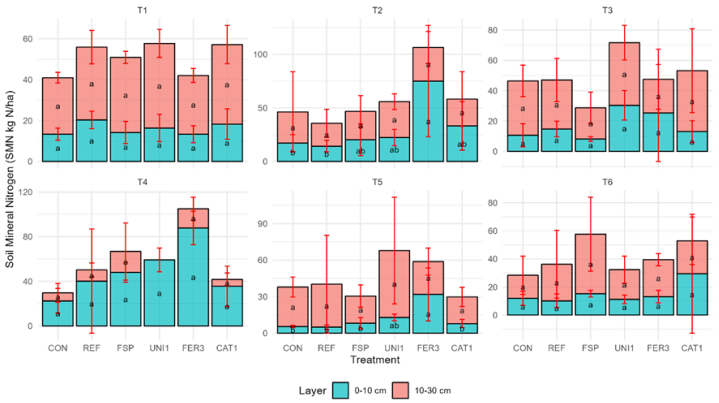

Figure 1: Soil mineral N levels (SMN kg ha^{-1}) of the field in Belgium

Further information

Deliverable 5.1 Agronomic behavior and environmental effects of developed fertilisers.

About this abstract

Authors: Jingsi Zhang, Çağrı Akyol, Evi Michels and Erik Meers (Ghent University)
Date: May 2025

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PRACTICE ABSTRACT NO. 4

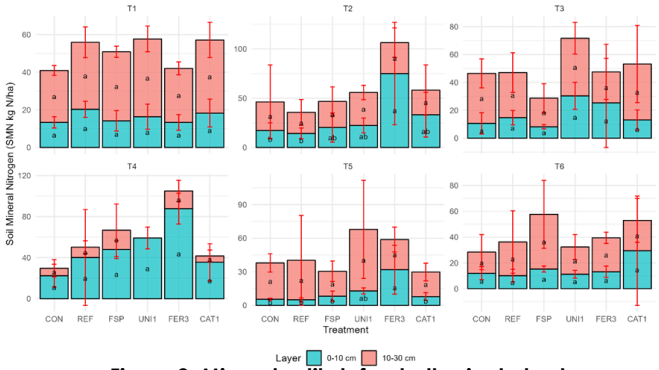
Stikstofmineralisatiepatronen van biogebaseerde meststoffen: veldproef in België

Belangrijkste resultaten / uitkomsten

Minerale stikstof in de bodem (SMN) en zijn mineralisatie patroon werden tijdens veldproeven gemonitord om de stikstofdynamiek en -beschikbaarheid onder verschillende bemesting regimes te beoordelen. Bodemmonsters werden verzameld tijdens een veldproef in Upigny, België, waar broccoli werd geteeld op een klei-leem grond. Vier biogebaseerde meststoffen (BBFs) werden getest: een NPK-oplossing met aminozuren (FER3), pellets van visslib (FSP), een eiwitrijke fractie uit visafval na tweeschroefsextrusie (CAT1) en een hydrolysaat van schelpdierafval. Monsters werden genomen op dieptes van 0–90 cm op cruciale tijdstippen: vóór (T1) en na bemesting (T2), tijdens de groei (T3: BBCH 25, T4: BBCH 51), na de oogst (T5), en na planten van het wintergewas (T6). De bemestingsdoseringen waren gericht op 120 kg N ha^{-1}; de controle (CON) kreeg geen meststof en de referentiebemesting (REF) werd uitgevoerd met kippenmest. Tegen T4 nam de SMN-concentratie toe in alle behandelingen, voornamelijk bestaande uit nitraatstikstof in de bovenste bodemlaag, waarschijnlijk als gevolg van mineralisatie van organische resten en snelle nitrificatie onder vochtige omstandigheden. Hierbij vertoonde FER3 de hoogste concentratie (49 mg kg^{-1} bij T4, 0–10 cm). De SMN-niveaus in de behandelingen tonen de potentieel plantbeschikbare stikstofvoorraad in de bodem tijdens de studieperiode. Na de oogst bleef de SMN-concentratie in de bovenste bodemlaag het hoogst in de FER3-behandeling (32 kg ha^{-1}), gevolgd door CAT1 (13 kg ha^{-1}). Tegen T6 werden er geen significante verschillen meer waargenomen in beide lagen. De lange geschiedenis van biologische landbouw op het perceel heeft mogelijk geleid tot een aanhoudende vrijgave van mineraal stikstof uit achtergebleven organisch materiaal. De concentraties van mineraal stikstof vertoonden weinig variatie tussen behandelingen en meetmomenten. Regenval en vochtige bodemomstandigheden beïnvloedden bovendien de uitspoeling en verplaatsing van stikstof, waardoor de gebruikelijke afname van mineraal stikstof met de diepte niet werd waargenomen, zoals normaal gesproken in andere percelen het geval is.

Praktische aanbevelingen

Het regelmatig meten van het niveau van mineraal stikstof (SMN) vóór en tijdens veldproeven maakt een nauwkeurige afstemming van stikstoftoediening mogelijk, waardoor over- of onderbemesting wordt voorkomen. Dit bevordert een efficiënt gebruik van vloeibare meststoffen – die gevoeliger zijn voor uitspoeling – door dosering en timing beter af te stemmen op de behoeften van het gewas. Zo wordt de stikstofbenutting verbeterd en het risico op nitraatuitspoeling naar het grondwater verminderd.



Figuur 2: Minerale stikstof gehaltes in de bodem (SMN kg ha^{-1}) van het veld in België

Verdere informatie

Deliverable 5.1 Agronomic behavior and environmental effects of developed fertilisers.

Over deze samenvatting

Auteurs : Jingsi Zhang, Çağrı Akyol, Evi Michels en Erik Meers (Universiteit Gent)
Datum: Mei 2025

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PRACTICE ABSTRACT NO. 5

Greenhouse gas emissions from biobased fertilizers derived from fishery waste and by-products

Main results / outcomes

Biobased fertilizers (BBFs) can emit greenhouse gases (GHGs) such as nitrous oxide (N_2O), carbon dioxide (CO_2), and methane (CH_4), affecting climate, air quality, and ecosystems. Assessing their emission profiles is key to minimizing environmental impacts while maintaining agronomic performance. This study evaluated GHG emissions from eight potential organic fertilizers in a controlled incubation test at 20 ± 2°C: bokashi pellets (BP), an NPK solution with amino acids (FER3), hydrolysates (UNI1), a chitin-rich fertilizer (UNI3), a protein fraction (CAT1), pelleted fish sludge (FSP), fish mix pellets (FMP), and an organic amendment (OA1) – in comparison to mineral fertilizer (CAN) and unfertilized soil as control (CON). Gas emissions peaked early, then dropped to control (CON) levels after seven days. FER3 showed the highest cumulative N_2O emissions, with 4.8% of its nitrogen (N) and 30% of its carbon (C) lost. UNI1 followed with 1.8% N loss as N_2O. BP (C/N ratio 12.3) led to elevated CO_2 and CH_4 emissions, accounting for 17% of its C content.

Practical recommendations

The global warming potential (GWP) of these fertilizers, based solely on their soil application, was primarily driven by N_2O emissions. The liquid fertilizer FER3 showed the highest GWP at 13 kg CO_2-equivalent per kg of N applied, while the other organic fertilizers ranged from 0.96 to 5.3 kg CO_2-eq kg^{-1} N. Although comparable to other organic amendments, these values were still lower than those of some commonly used synthetic mineral fertilizers (except for FER3). Therefore, special attention is needed—particularly with liquid fertilizers—during the first week after application. Practices like irrigation should be carefully managed during this critical period.

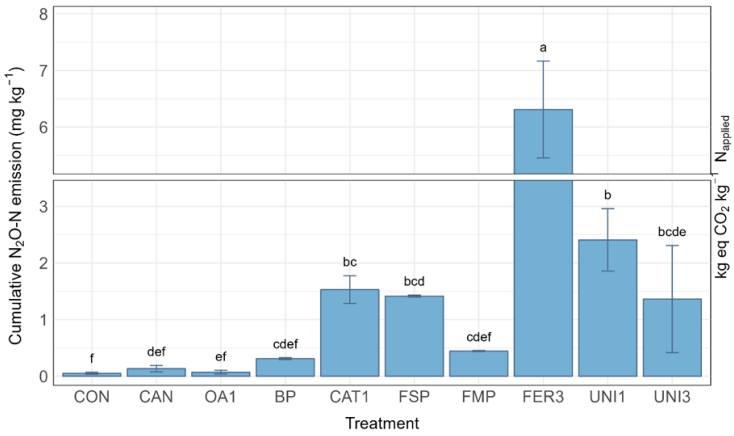

Figure 1: Cumulative emissions of N_2O from the control, synthetic and biobased fertilizers

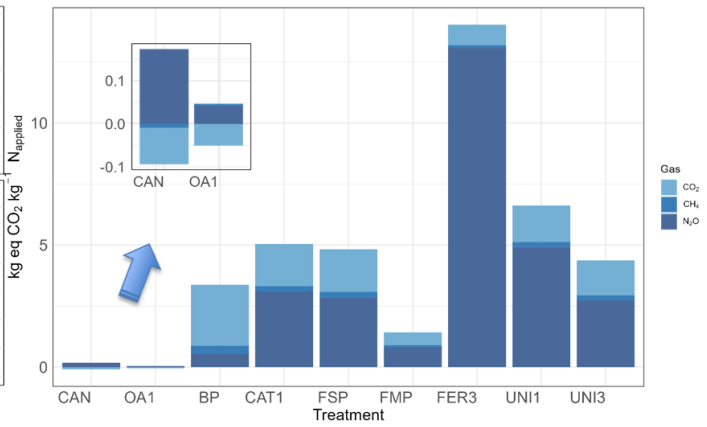

Figure 2: Global warming potential of synthetic and biobased fertilizers

Further information

Deliverable 6.3 Report on nitrogen mineralisation pattern and associated risks

About this abstract

Authors: Jingsi Zhang, Çağrı Akyol, Evi Michels and Erik Meers (Ghent University)
Date: May 2025

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PRACTICE ABSTRACT NO. 5

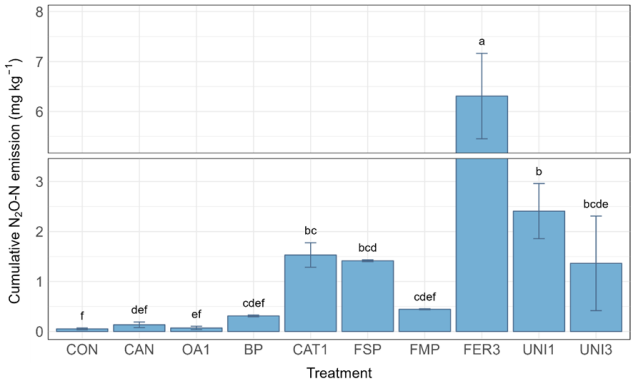
Broeikasgasemissies van biogebaseerde meststoffen afkomstig van visserijafval en -nevenstromen

Belangrijkste resultaten / uitkomsten

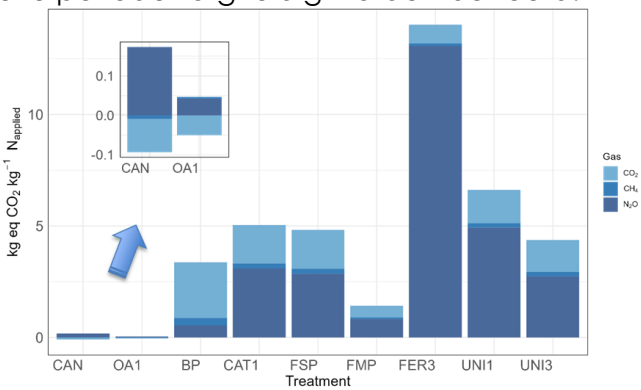
Biogebaseerde meststoffen (BBFs) kunnen broeikasgassen (BKG's) uitstoten zoals lachgas (N_2O), koolstofdioxide (CO_2) en methaan (CH_4), wat invloed heeft op klimaat, luchtkwaliteit en ecosystemen. Het beoordelen van emissieprofielen is essentieel om milieueffecten te minimaliseren en agronomische prestaties te behouden. In deze studie werden emissies van acht organische meststoffen getest in een incubatietest bij 20 ± 2°C: bokashi-pellets (BP), NPK-oplossing met aminozuren (FER3), hydrolysaten (UNI1), chitinerijke meststof (UNI3), eiwitfractie (CAT1), gepelleteerde visafvalmest (FSP), vismixpellets (FMP) en organisch bodemverbeteringsmiddel (OA1) – in vergelijking met minerale meststof (CAN) en een ongefertiliseerde bodem als controle (CON)). De gasemissies piekten in de beginfase en daalden daarna tot het niveau van de controle (CON) na zeven dagen. FER3 vertoonde de hoogste cumulatieve N_2O-emissies, waarbij 4.8% van de stikstof (N) en 30% van de koolstof (C) verloren ging. UNI1 volgde met een stikstofverlies van 1.8% als N_2O. BP (C/N-verhouding 12.3) leidde tot verhoogde CO_2- en CH_4-emissies, goed voor 17% van het koolstofgehalte.

Praktische aanbevelingen

Het broeikaseffectpotentieel (GWP) van deze meststoffen, uitsluitend op basis van hun toepassing in de bodem, werd voornamelijk bepaald door N_2O-emissies. De vloeibare meststof FER3 vertoonde het hoogste GWP, met 13 kg CO_2-equivalent per kg toegediende N, terwijl de andere organische meststoffen varieerden van 0.96 tot 5.3 kg CO_2-eq kg^{-1} N. Hoewel dit vergelijkbaar is met andere organische bodemverbeteraars, lagen deze waarden nog steeds lager dan deze van enkele veelgebruikte synthetische minerale meststoffen (behaalve voor FER3). Daarom is extra aandacht nodig – vooral bij vloeibare meststoffen – tijdens de eerste week na toediening. Landbouwpraktijken zoals irrigatie moeten in deze kritieke periode zorgvuldig worden beheerd.



Figuur 1: Cumulatieve N_2O-emissies van de controle, synthetische en biogebaseerde meststoffen



Figuur 2: Broeikaseffectpotentieel van synthetische en biogebaseerde meststoffen

Verdere informatie

Deliverable 6.3 Report on nitrogen mineralisation pattern and associated risks

Over deze samenvatting

Auteurs : Jingsi Zhang, Çağrı Akyol, Evi Michels en Erik Meers (Universiteit Gent)
Datum: Mei 2025

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PRACTICE ABSTRACT NO. 6

Microplastics in biobased fertilizers derived from fishery waste and by-products

Main results / outcomes

Microplastics (MPs) are tiny plastic particles with size range between 1µm and 5 mm, and can enter soil ecosystems through the application of organic fertilizers. Fisher waste-based organic fertilizers can potentially contain significant number of MPs due to the current plastic contamination of marine environment. Analyzing MPs in organic fertilizers is challenging due to the complex organic matrix — rich in proteins, fats, and mineral residues — which interferes with the extraction of MPs. The most common type of MPs in the examined 8 organic fertilizers — bokashi pellets (BP), an NPK solution with amino acids (FER3), hydrolysates (UNI1), a chitin-rich fertilizer (UNI3), a protein fraction (CAT1), pelleted fish sludge (FSP), fish mix pellets (FMP), and an organic amendment (OA1) — included polyethylene (PE), polypropylene (PP), polystyrene (PS), polyamide (PA), polyurethane (PU) and polyvinyl chloride (PVC), as well as thermoplastics. MP concentrations showed variations across the fertilizers, reaching up to approx. 23,000 items/kg fertilizer.

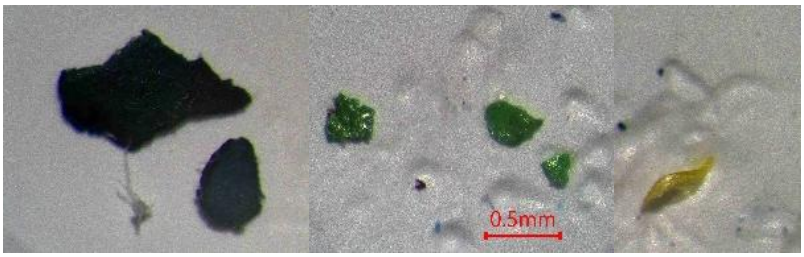

Figure 1: Dark green, green and yellow fragments sorted from the digested CAT1 (protein fraction).

Practical recommendations

Monitoring MPs in organic fertilizers is important for farmers to protect soil health, crop quality, and long-term productivity. MPs can damage soil organisms, reduce fertility, and may be taken up by crops, posing risks to food safety and consumer trust. However, analyzing MPs is technically challenging, often requiring expensive equipment, expert handling, and no universally accepted testing methods — making routine monitoring difficult for most farms. To address this, better waste sorting and treatment — especially in compost and biosolid production — can reduce contamination at the source. Raising awareness, improving guidelines, and investing in simpler, cost-effective testing methods can also help farmers manage this issue more effectively.

Further information

Deliverable 6.4 Report on presence of microplastics

About this abstract

Authors: Jingsi Zhang, Çağrı Akyol, Evi Michels and Erik Meers (Ghent University)
Date: May 2025
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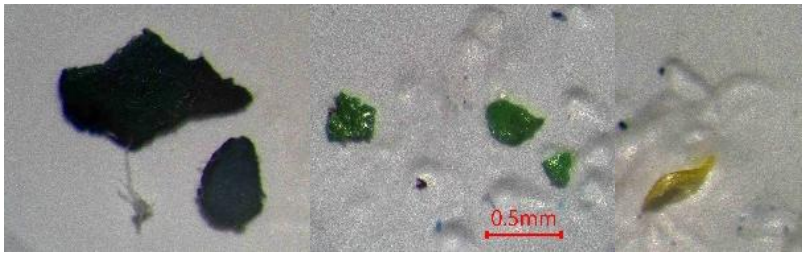
PRACTICE ABSTRACT NO. 6

Microplastics in biogebaseerde meststoffen afkomstig van visserijafval en -nevenstromen

Belangrijkste resultaten / uitkomsten

Microplastics (MPs) zijn kleine plasticdeeltjes met een grootte tussen 1 µm en 5 mm, en kunnen in bodemecosystemen terechtkomen via het gebruik van organische meststoffen. Organische meststoffen op basis van visserijafval kunnen mogelijk een aanzienlijk aantal MPs bevatten, als gevolg van de huidige plasticvervuiling van het mariene milieu. Het analyseren van MPs in organische meststoffen is uitdagend vanwege de complexe organische matrix — rijk aan eiwitten, vetten en minerale reststoffen — die de extractie van MPs belemmert. Het meest voorkomende type MPs in de onderzochte 8 organische meststoffen — bokashi-pellets (BP), NPK-oplossing met aminozuren (FER3), hydrolysaten (UNI1), chitinerijke meststof (UNI3), eiwitfractie (CAT1), gepelleteerde visafvalmest (FSP), vismixpellets (FMP) en organisch bodemverbeteringsmiddel (OA1) — omvatten polyethyleen (PE), polypropyleen (PP), polystyreen (PS), polyamide (PA), polyurethaan (PU) en polyvinylchloride (PVC), evenals thermoplasten. De concentraties MPs varieerden tussen de meststoffen en liepen op tot ongeveer 23,000 deeltjes/kg meststof.



Figuur 1: Donkergroene, groene en gele fragmenten gesorteerd uit het verteerde CAT1 (eiwitfractie).

Praktische aanbevelingen

Het monitoren van MPs in organische meststoffen is belangrijk voor boeren om de bodemgezondheid, de gewaskwaliteit en de lange termijn productiviteit te beschermen. MPs kunnen schadelijk zijn voor bodemorganismen, de vruchtbaarheid verminderen en mogelijk door gewassen worden opgenomen, wat risico's oplevert voor voedselveiligheid en het vertrouwen van consumenten. Het analyseren van MPs is echter technisch uitdagend en vereist vaak dure apparatuur, specialistische kennis en ontbreekt aan gestandaardiseerde methoden, waardoor regelmatige controles voor veel boeren lastig zijn. Om dit aan te pakken, kan betere afvalscheiding en –verwerking — vooral bij compost en rioolslib — de vervuiling bij de bron verminderen. Meer bewustwording, duidelijke richtlijnen en investeringen in eenvoudigere, betaalbare testmethoden kunnen boeren helpen dit probleem effectiever te beheersen.

Verdere informatie

Deliverable 6.4 Report on presence of microplastics

Over deze samenvatting

Auteurs : Jingsi Zhang, Çağrı Akyol, Evi Michels en Erik Meers (Universiteit Gent)
Datum: Mei 2025

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PRACTICE ABSTRACT NO. 7

Soil health assessment using bio-indicators in an Estonian field trial with bio-based fertilizers

Main results / outcomes

It is important to assess the impact of various bio-based fertilizers derived from fish and aquaculture by-products on soil health. Dehydrogenase activity (DHA), soil basal respiration (RCO2), microbial biomass carbon (MBC) and soil fauna (springtails and mites) were used as bioindicators to evaluate the impact of fertilization.

Practical recommendations

Photo 1. Field trial in Estonia

Photo 2. Collection of soil samples

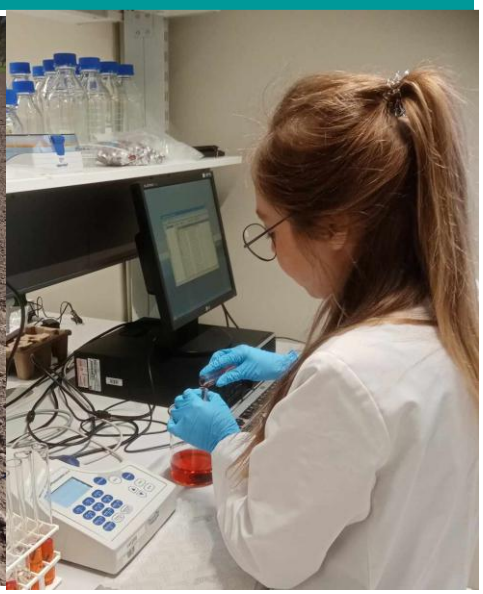

Photo 3. Soil DHA analyses

Dehydrogenase activity is an indicator of soil microbial activity and functionality. Basal respiration, expressed in mg CO_2 released in per gramm of soil per hour, indicates the energy source in the soil and the number of microorganisms. Microbial biomass carbon is directly related to soil microbial biomass and can serve as an early indicator of changes in the soil. Microarthropods, such as mites and springtrails, paly an important role in the decomposition of organic matter and produce feces that serve as a substrate for soil microbes.

Different organic fertilizers applied to the soil resulted in higher bioindicator values compared to mineral fertilizers or no fertilization. In conclusion, the tested bio-based fertilizers significantly enhanced microbial indicators such as microbial biomass carbon and dehydrogenase activity, indicating increased microbial activity. These findings suggest that such bio-based fertilizers can promote soil microbial processes and potentially enhance soil fertility.

About this abstract

Authors: Tiina Talve and Liina Edesi, The Centre of Estonian Rural Research and Knowledge (METK); Jingsi Zhang and Çağrı Akyol, Ghent University (UGENT); Annely Kuu, Estonian University of Life Sciences(EMÜ)
Date: May 2025
SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe.
The project is running from January 2021 to December 2024.
Website: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 7

Biopõhiste väetiste mõju hindamine mulla tervisele bioindikaatoritega Eesti põldkatses

Peamised tulemused/väljund

Oluline on hinnata erinevate kalatööstuse ja vesiviljeluse kõrvalsaadustest toodetud biopõhiste väetiste mõju mulla tervisele. Väetamise mõju hindamiseks kasutati bioindikaatoritena dehüdrogenaasi aktiivsust (DHA), mulla basaalhingamist (RCO2), mikroobse biomassi süsinikku (MBC) ning mulla faunat (hooghännalised ja lestad).

Praktilised soovitused

Foto 1. SEA2LAND põldkatse

Foto 2. Mullaproovide kogumine

Foto 3. DHA analüüs laboris

Dehüdrogenaasi aktiivsus on mulla mikroobide aktiivsuse ja funktsionaalsuse näitaja. Basaalhingamine, väljendatuna vabanenud CO_2 milligrammi mulla grammi kohta tunnis näitab mullas leiduvat energiaallikat ja mikroorganismide arvu. Mikroobne biomassi süsinik on otseselt seotud mulla mikroobse biomassiga ja võib varajaselt näidata mulla muutusi. Mikrolülijalgsed, nagu lestad ja hooghännalised, mängivad olulist rolli orgaanilise aine lagunemisel ja nende väljaheited on mullaelustikule substraadiks.

Erinevate biopõhiste orgaaniliste väetistega töötlused näitasid kõrgemaid bioindikaatorite väärtusi kui mineraalväetisega või üldse väetamata töötlused. Kokkuvõttes võib öelda, et katsetes olevad biopõhised väetised suurendasid oluliselt mullaelustiku näitajaid, nagu mikroobse süsiniku sisaldus ning dehüdrogenaasi aktiivsus. Need tulemused viitavad, et biopõhised väetised võivad soodustada mulla mikroobseid protsesse ja suurendada mulla viljakust.

Info abstrakti kohta

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Kuupäev: May, 2025

Projekt **SEA2LAND** on koostööl põhinev innovatsioonitegevus (IA), mida EL rahastab programmi Horisont 2020 raames. Projekti eesmärk on pakkuda lahendusi, mis aitavad ületada toidutootmise, kliimamuutuste ja jäätmete taaskasutusega seotud väljakutseid. Ringmajanduse mudelist lähtuvalt edendab SEA2LAND EL-s suuremahuliste väetiste tootmist oma toorainest. Selle lahendusega loodetakse vähendada mulla toitainete tasakaalustamatust Euroopas. Projekt kestab 2021. aasta jaanuarist kuni 2024. aasta detsembrini.

Veebileht: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 8

Biofertilisers from fish by-products for organic farming

Main results

Organic farming imposes restrictions on the use of fertilisers, such as the exclusion of easily soluble mineral fertilisers. This may result in nutrient limitations in some cases. Bio-based fertilisers derived from fishery and aquaculture by-products are a valuable source of nitrogen, phosphorous and potassium. They present a sustainable solution to nutrient management in organic agriculture.

Practical recommendations

Eight different fertilisers were developed in SEA2LAND. Out of these, three products comply with the relevant legislation for EU organic production. These products, mainly consisting of fish proteins, valorise residues from fisheries and aquaculture, contribute to nutrient recycling, lower environmental impact and help reduce the EU's dependency on imported nutrients. Both, organic and conventional farmers are allowed to use these products when respecting certain restrictions. In particular, farmers should not apply them directly on edible parts of the plant and be sure to comply with applicable national legislation in the Member State.

Four other fertilisers developed in the project are currently not allowed for use in organic farming. Their non-compliance is mainly because of legal formalities, not because of fundamental non-compliance with the principles of organic farming. To bring more of these valuable, recycled fertilisers to market, more dialogue between the central stakeholders, such as farmers, advisers, policymakers and certifiers is needed.

Fish hydroloysates | Chitin-rich fertiliser | Fish protein fraction

Figure 1: Three fertilisers from fish by-products complying with EU organic production rules (Credits: Çağrı Akyol)

Further information

Report: Pedross P (2024). Evaluation of bio-fertiliser prototypes against their compliance with EU organic legislation. FiBL Europe.
Report: Zhang J & Akyol Ç (2023). Composition & quality report of tailor-made bio-based fertilisers. UGENT.

About this abstract

Authors: Bram Moeskops (FiBL Europe), Pia Pedross (FiBL Europe)
Date: May 2025
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PRACTICE ABSTRACT NO. 9

Bio-based P fertilisers perform as well as conventional ones under real field conditions

Main results / outcomes

Phosphorus is essential for crop growth, but Europe relies heavily on imported P fertilisers made from mined, non-renewable resources. New field trials in cereals and sunflower across Europe showed that several bio-based fertilisers performed just as well as conventional inorganic fertilisers. The best results came from products based on struvite, dicalcium phosphate, or phytate.

Practical recommendations

Farmers can use these bio-based fertilisers as reliable alternatives to conventional P products, especially on fields with low P levels. They offer a way to reduce dependence on imported phosphate while recycling valuable nutrients from organic waste. Struvite and dicalcium phosphate products showed the most consistent performance across sites. Regular use over time may also build up benefits. However, not all bio-based fertilisers work equally well in all conditions. As for any other P-fertiliser, soil tests (especially Olsen P) help predict whether a crop will respond to P application. Farmers should start by trialling bio-based fertilisers on a small area and comparing yields. Sharing field experiences at regional level can help build confidence and develop clear, locally adapted recommendations.

Figure 1: Phosphorite mine (CC0 1.0; Mark A. Wilson)

Figure 2: Readily dried struvite (CC 2.0; M. Winker)

Further information

Frick H et al. (2025) Bio-based fertilisers can replace conventional inorganic P fertilisers under European pedoclimatic conditions. Field Crops Research: 109803
https://doi.org/10.1016/j.fcr.2025.109803
Recena R et al. (2022) Assessing the phosphorus demand in European agricultural soils based on the Olsen method." Journal of Cleaner Production 379: 134749.
https://doi.org/10.1016/j.jclepro.2022.134749

About this abstract

Authors: Bram Moeskops (FiBL Europe), Hanna Frick (FiBL), Else K. Bünemann (FiBL)

Date: May 2025

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PRACTICE ABSTRACT NO. 10

Social life cycle assessment of fishery-based bio-fertilisers (BBF)

Main results / outcomes

The social life-cycle assessment could indicate the main hotspots of BBF production in five impact categories (fig.1 & fig.2). The study considered different sources of impacts :

- Impacts resulting from process implementation : The Estonian case study process would have the most positive impacts, inducing **significant job creation** with low water and energy consumption and low health concerns.
- Impacts of the fishing/aquaculture and fertilizing/chemistry (fig. 1) sectors in the different countries. European and national regulations largely shape social impacts but significant differences are observed between countries. **Health and Safety risks** are prevalent with musculoskeletal disorders, acute injuries, and exposure to hazardous conditions. Issues of **migrant labor, gender representation and discrimination** were also observed.
- Impacts of the supply chain of the different BBFs (fig. 2). **Transport** and **production** of high-cost ingredients (e.g. enzymes in Italian case study) contribute significantly to social impacts, with health and safety being the most impacted category. These impacts increase significantly with the price of fish wastes.

Practical recommendations

Implementing the findings of this sLCA can help addressing different hotspots. For example :

- Prioritize local and responsible sourcing to minimize supply chain impacts. Collaborate with suppliers to ensure compliance with social standards
- Encourage companies to implement extensive health and safety training and awareness programs for workers, adopt stricter safety regulations and certifications (e.g., ISO 45001, Responsible Care), implement diversity programs and anti-discrimination policies,

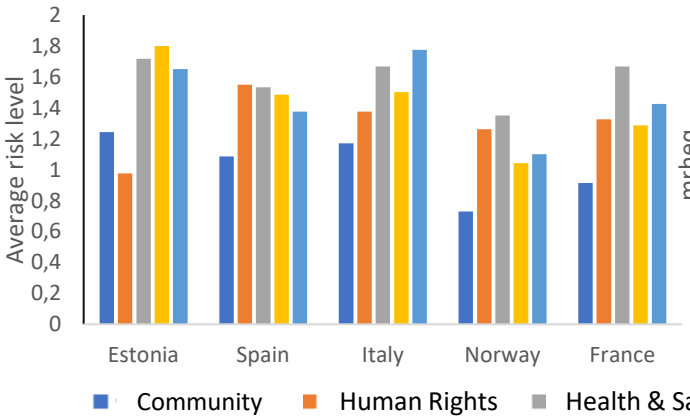

Figure 1: average level of social risk in five impact categories for the chemical sector in different countries of BBF production (0 : No risk ; 1: Low evidence ; 2 : Medium risk)

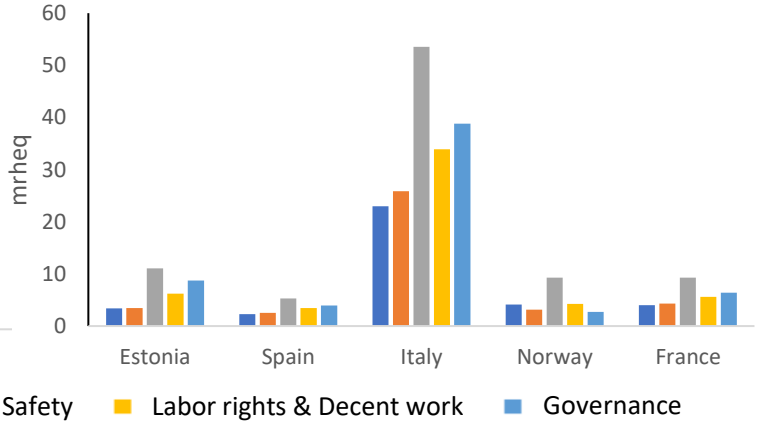

Figure 2: number of medium risk-hour equivalent in five impact categories for the supply chain of the production of 1 ton of BBF (considering wastes as burden-free)

Further information

Kurniawati, A., Stankovics, P., Hilmi, Y.S., Toth, G., Smol, M., Toth, Z., 2023. Understanding the future of bio-based fertilisers: The EU's policy and implementation. Sustainable Chemistry for Climate Action 3, 100033. https://doi.org/10.1016/j.scca.2023.100033

About this abstract

Authors: Jean-François FABRE, Claire VIALLE, Caroline SABLAYROLLES / Toulouse

Date: May 2025

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PRACTICE ABSTRACT NO. 10

Analyse sociale du cycle de vie des bio-fertilisants issus des déchets de la pêche/aquaculture

Résultats principaux

L'analyse sociale du cycle de vie a pu identifier les risques majeurs inhérents à la production de biofertilisants dans cinq catégories d'impact (fig.1 & fig.2). L'étude a pris en compte différentes sources d'impact :

- Impacts résultant de la mise en œuvre des procédés : le procédé mis en place en Estonie aurait les meilleurs impacts sociaux alliant **création d'emplois,** faible consommation d'eau et d'énergie et faibles impacts sur la santé.
- Impacts des secteurs de la pêche/aquaculture et de la fertilisation/chimie (fig. 1) dans les différents pays. Les impacts sociaux sont largement influencés par les réglementations européennes et nationales avec des différences marquées entre pays. Les **risques en matière de santé et de sécurité** prévalent, avec des troubles musculo-squelettiques et des blessures aiguës. Des problèmes de **main-d'œuvre immigrée, parité homme/femme et discrimination** ont également été observés.
- Impacts de la chaîne d'approvisionnement des différents biofertilisants (fig. 2). Le transport et la production de certains ingrédients coûteux (par exemple, les enzymes dans l'étude de cas italienne) contribuent de manière significative aux impacts sociaux, la santé et la sécurité étant la catégorie la plus touchée. Ces impacts augmentent avec le prix des déchets de poisson.

Recommandations pratiques

Cette étude fournit plusieurs recommandations comme, par exemple :

- Favoriser l'approvisionnement local et responsable en collaborant avec les fournisseurs pour garantir le respect des normes sociales.
- Encourager les entreprises à mettre en place d'importants programmes de formation et de sensibilisation des travailleurs en matière de santé et de sécurité, à adopter des réglementations et des certifications plus strictes en matière de sécurité (par exemple, ISO 45001, Responsible Care), à mettre en œuvre des programmes de diversité et des politiques antidiscriminatoires,

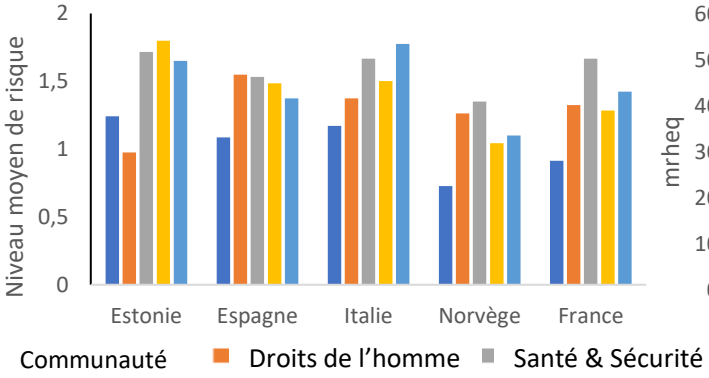

Figure 1: niveau moyen de risque social pour le secteur de la chimie dans différents pays producteurs de BBF (0 : Pas de risque; 1: Risque faible ; 2 : Risque moyen)

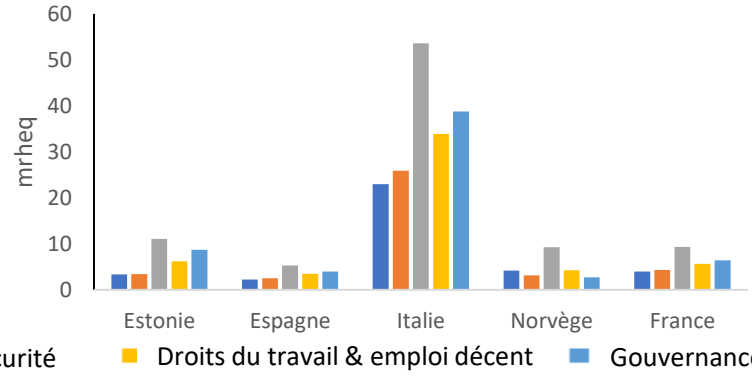

Figure 2: nombre d'heures en équivalent "risque moyen" pour la chaîne d'approvisionnement d'1 tonne de BBF (déchets de poisson sans valeur marchande)

Informations complémentaires

Kurniawati, A., Stankovics, P., Hilmi, Y.S., Toth, G., Smol, M., Toth, Z., 2023. Understanding the future of bio-based fertilisers: The EU's policy and implementation. Sustainable Chemistry for Climate Action 3, 100033. https://doi.org/10.1016/j.scca.2023.100033

A propos de ce résumé

Auteurs: Jean-François FABRE, Claire VIALLE, Carolline SABLAYROLLES / Toulouse

Date: Mai 2025

Le projet **SEA2LAND** est une action d'innovation collaborative (IA) financée par l'UE dans le cadre du programme Horizon 2020. Le projet vise à fournir des solutions pour aider à surmonter les défis liés à la production alimentaire, au changement climatique et à la réutilisation des déchets. Sur la base du modèle d'économie circulaire, SEA2LAND encourage la production d'engrais à grande échelle dans l'UE à partir de matières premières propres. Cette solution devrait permettre de réduire le déséquilibre des nutriments du sol en Europe. Le projet se déroule de janvier 2021 à décembre 2024.

Site web : www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 11

SEA2LAND

UNIVERSITÀ POLITECNICA DELLE MARCHE

UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE AGRARIE E AMBIENTALI - PRODUZIONE, TERRITORIO, AGROENERGIA

Testing the amending efficacy of compost-biochar composite from fish waste

Main results / outcomes

A compost–biochar composite (CB) was produced by co-composting fish waste with biochar, also derived from fish waste, and a bulking agent (pruning waste), (biorefinery scheme in Figure 1). CB was analyzed (Table 1) to evaluate its compliance with REGULATION (EU) 2019/1009 for classification as an organic soil improver (PFC 3(A)). Its properties were also compared with a reference compost (C), obtained by composting fish waste with pruning waste without biochar. In addition, a pot incubation trial was conducted to assess the soil amending efficacy of CB relative to C. The trial evaluated their effects on water holding capacity (WHC) and retained water after 7 days without watering in two soils with contrasting textures: a sandy-loam (SL) and a clay-loam soil (CL) (Table 2).

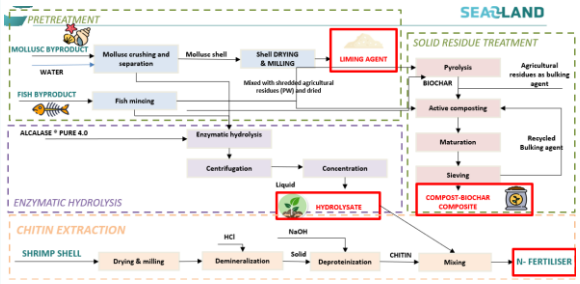

Figure 1 Biorefinery scheme of Adriatic Sea pilot

Table 1 Chemical characterization of simple compost (C) and Compost-Biochar composite (CB)

Parameter	C	CB	EU 2019/1009
Dry matter	89.64 ± 0.02	90.17 ± 0.07	> 20
pH	7.11 ± 0.02	7.15 ± 0.04	
Electrical conductivity	2.42 ± 0.00	2.1 ± 0.03	
Organic carbon %	30.64 ± 0.99	43.89 ± 1.11	> 7.5
Total Nitrogen %	3.47 ± 0.04	2.93 ± 0.11	
Organic Nitrogen %	3.44 ± 0.04	2.89 ± 0.11	
C_{org}/N	8.82	14.96	
P_2O_5 %	1.65 ± 0.09	1.08 ± 0.17	
K_2O %	1.05 ± 0.1	0.9 ± 0.07	
Salmonella	Not detected	Not detected	0
E. coli	<10	<10	< 1 000

Table 2 Residual water after 7 days withot watering and water contet at full WHC

	residual water after 7 d	water content at WHC
	% D.M.	% D.M.
SL soil		
B	4.1 ± 0.3	31.6 ± 3.3
C	5.0 ± 0.2	35.1 ± 0.2
CB	5.6 ± 0.4	35.5 ± 0.2
CL soil		
B	10.6 ± 0.5	51.7 ± 2.7
C	11.3 ± 0.3	55.3 ± 2.6
CB	12.0 ± 0.4	53.2 ± 1.5

Practical recommendations

Several bio-based, waste-derived materials are used as soil improvers due to their high organic C content and positive influence on soil physical and chemical properties, such as soil-water relationships and soil's ability to retain nutrients in bioavailable forms. Compliance with parameters established by REGULATION (EU) 2019/1009 for organic soil improvers (PFC 3 (A)) alone does not provide comprehensive information about a product's actual effectiveness in enhancing soil fertility. Field trials can offer such insights, but they are resource-intensive. In contrast, pot trials offer a more efficient and versatile alternative, enabling to test different materials across various soil types simultaneously. Moreover, they allow for greater flexibility: testing parameters can be expanded and the incubation time adjusted as needed. This adaptability enhances the reliability and applicability of pot trials as a practical tool for evaluating the efficacy of organic soil improvers.

Further information

https://biochar.co.uk/soil-improver/

Garbowski et al. An overview of natural soil amendments in agriculture. Soil&Tillage Res. 225, 105462 (2023)

About this abstract

Authors: Marta Dell'Orto (UMIL), Salman Nisar (UNIVPM), Carla Maggetti (UNIVPM), Francesco Fatone (UNIVPM), Fabrizio Adani (UMIL)

Date: May 2025

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UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE AGRARIE E AMBIENTALI - PRODUZIONE, TERRITORIO, AGROENERGIA

Valutazione dell'efficacia ammendante di un composito compost-biochar

Main results / outcomes

Un composito compost-biochar (CB) è stato prodotto mediante co-compostaggio di scarti di pesce con biochar, anch'esso derivato da scarti di pesce, e scarti di potatura (schema di bioraffineria in Figura 1). Il CB è stato analizzato (Tabella 1) per valutarne la conformità al REGOLAMENTO (UE) 2019/1009 come ammendante organico (PFC 3(A)). Le sue proprietà sono state inoltre confrontate con quelle di un compost di riferimento (C), ottenuto mediante compostaggio di scarti di pesce con scarti di potatura senza biochar. Inoltre, è stata condotta una prova di incubazione in vaso per valutare l'efficacia ammendante del CB rispetto al C. La prova ha valutato i loro effetti sulla capacità idrica massima (WHC) e sulla ritenzione idrica dopo 7 giorni senza irrigazione in due suoli con tessiture contrastanti: uno franco sabbioso (SL) e uno franco-argilloso (CL).

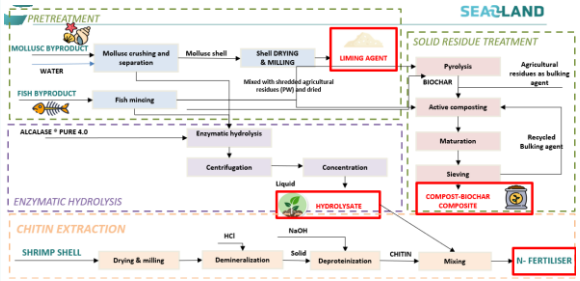

Figura 1 Schema di bioraffineria impianto pilota Adriatico

Tabella 1 Caratterizzazione chimica di un compost senza biochar (C) e di un composito compost-biochar

Parameter	C	CB	EU 2019/1009
Dry matter	89.64 ± 0.02	90.17 ± 0.07	> 20
pH	7.11 ± 0.02	7.15 ± 0.04	
Electrical conductivity	2.42 ± 0.00	2.1 ± 0.03	
Organic carbon %	30.64 ± 0.99	43.89 ± 1.11	> 7.5
Total Nitrogen %	3.47 ± 0.04	2.93 ± 0.11	
Organic Nitrogen %	3.44 ± 0.04	2.89 ± 0.11	
C_{org}/N	8.82	14.96	
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K_2O %	1.05 ± 0.1	0.9 ± 0.07	
Salmonella	Not detected	Not detected	0
E. coli	<10	<10	< 1 000

Tabella 2 Acqua residua dopo 7 giorni senza irrigazione e capacità idrica

	residual water after 7 d	water content at WHC
	% D.M.	% D.M.
SL soil		
B	4.1 ± 0.3	31.6 ± 3.3
C	5.0 ± 0.2	35.1 ± 0.2
CB	5.6 ± 0.4	35.5 ± 0.2
CL soil		
B	10.6 ± 0.5	51.7 ± 2.7
C	11.3 ± 0.3	55.3 ± 2.6
CB	12.0 ± 0.4	53.2 ± 1.5

Practical recommendations

Diversi materiali biologici derivati da rifiuti vengono utilizzati come ammendanti grazie al loro elevato contenuto di C organico e all'influenza positiva sulle proprietà fisiche e chimiche del suolo, come il rapporto suolo-acqua e la capacità di trattenere i nutrienti in forme biodisponibili. Il solo rispetto dei parametri stabiliti dal REGOLAMENTO (UE) 2019/1009 per gli ammendanti organici (PFC 3 (A)) non fornisce informazioni esaustive sull'effettiva efficacia di un prodotto nel migliorare la fertilità del suolo. Le prove in campo possono offrire tali informazioni, ma richiedono un elevato impiego di risorse. Al contrario, le prove in vaso offrono un'alternativa più efficiente e versatile, consentendo di testare contemporaneamente materiali diversi su diversi tipi di terreno. Inoltre, consentono una maggiore flessibilità: i parametri di prova possono essere aumentati e il tempo di incubazione regolato in base alle esigenze. Questa adattabilità aumenta l'affidabilità e l'applicabilità delle prove in vaso come strumento pratico per valutare l'efficacia degli ammendanti organici.

Further information

https://biochar.co.uk/soil-improver/

Garbowski et al. An overview of natural soil amendments in agriculture. Soil&Tillage Res. 225, 105462 (2023)

About this abstract

Authors: Marta Dell'Orto (UMIL), Salman Nisar (UNIVPM), Carla Maggetti (UNIVPM), Francesco Fatone (UNIVPM), Fabrizio Adani (UMIL)

Date: May 2025

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Website: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 12

Assessing the Economic Viability of Biochar-compost Composite Production as an Innovative Bio-Based Fertiliser

Main results / outcomes

The analysis shows that all financial indicators are strongly negative when using the nutrient price method, indicating that producing biochar-compost composite, under this pricing strategy, is economically unfeasible. A total of 635 tons of waste is required to produce the targeted amount of bio-based fertilizer (BBF). Using self-sourced inputs does not significantly improve profitability due to the low raw material (input) cost and high equipment expenses. However, under the cost-based method, the most favorable outcome was achieved using own input, with a BBF selling price of €62,800 per ton, when a payback period is 8.03 years, and a gross margin 41.34%. This represents the most economically viable scenario identified in the study.

Practical recommendations

Efforts should be focused on regions with favorable economic conditions, such as lower labour and energy costs, to maximize the viability of production. Where feasible, using self-sourced inputs may offer marginal benefits but is not a key factor in profitability due to the dominant influence of equipment costs. To improve financial outcomes, practitioners should explore cost-reduction strategies, such as shared equipment, energy-efficient technologies, or process optimization. Finally, pilot implementations should be concentrated in areas like Italy, where the model has shown the best potential for economic sustainability.

	Nutrient price method			
Biochar composite	STREAM INPUT	BBF PRODUCED	Net profit (EBIT)	PRICE
Norway				
purchased input	635,00 ton/year	16,584 ton/year	-811.038,48	20,84 eur/t
own input	635,00 ton/year	16,584 ton/year	-677.688,48	20,84 eur/t
Italy				
purchased input	635,00 ton/year	16,584 ton/year	-788.428,06	20,84 eur/t
own input	635,00 ton/year	16,584 ton/year	-610.628,06	20,84 eur/t

Figure 1: Nutrient price method financial results

	Cost method					
Biochar composite	STREAM INPUT	BBF PRODUCED	Net profit (EBIT)	Gross margin (GM)	Payback period (PP)	PRICE
Norway						
purchased input	635,00 ton/year	16,584 ton/year	424.123,91	34,33%	8,15 year	74.500 eur/t
own input	635,00 ton/year	16,584 ton/year	424.801,91	38,52%	8,14 year	66.500 eur/t
Italy						
purchased input	635,00 ton/year	16,584 ton/year	421.858,33	34,85%	8,19 year	73.000 eur/t
own input	635,00 ton/year	16,584 ton/year	430.501,53	41,34%	8,03 year	62.800 eur/t

Figure 2: Cost method financial results

Further information

SEA2LAND project website - https://sea2landproject.eu/

About this abstract

Authors: IPS Konzalting d.o.o. za poslovne usluge
Date: May 2025
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PRACTICE ABSTRACT NO. 12

Procjena ekonomske isplativosti proizvodnje biougljena kao inovativnog biognojiva

Glavni rezultati/ishodi

Istraživanje pokazuje da su svi financijski pokazatelji izrazito negativni kada se koristi metoda cijene hranjivih tvari, što ukazuje da je proizvodnja biougljena prema ovoj strategiji ekonomski neisplativa. Za proizvodnju ciljane količine ovog biognojiva potrebno je ukupno 635 tona ribljeg otpada. Korištenje sirovina iz vlastitih izvora ne poboljšava značajno profitabilnost zbog niske cijene sirovina i visokih troškova opreme. Međutim, prema metodi koja se temelji na troškovima, najpovoljniji ishod postignut je ipak korištenjem vlastitih sirovina, s cijenom biognojiva od 62.800 € po toni, razdobljem povrata od 8,03 godine i bruto maržom od 41,34%. Ovo predstavlja ekonomski najodrživiji scenarij identificiran u studiji.

Preporuke

Napore treba usmjeriti na regije s povoljnim gospodarskim uvjetima, kao što su niži troškovi rada i energije, kako bi se povećala održivost proizvodnje. Gdje je to izvedivo, korištenje sirovina iz vlastitih izvora može omogućiti marginalne koristi, ali nije ključni čimbenik profitabilnosti, i to zbog dominantnog utjecaja troškova opreme. Kako bi poboljšali financijske rezultate, potencijalni ulagači bi trebali istražiti strategije smanjenja troškova, kao što su zajednička oprema, energetski učinkovite tehnologije ili optimizacija procesa. Konačno, implementacija postrojenja trebala bi se fokusirati na područja poput Italije, gdje je model pokazao dobar potencijal za ekonomsku održivost.

	Nutrient price method			
Biochar composite	STREAM INPUT	BBF PRODUCED	Net profit (EBIT)	PRICE
Norway				
purchased input	635,00 ton/year	16,584 ton/year	-811.038,48	20,84 eur/t
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own input	635,00 ton/year	16,584 ton/year	-610.628,06	20,84 eur/t

Slika 1. Rezultati profitabilnosti uz „metodu cijene nutrijenata" određivanja prodajne cijene

	Cost method					
Biochar composite	STREAM INPUT	BBF PRODUCED	Net profit (EBIT)	Gross margin (GM)	Payback period (PP)	PRICE
Norway						
purchased input	635,00 ton/year	16,584 ton/year	424.123,91	34,33%	8,15 year	74.500 eur/t
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own input	635,00 ton/year	16,584 ton/year	430.501,53	41,34%	8,03 year	62.800 eur/t

Slika 2. Rezultati profitabilnosti uz troškovnu metodu određivanja prodajne cijene

Više informacija

SEA2LAND projektna stranica - https://sea2landproject.eu/

Opširnije o praktičnom sažetku

Autor: IPS Konzalting d.o.o. za poslovne usluge
Datum: Svibanj 2025

SEA2LAND projekt je suradnička inovacijska akcija (IA) koju financira EU u okviru programa Horizon 2020. Cilj projekta je pružiti rješenja koja će pomoći u prevladavanju izazova povezanih s proizvodnjom hrane, klimatskim promjenama i ponovnom uporabom otpada. Na temelju modela kružnog gospodarstva, SEA2LAND promiče proizvodnju velikih količina gnojiva u EU iz vlastitih sirovina. Očekuje se da će ovo rješenje smanjiti neravnotežu hranjivih tvari u tlu u Europi. Projekt traje od siječnja 2021. do lipnja 2025. godine. Web stranica: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 13

Assessing the Economic Viability of Biostimulant Production as an Innovative Bio-Based Fertiliser

Main results / outcomes

This study assesses the economic feasibility of producing Foliar fertilizer incorporating amino acids, humic extract, and organic matter(FER4) – „biostimulant" in Norway and Italy, utilizing two pricing models: nutrient-based and cost-based model. The nutrient-based pricing model resulted in negative profitability across all scenarios, indicating its impracticality. In contrast, the cost-based pricing model generated positive profitability in both countries, with Norway exhibiting a marginally higher selling price for the bio-based fertilizer (BBF). The findings conclude that the cost-based approach is the only financially viable method for determining the selling price of FER4.

Practical recommendations

The primary benefit of applying these findings for end-users and practitioners is the reduction of financial risks of the establishment of BBF production and enhanced decision-making. By adopting a cost-based pricing strategy, producers can secure profitability and long-term financial stability. These results are particularly relevant for regions with lower operating costs, such as labuor and electricity, where the business model proves more advantageous. Practitioners should prioritize optimizing cost-efficiency, focusing on energy savings and resource management, rather than solely on input sourcing. This approach makes bio-based fertilizers production a more practical and feasible solution within the bioeconomy, supporting circular resource utilization and promoting sustainable agricultural practices.

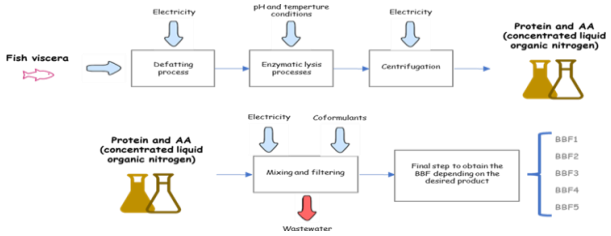

Figure 1: Production scheme of „biostimulant"

	Cost method					
Foliar fertilizer with amino acid, humic extract, organic matter (FER4)	Net profit (EBIT)	Net profit before amortization (EBITDA)	Gross margin (GM)	Return on investment (ROI)	Payback period (PP)	PRICE
Norway						
purchased input	309.222,73	477.392,72	22,04%	12,25%	8,17 years	4.800 eur/ton
own input	312.736,73	480.906,72	29,31%	12,39%	8,07 years	3.650 eur/ton
Italy						
purchased input	314.965,22	483.135,21	24,22%	12,47%	8,02 years	4.450 eur/ton
own input	314.095,02	482.265,01	32,71%	12,44%	8,04 years	3.285 eur/ton

Figure 2: Sum up table for financial indicators of FER4 production

Further information

SEA2LAND project website - https://sea2landproject.eu/

About this abstract

Authors: IPS Konzalting d.o.o. za poslovne usluge
Date: May 2025
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PRACTICE ABSTRACT NO. 13

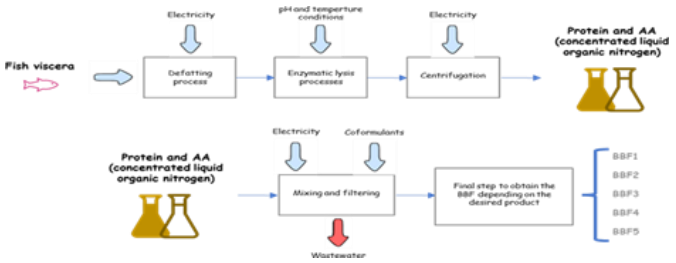
Procjena ekonomske isplativosti proizvodnje biostimulansa kao inovativnog biognojiva

Glavni rezultati/ishodi

Analiza procjenjuje ekonomsku isplativost proizvodnje folijarnog gnojiva koje uključuje aminokiseline, huminske kiselone i organsku tvar – tzv. „biostimulansa" u Norveškoj i Italiji, koristeći dva modela određivanja cijena: na temelju udjela nutrijenata (NPK) i na temelju troškova proizvodnje. Model određivanja cijene proizvoda - biostimulansa na temelju udjela nutrijenata rezultirao je negativnom profitabilnošću u svim scenarijima, što ukazuje na nepraktičnost ove metode. Nasuprot tome, model određivanja cijene koji se temelji na troškovima proizvodnje generirao je pozitivnu profitabilnost u obje zemlje na kojima se temeljio poslovni scenarij, pri čemu je u Norveškoj formirana neznatna viša cijena kao prodajna cijena biostimulansa. Rezultati zaključuju da je pristup temeljen na troškovima jedina financijski održiva metoda za određivanje prodajne cijene biostimulansa.

Preporuke

Uz pomoć dobivenih rezultata potencijalni ulagači mogu smanjiti proizvodne rizike i poboljšati donošenje odluka. Usvajanjem strategije određivanja cijena koja se temelji na troškovima, proizvođači mogu osigurati profitabilnost i dugoročnu financijsku stabilnost. Ovi su rezultati osobito relevantni za regije s nižim operativnim troškovima, poput troška rada i električne energije, gdje se poslovni model proizvodnje pokazao povoljnijim. Ulagači bi trebali dati prednost optimizaciji troškovne učinkovitosti, usredotočujući se na uštedu energije i upravljanje resursima, a ne samo na izvor ulaznih sirovina. Ovaj pristup čini proizvodnju praktičnim i izvedivim rješenjem unutar biogospodarstva, podupirući kružno korištenje resursa i promičući održive poljoprivredne prakse.



Slika 1. Prikaz tijeka proizvodnje „biostimulansa"

Foliar fertilizer with amino acid, humic extract, organic matter (FER4)	Cost method					
	Net profit (EBIT)	Net profit before amortization (EBITDA)	Gross margin (GM)	Return on investment (ROI)	Payback period (PP)	PRICE
Norway						
purchased input	309.222,73	477.392,72	22,04%	12,25%	8,17 years	4.800 eur/ton
own input	312.736,73	480.906,72	29,31%	12,39%	8,07 years	3.650 eur/ton
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own input	314.095,02	482.265,01	32,71%	12,44%	8,04 years	3.285 eur/ton

Slika 2. Financijski pokazatelji proizvodnje „biostimulansa"

Više informacija

SEA2LAND projektna stranica - https://sea2landproject.eu/

Opširnije o praktičnom sažetku

Autor: IPS Konzalting d.o.o. za poslovne usluge
Datum: Svibanj 2025

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PRACTICE ABSTRACT NO. 14

Business Model Canvas for agricultural producers

Main results / outcomes

Within **the SEA2LAND project**, business models **for agricultural producers** were developed using a holistic CANVAS approach. This process integrated data from dissemination activities, project outcomes and direct stakeholder input via surveys, interviews and workshops. The final model reflects the needs and priorities of agricultural producers, emphasizing the benefits of bio-based fertilizers (BBFs) derived from fishery by-products. Key value propositions identified include sustainability, improved soil health, long-term cost-effectiveness, and alignment with circular economy principles. BBFs offer an eco-friendly alternative to mineral fertilizers, enhancing soil fertility and structure while reducing environmental impact. Their slow-release nutrient profile supports healthier crops and higher yields, making BBFs a viable solution for sustainable and resilient agriculture.

Practical recommendations

To ensure successful adoption, agricultural producers should be supported through continuous consultations, field demonstrations and personalized agronomic advice to optimize BBF use. Education efforts such as workshops, webinars and user-friendly guides should highlight BBF advantages. Pilot projects and on-farm trials, supported by testimonials and transparent data, will build trust and demonstrate real-world benefits. Collaborations with cooperatives and associations can improve accessibility through group purchasing and collective trials, while aligning BBFs with policy incentives and subsidy schemes. These combined efforts will empower farmers to confidently transition to BBFs, strengthening both farm resilience and environmental sustainability.

Figure 1: Business Model Canvas for agricultural producers

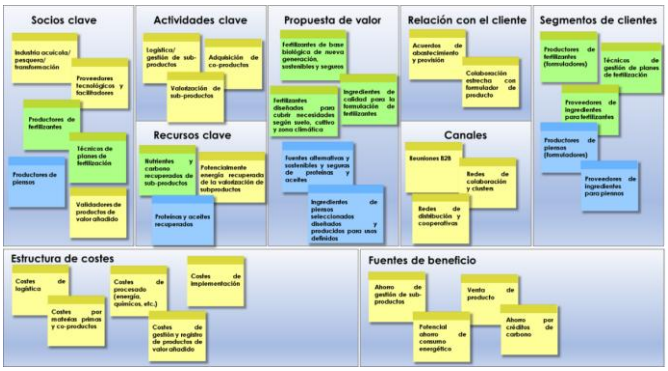

Figure 2: Input for Business Model Canvases recieved through brainstorm sessions

Further information

SEA2LAND project website - https://sea2landproject.eu/

About this abstract

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PRACTICE ABSTRACT NO. 14

Poslovni model Canvas za poljoprivredne proizvođače

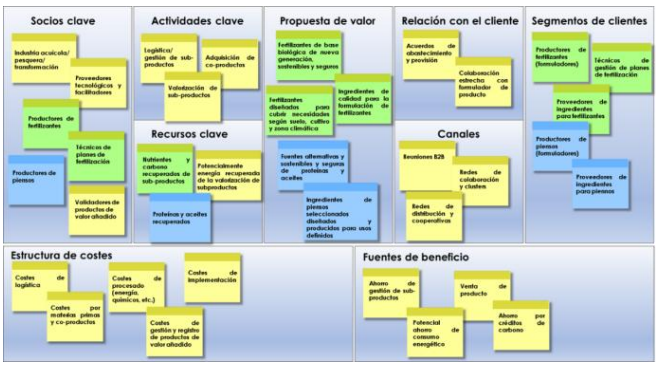
Glavni rezultati / ishodi

U sklopu **SEA2LAND projekta** razvijeni su poslovni modeli **za poljoprivredne proizvođače** koristeći holistički CANVAS pristup. Proces je uključivao podatke iz aktivnosti diseminacije, rezultata projekta i izravnih povratnih informacija dionika putem anketa, intervjua i radionica. Konačni model odražava potrebe i prioritete poljoprivrednika, naglašavajući prednosti bio-gnojiva (BBF) dobivenih iz ribljih nusproizvoda. Ključne vrijednosti uključuju održivost, zdravlje tla, dugoročnu isplativost i usklađenost s načelima kružnog gospodarstva. BBF-ovi predstavljaju ekološki prihvatljivu alternativu mineralnim gnojivima, poboljšavajući plodnost i strukturu tla te smanjujući negativan utjecaj na okoliš. Njihovo postupno otpuštanje hranjiva potiče zdraviji rast usjeva i veće prinose, čineći ih održivim rješenjem za otporniju poljoprivredu.

Preporuke

Za uspješnu primjenu BBF-a poljoprivrednicima je potrebna kontinuirana podrška kroz savjetovanja, terenske demonstracije i prilagođene agronomske preporuke. Edukacijske aktivnosti poput radionica, webinara i pristupačnih vodiča trebaju istaknuti prednosti BBF-a u odnosu na mineralna gnojiva. Pilot-projekti i ogledi na farmama, potkrijepljeni svjedočanstvima i transparentnim podacima, izgradit će povjerenje i prikazati stvarne koristi. Suradnja sa zadrugama i udrugama može povećati dostupnost kroz zajedničke nabave i grupne pokuse, dok usklađivanje s poticajima i politikama dodatno potiče usvajanje. Ove aktivnosti omogućuju poljoprivrednicima sigurnu tranziciju prema održivim gnojivima, jačajući otpornost proizvodnje i zaštitu okoliša.

Slika 1: Poslovni model Canvas za poljoprivredne proizvođače



Slika 2: Prikupljene informacije za Canvas poslovne modele kroz brainstorm radionice

Više informacija

SEA2LAND projektna stranica - https://sea2landproject.eu/

Detaljnije o praktičnom sažetku

Autor: IPS Konzalting d.o.o. za poslovne usluge
Datum: Svibanj 2025

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PRACTICE ABSTRACT NO. 15

Business Model Canvas for fertilizing industry

Main results / outcomes

The SEA2LAND project developed **a Business Model Canvas (BMC) for the fertilizing industry**, providing an overview of the bio-based fertilizers (BBFs) value chain. The BMC integrates key activities, partnerships, and resources for BBF production, processing, and market integration. It supports sustainable agriculture by promoting circular economy principles, reducing waste, and offering eco-friendly fertilizer solutions. Key customer segments include farmers, horticulturists, gardeners, and local markets. The model focuses on building strong relationships through direct engagement, tailored fertilization plans, and long-term partnerships. Close collaboration with farmers ensures effective BBF application, improved soil health, and increased productivity. Advisory services and customized strategies optimize fertilization based on geo-climatic conditions, driving the adoption of BBFs across agriculture and horticulture sectors while supporting sustainable farming practices and healthier ecosystems.

Practical recommendations

To maximize BBF adoption and optimize their benefits, the fertilizing industry should focus on strengthening customer relationships. Establishing direct engagement with farmers and providing personalized nutrition plans will ensure BBF's effectiveness and better integration into existing agricultural practices. Offering expert advisory services will support farmers in understanding the full potential of BBFs and adapting them to different soil and crop conditions. Long-term partnerships with agricultural cooperatives and food companies will foster trust and facilitate the continued use of BBFs. Additionally, the industry should target diverse customer segments, such as farmers, horticulturists, and gardeners, to expand BBF adoption across multiple sectors. Digital platforms and workshops can further raise awareness, while partnerships with local markets and retailers will enhance BBF accessibility. By focusing on these strategies, the fertilizer industry can drive the adoption of eco-friendly, circular economy solutions that promote sustainable farming, boost soil health, and improve long-term agricultural efficiency.

Figure 1: Business Model Canvas for the fertilizing industry

Figure 2: Business Model Canvas – 3 main segments

Further information

SEA2LAND project website - https://sea2landproject.eu/

About this abstract

Authors: IPS Konzalting d.o.o. za poslovne usluge
Date: May 2025
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Website: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 15

Poslovni model Canvas za industriju gnojiva

Glavni rezultati / ishodi

Projekt SEA2LAND razvio je **Business Model Canvas (BMC) za industriju gnojiva**, pružajući pregled lanca vrijednosti bio-baziranih gnojiva (BBF). BMC integrira ključne aktivnosti, partnerstva i resurse za proizvodnju, preradu i tržišnu integraciju BBF-ova. Podržava održivu poljoprivredu promicanjem principa kružne ekonomije, smanjenjem otpada i ponudom ekoloških rješenja za gnojiva. Ključni korisnički segmenti uključuju poljoprivrednike, hortikulturiste, vrtlara i lokalna tržišta. Model se fokusira na izgradnju snažnih odnosa kroz izravnu suradnju, prilagođene planove gnojidbe i dugoročna partnerstva. Bliska suradnja s poljoprivrednicima osigurava učinkovitu primjenu BBF-ova, poboljšanje zdravlja tla i povećanje produktivnosti. Savjetodavne usluge i prilagođene strategije optimiziraju gnojidbu prema geo-klimatskim uvjetima, čime se potiče primjena BBF-ova u poljoprivredi i hortikulturi, podržavajući održive poljoprivredne prakse i zdravije ekosustave.

Preporuke

Kako bi maksimizirala prihvaćanje BBF-ova i optimizirala njihove koristi, industrija gnojiva trebala bi se fokusirati na jačanje odnosa s korisnicima. Usmjeravanje na izravnu suradnju s poljoprivrednicima i pružanje personaliziranih planova ishrane osigurat će učinkovitost BBF-ova i bolju integraciju u postojeće poljoprivredne prakse. Pružanje stručnih savjetodavnih usluga pomoći će poljoprivrednicima da shvate puni potencijal BBF-ova i prilagode ih različitim uvjetima tla i usjeva. Dugoročna partnerstva s poljoprivrednim zadrugama i prehrambenim tvrtkama potaknut će povjerenje i olakšati kontinuiranu upotrebu BBF-ova. Osim toga, industrija bi trebala ciljati različite korisničke segmente, poput poljoprivrednika, proizvođača povrća i voća te vrtlara, kako bi proširila prihvaćanje BBF-ova u više sektora. Digitalne platforme i radionice mogu dodatno podići svijest, dok će partnerstva s lokalnim tržištima i maloprodajom poboljšati dostupnost BBF-ova. Fokusiranjem na ove strategije, industrija gnojiva može potaknuti prihvaćanje ekoloških rješenja u okviru kružne ekonomije koja promiče održivu poljoprivredu, poboljšava zdravlje tla i dugoročnu poljoprivrednu učinkovitost.

Slika 1: Poslovni model Canvas za industriju gnojiva

Slika 2: Poslovni model Canvas – glavni koraci

Više informacija

SEA2LAND projektna stranica - https://sea2landproject.eu/

Detaljnije o praktičnom sažetku

Autor: IPS Konzalting d.o.o. za poslovne usluge
Datum: Svibanj 2025

SEA2LAND projekt je suradnička inovacijska akcija (IA) koju financira EU u okviru programa Horizon 2020. Cilj projekta je pružiti rješenja koja će pomoći u prevladavanju izazova povezanih s proizvodnjom hrane, klimatskim promjenama i ponovnom uporabom otpada. Na temelju modela kružnog gospodarstva, SEA2LAND promiče proizvodnju velikih količina gnojiva u EU iz vlastitih sirovina. Očekuje se da će ovo rješenje smanjiti neravnotežu hranjivih tvari u tlu u Europi. Projekt traje od siječnja 2021. do lipnja 2025. godine. Web stranica: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 16

Business Model Canvas for fisheries, aquaculture sectors

Main results / outcomes

As part of **the SEA2LAND project**, a tailored **Business Model Canvas (BMC) was developed for the fisheries and aquaculture sectors** using a comprehensive approach. It integrated project outcomes, dissemination activities, and extensive stakeholder input from surveys, workshops, and interviews. The model focuses on transforming fishery by-products into bio-based fertilizers (BBFs), creating new value chains while supporting a circular economy. Key channels include B2B supply to fertilizer producers, partnerships with cooperatives and institutions, direct sales to farmers, and digital outreach. Core resources identified include recovered nutrients from fish side streams and brine, advanced processing technologies, skilled R&D personnel, and regulatory expertise. These elements ensure BBF innovation, regulatory compliance, and environmental benefits.

Practical recommendations

To ensure successful adoption, the fisheries and aquaculture sectors should strengthen B2B networks, focusing on partnerships with fertilizer producers, wholesalers, and industry stakeholders. Collaboration with farming cooperatives and research institutions is essential to foster large-scale implementation and access to funding. Investment in biorefinery and biostimulant technologies will improve BBF quality, efficiency, and performance. Digital platforms and industry events should be leveraged to raise awareness and educate both farmers and stakeholders about the benefits of BBFs. Offering technical guidance, training workshops, and regulatory support will encourage farmers to integrate BBFs into their practices. Finally, collaboration with policymakers will help align regulations and secure financial incentives to drive the widespread adoption of BBFs.

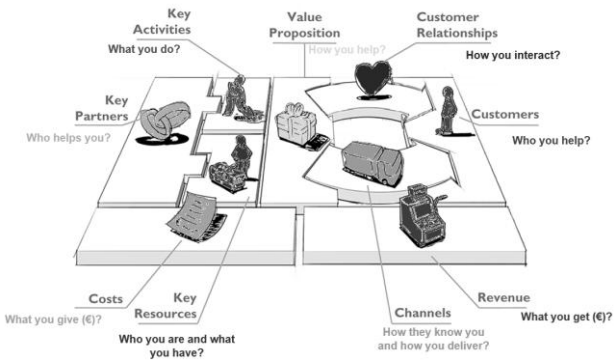

Figure 1: Elements of Business Model Canvas

Figure 2: Business Model Canvas for fisheries, aquaculture sectors

Further information

SEA2LAND project website - https://sea2landproject.eu/

About this abstract

Authors: IPS Konzalting d.o.o. za poslovne usluge
Date: May 2025
SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe. The project is running from January 2021 to June 2025.
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PRACTICE ABSTRACT NO. 16

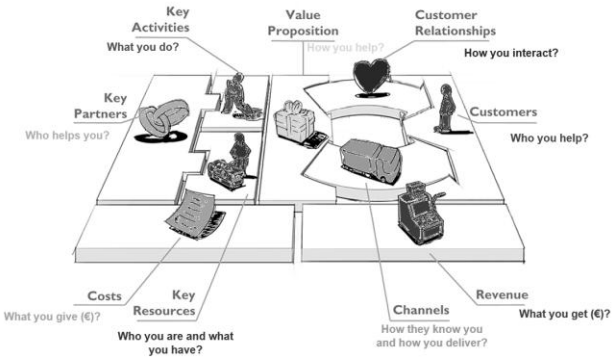
Poslovni model Canvas za sektor ribarstva i akvakulture

Glavni rezultati / ishodi

U sklopu **SEA2LAND projekta** razvijen je **Poslovni model Canvas (BMC) za sektore ribarstva i akvakulture**. Model integrira rezultate projekta, aktivnosti diseminacije i opsežan ulaz dionika prikupljen kroz ankete, radionice i intervjue. Fokusira se na transformaciju ribarskih nusproizvoda u bio-gnojiva (BBF), stvarajući nove lance vrijednosti i podržavajući kružno gospodarstvo. Ključni kanali uključuju B2B opskrbu proizvođača gnojiva, partnerstva s zadrugama i institucijama, izravnu prodaju poljoprivrednicima i digitalne kanale. Identificirani ključni resursi uključuju oporavljene hranjive tvari iz nusproizvoda ribe i riblje slane vode, napredne tehnologije obrade, stručni istraživačko-razvojni kadar i regulatornu stručnost. Ovi elementi osiguravaju inovacije BBF-a, usklađenost s propisima i koristi za okoliš.

Preporuke

Za uspješnu primjenu, sektori ribarstva i akvakulture trebaju ojačati B2B mreže, fokusirajući se na partnerstva s proizvođačima gnojiva, veletrgovcima i dionicima iz industrije. Suradnja s poljoprivrednim zadrugama i istraživačkim institucijama ključna je za poticanje široke implementacije i pristup financiranju. Ulaganje u biorefinerijske i biostimulantske tehnologije poboljšat će kvalitetu, učinkovitost i performanse BBF-a. Digitalne platforme i industrijski događaji trebaju se iskoristiti za podizanje svijesti i edukaciju poljoprivrednika i dionika o prednostima BBF-a. Pružanje tehničkog savjetovanja, radionica i regulatorne podrške potaknut će poljoprivrednike da integriraju BBF u svoje prakse. Na kraju, suradnja s kreatorima politika pomoći će usklađivanju propisa i osiguravanju financijskih poticaja za široku primjenu BBF-a.



Slika 1: Elementi poslovnog modela Canvas

Slika 2: Poslovni model Canvas za sektor ribarstva i akvakulture

Više informacija

SEA2LAND projektna stranica - https://sea2landproject.eu/

Detaljnije o praktičnom sažetku

Autor: IPS Konzalting d.o.o. za poslovne usluge
Datum: Svibanj 2025

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PRACTICE ABSTRACT NO. 17

Business Model Canvas for technology sellers, suppliers

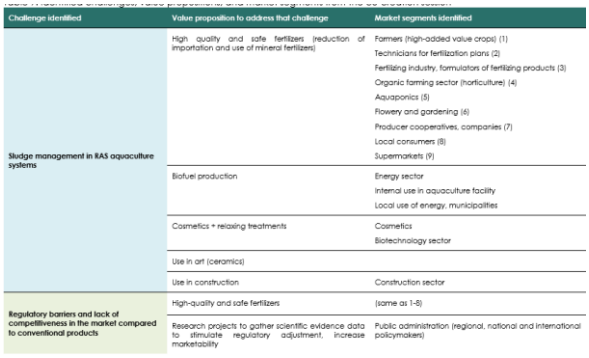
Main results / outcomes

The SEA2LAND project developed **a Business Model Canvas for technology sellers and suppliers**, focusing on the production and application of bio-based fertilizers (BBFs). The BMC integrates essential activities, partnerships, and resources required for optimizing BBF production through advanced processing technologies. Key value propositions include the transformation of fishery by-products into high-quality fertilizers, support for biowaste recycling, and the contribution to a circular economy. Technology sellers and suppliers play a critical role in providing innovative solutions to increase production efficiency and meet market demands. Customer segments identified include farmers, bio-waste recycling companies, gardeners, and government agencies. By providing sustainable and efficient agricultural solutions, technology suppliers enable the widespread adoption of BBF technologies, fostering a more sustainable agricultural sector.

Practical recommendations

To successfully implement BBF production, technology suppliers should focus on developing strong partnerships with key stakeholders, such as fishing processing plants, biowaste recycling companies, and organic farms. Offering a full package of expertise and technologies will help businesses integrate fishery waste into valuable fertilizers. Additionally, promoting the benefits of BBFs to farmers and agricultural cooperatives will encourage adoption and optimize fertilization strategies. Suppliers should invest in educating customers through workshops, demonstrations, and technical guidance to ensure BBF technologies are effectively utilized. Furthermore, leveraging government support and policies for circular economy initiatives can drive adoption. By adopting these strategies, technology sellers and suppliers can accelerate the transition towards sustainable, resource-efficient agricultural practices.

Figure 1: Business Model Canvas for technology seller/supplier



Challenge identified	Value proposition to address that challenge	Market segments identified
Sludge management in RAS aquaculture systems	High quality and safe fertilizers (reduction of importation and use of mineral fertilizers)	Farmers (high-added value crops) (1) Technicians for fertilization plans (2) Fertilizing industry, formulators of fertilizing products (3) Organic farming sector (horticulture) (4) Aquaponics (5) Flowery and gardening (6) Producer cooperatives, companies (7) Local consumers (8) Supermarkets (9)
	Biofuel production	Energy sector Internal use in aquaculture facility Local use of energy, municipalities
	Cosmetics + relaxing treatments	Cosmetics Biotechnology sector
	Use in art (ceramics)	
	Use in construction	Construction sector
Regulatory barriers and lack of competitiveness in the market compared to conventional products	High-quality and safe fertilizers	(same as 1-8)
	Research projects to gather scientific evidence data to stimulate regulatory adjustment, increase marketability	Public administration (regional, national and international policymakers)

Figure 2: Brainstorm session input from stakeholders for Business Model Canvas

Further information

SEA2LAND project website - https://sea2landproject.eu/

About this abstract

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SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe. The project is running from January 2021 to June 2025.
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PRACTICE ABSTRACT NO. 17

Poslovni model Canvas za prodavatelje i dobavljače tehnologija

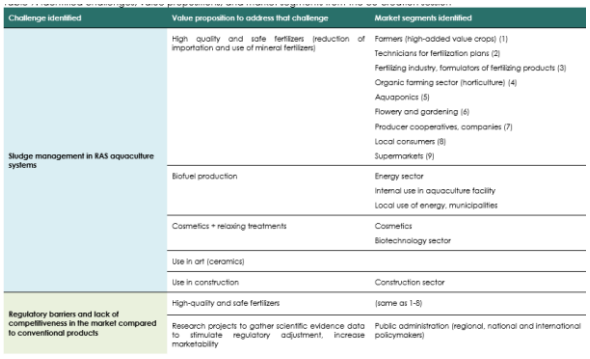
Glavni rezultati / ishodi

Projekt SEA2LAND razvio je **Business Model Canvas za prodavatelje i dobavljače tehnologije**, fokusirajući se na proizvodnju i primjenu bio-baziranih gnojiva (BBF). BMC integrira ključne aktivnosti, partnerstva i resurse potrebne za optimizaciju proizvodnje BBF-a kroz napredne tehnologije obrade. Ključne vrijednosne ponude uključuju transformaciju nusproizvoda iz ribarstva u visokokvalitetna gnojiva, podršku recikliranju bio-otpada i doprinos kružnoj ekonomiji. Prodavatelji i dobavljači tehnologije igraju ključnu ulogu u pružanju inovativnih rješenja za povećanje učinkovitosti proizvodnje i zadovoljenje tržišnih zahtjeva. Identificirani su sljedeći korisnički segmenti: poljoprivrednici, tvrtke za reciklažu bio-otpada, vrtlari i vladine agencije. Pružajući održiva i učinkovita poljoprivredna rješenja, dobavljači tehnologije omogućuju široku primjenu BBF tehnologija, potičući održiviji poljoprivredni sektor.

Preporuke

Za uspješnu implementaciju proizvodnje BBF-a, dobavljači tehnologije trebaju se fokusirati na razvoj snažnih partnerstava s ključnim dionicima, poput tvornica za preradu ribe, tvrtki za reciklažu bio-otpada i ekoloških farmi. Pružanje potpune stručnosti i tehnologija pomoći će tvrtkama da integriraju nusproizvode iz ribarstva u vrijedna gnojiva. Osim toga, promicanje prednosti BBF-a poljoprivrednicima i poljoprivrednim zadrugama poticat će prihvaćanje i optimizaciju strategija gnojidbe. Dobavljači trebaju ulagati u edukaciju kupaca putem radionica, demonstracija i tehničkog savjetovanja kako bi osigurali učinkovitu primjenu BBF tehnologija. Nadalje, korištenje vladine podrške i politika za inicijative kružne ekonomije može ubrzati prihvaćanje. Primjenom ovih strategija, prodavatelji i dobavljači tehnologije mogu ubrzati prijelaz prema održivim, resursno učinkovitijim poljoprivrednim praksama.

Slika 1: Poslovni model Canvas za prodavatelje/dobavljače tehnologija



Challenge identified	Value proposition to address that challenge	Market segments identified
Sludge management in RAS aquaculture systems	High quality and safe fertilizers (reduction of importation and use of mineral fertilizers)	Farmers (high-added value crops) (1) Technicians for fertilization plans (2) Fertilizing industry, formulators of fertilizing products (3) Organic farming sector (horticulture) (4) Aquaponics (5) Flowery and gardening (6) Producer cooperatives, companies (7) Local consumers (8) Supermarkets (9)
	Biofuel production	Energy sector Internal use in aquaculture facility Local use of energy, municipalities
	Cosmetics + relaxing treatments	Cosmetics Biotechnology sector
	Use in art (ceramics)	
	Use in construction	Construction sector
Regulatory barriers and lack of competitiveness in the market compared to conventional products	High-quality and safe fertilizers	(same as 1-8)
	Research projects to gather scientific evidence data to stimulate regulatory adjustment, increase marketability	Public administration (regional, national and international policymakers)

Slika 2: Input brainstorm radionica za Poslovni model Canvas

Više informacija

SEA2LAND projektna stranica - https://sea2landproject.eu/

Detaljnije o praktičnom sažetku

Autor: IPS Konzalting d.o.o. za poslovne usluge
Datum: Svibanj 2025

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PRACTICE ABSTRACT NO. 18

Assesing the economic viability of Bokashi pellet production as an innovative bio-based fertilizer

Main results / outcomes

The economic viability of producing Bokashi pellets (BP) as a bio-based fertilizer was assessed using two different pricing methodologies—nutrient price and cost-based methods—across two countries, Norway and Italy. The study modeled scenarios using either purchased fish waste or own fish waste as input. Under the nutrient price method, all scenarios resulted in negative profitability, regardless of input source or country, indicating the approach is not viable. However, the cost-based method demonstrated positive financial results, particularly in Italy where operating costs are lower. The difference in profitability between using purchased and own fish waste was marginal, suggesting input source has limited influence on overall viability. The analysis clearly indicates that the cost-based pricing method is the only economically feasible approach for BP production.

Practical recommendations

For end-users and practitioners, the main benefit of implementing these findings lies in reduced production risk and improved decision-making. By adopting the cost-based pricing approach, producers can ensure profitability and financial sustainability. The results are especially useful for regions with lower operating costs (such as labour and electricity), where the business model is more favorable. Practitioners should focus on optimizing cost-efficiency, such as through energy savings and resource management, rather than input sourcing. This makes BP production a more realistic and implementable solution in the bioeconomy, contributing to circular resource use and sustainable agriculture.

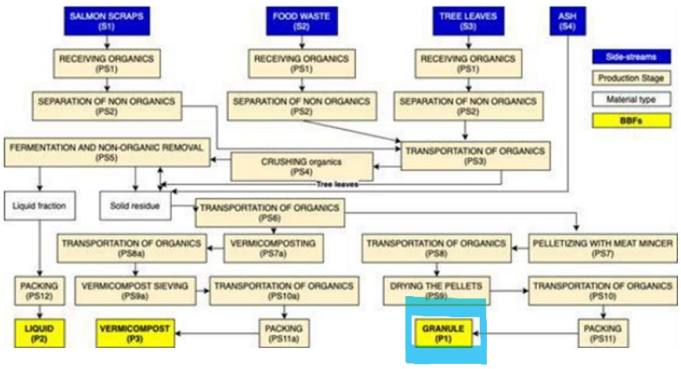

Figure 1: Scheme of Bokashi pellet production

Pelleted fish sludge (FSP)	STREAM INPUT	BBF PRODUCED	Net profit (EBIT)	Net profit before amortization (EBITDA)	Gross margin (GM)	Return on investment (ROI)	Payback period (PP)	PRICE
Nutrient price method								
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
Cost method								
Pelleted fish sludge (FSP)	**STREAM INPUT**	**BBF PRODUCED**	**Net profit (EBIT)**	**Net profit before amortization (EBITDA)**	**Gross margin (GM)**	**Return on investment (ROI)**	**Payback period (PP)**	**PRICE**
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

Figure 2: Sum up of financial indicators

Further information

SEA2LAND project website - https://sea2landproject.eu/

About this abstract

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PRACTICE ABSTRACT NO. 18

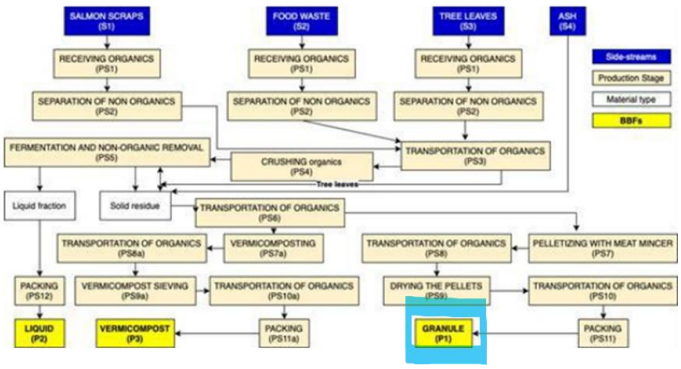
Procjena ekonomske isplativosti proizvodnje Bokashi peleta kao inovativnog biognojiva

Glavni rezultati/ishodi

Ekonomska isplativost proizvodnje Bokashi peleta (BP) kao biognojiva procijenjena je primjenom dvije metodologije određivanja cijena – metode cijene hranjivih tvari i metode određivanja cijene na temelju troškova – u dvije zemlje, Norveškoj i Italiji. Analizirani su scenariji koji koriste ili kupljeni riblji otpad ili vlastiti otpad kao sirovinu. Rezultati pokazuju da su svi scenariji prema metodi cijene hranjivih tvari ekonomski neisplativi, bez obzira na vrstu inputa ili zemlju. S druge strane, metoda određivanja cijene na temelju troškova pokazuje pozitivnu isplativost, osobito u Italiji gdje su operativni troškovi niži. Razlika u isplativosti između korištenja kupljenog i vlastitog otpada je minimalna, što sugerira da izvor sirovine ima ograničen utjecaj na ukupnu isplativost. Zaključno, poslovni model je isplativ isključivo pri primjeni pristupa određivanja cijene temeljenog na troškovima.

Preporuke

Krajnjim korisnicima glavna korist implementacije ovih saznanja je smanjenje rizika proizvodnje i donošenje informiranih poslovnih odluka. Usvajanjem pristupa određivanja cijene na temelju troškova, proizvođači mogu osigurati profitabilnost i financijsku održivost. Rezultati su posebno korisni za regije s nižim operativnim troškovima, poput cijene rade i struje, gdje je poslovni model povoljniji. Proizvođačima se preporučuje fokusiranje na optimizaciju troškova, primjerice kroz uštede energije i upravljanje resursima, umjesto na izvor sirovine. Time se proizvodnja BP-a čini realnijim i primjenjivim rješenjem u bioekonomiji, uz doprinos kružnom gospodarstvu i održivoj poljoprivredi.



Slika 1: Shema proizvodnje Bokashi peleta

Pelleted fish sludge (FSP)	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
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

Pelleted fish sludge (FSP)	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
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

Slika 2: Sažetak financijskih pokazatelja

Više informacija

SEA2LAND projektna stranica - https://sea2landproject.eu/

Detaljnije o praktičnom sažetku

Autor: IPS Konzalting d.o.o. za poslovne usluge
Datum: Svibanj 2025

SEA2LAND projekt je suradnička inovacijska akcija (IA) koju financira EU u okviru programa Horizon 2020. Cilj projekta je pružiti rješenja koja će pomoći u prevladavanju izazova povezanih s proizvodnjom hrane, klimatskim promjenama i ponovnom uporabom otpada. Na temelju modela kružnog gospodarstva, SEA2LAND promiče proizvodnju velikih količina gnojiva u EU iz vlastitih sirovina. Očekuje se da će ovo rješenje smanjiti neravnotežu hranjivih tvari u tlu u Europi. Projekt traje od siječnja 2021. do lipnja 2025. godine. Web stranica: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 19

Assessing the Economic Viability of Fish Sludge Pelleted Fertiliser Production as an Innovative Bio-Based Fertiliser

Main results / outcomes

The analysis shows that the production of fish sludge pelleted fertilizer (FSP) using the nutrient price method results in significant financial losses, making it an unviable option. In contrast, the cost-based pricing method demonstrates much stronger economic feasibility. While production with both purchased and own input scenarios performs positively under this method, using own input leads to a nearly 30% higher gross margin and a BBF price almost 50% lower. These results highlight the clear advantage of the cost-based approach, particularly when fish waste is self-supplied. Producing the reference quantity of 1,000 tons of BBF annually requires 1,700,000 liters of fish waste.

Practical recommendations

The nutrient price method consistently results in financial losses and should be avoided. The cost-based approach proves economically viable and should be the standard pricing model for BBF production. Where possible, stakeholders should use self-sourced fish waste, as it significantly improves profitability—raising gross margins and reducing product price. Projects should be designed to maximize internal resource efficiency, such as securing steady supplies of fish waste from within the value chain to reduce dependency on external inputs. Production should be prioritized in regions with favorable cost conditions (e.g., lower energy and labor costs) to further improve the economic viability of the model.

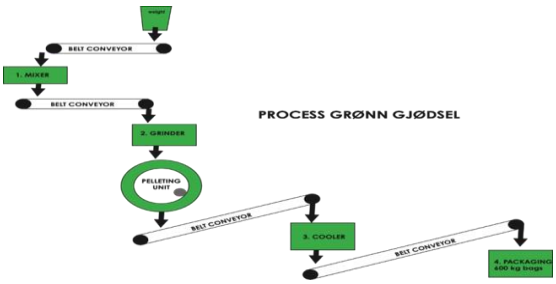

Figure 1: Fish sludge pelleted production process

	Nutrient price method			Cost method			
Pelleted fish sludge (FSP)	Net profit (EBIT)	Payback period (PP)	PRICE	Net profit (EBIT)	Gross margin (GM)	Payback period (PP)	PRICE
Norway							
purchased input	-223.604,32	-1,92 years	43,47 eur/t	52.925,68	16,54%	8,12 years	320 eur/t
own input	-19.604,32	-21,29 years	43,47 eur/t	52.925,68	45,63%	8,12 years	116 eur/t
Italy							
purchased input	-220.713,63	-1,95 years	43,47 eur/t	52.816,37	16,66%	8,14 years	317 eur/t
own input	-16.713,63	-25,72 years	43,47 eur/t	52.816,37	46,74%	8,14 years	113 eur/t

Figure 2: Main economic results for FSP production

Further information

SEA2LAND project website - https://sea2landproject.eu/

About this abstract

Authors: IPS Konzalting d.o.o. za poslovne usluge
Date: May 2025
SEA2LAND project is a collaborative Innovation Action (IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe. The project is running from January 2021 to June 2025.
Website: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 19

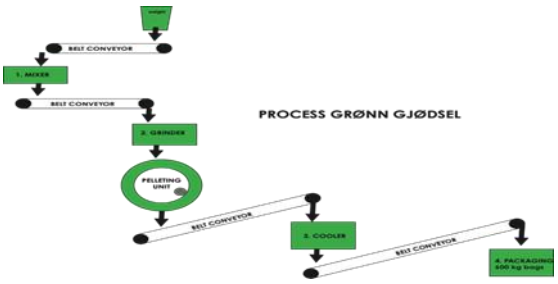
Procjena ekonomske isplativosti proizvodnje peletiranog gnojiva ribljeg mulja

Glavni rezultati/ishodi

Analiza pokazuje da određivanje prodajne cijene peletiranog gnojiva ribljeg mulja metodom cijene hranjivih tvari dovodi do značajnih financijskih gubitaka, što je čini neodrživom opcijom. Nasuprot tome, metoda određivanja cijena na temelju troškova pokazuje mnogo veću ekonomsku izvedivost. Dok oba scenarija i kupljene i vlastite ulazne sirovine imaju pozitivne rezultate prema ovoj metodi, korištenje vlastite ulazne sirovine dovodi do gotovo 30% veće bruto marže i prodajne cijene predmetnog biognojiva gotovo 50% niže. Ovi rezultati naglašavaju jasnu prednost pristupa koji se temelji na troškovima, osobito kada se riblji otpad već posjeduje. Za proizvodnju referentne količine od 1.000 tona BBF godišnje potrebno je 1.700.000 litara ribljeg otpada.

Preporuke

Prodaja cijena određena metodom cijene hranjivih tvari dosljedno rezultira financijskim gubicima i treba je izbjegavati. Pristup temeljen na troškovima pokazao se ekonomski isplativim i trebao bi biti standardni model određivanja cijena za prodaju predmetnog biognojiva. Gdje je to moguće, proizvođači bi trebali koristiti vlastiti riblji otpad, jer značajno poboljšava profitabilnost—podižući bruto marže i smanjujući cijenu proizvoda. Projekti bi trebali biti osmišljeni tako da maksimiziraju učinkovitost unutarnjih resursa, kao što je osiguravanje stalne opskrbe ribljim otpadom unutar lanca vrijednosti kako bi se smanjila ovisnost o vanjskoj ulaznoj sirovini. Proizvodnja bi trebala biti locirana u regijama s povoljnim troškovnim uvjetima (npr. niži troškovi energije i rada) kako bi se dodatno poboljšala ekonomska održivost modela.



Slika 1. Proizvodni proces peletiranog gnojiva ribljeg mulja

	Nutrient price method			Cost method			
Pelleted fish sludge (FSP)	Net profit (EBIT)	Payback period (PP)	PRICE	Net profit (EBIT)	Gross margin (GM)	Payback period (PP)	PRICE
Norway							
purchased input	-223.604,32	-1,92 years	43,47 eur/t	52.925,68	16,54%	8,12 years	320 eur/t
own input	-19.604,32	-21,29 years	43,47 eur/t	52.925,68	45,63%	8,12 years	116 eur/t
Italy							
purchased input	-220.713,63	-1,95 years	43,47 eur/t	52.816,37	16,66%	8,14 years	317 eur/t
own input	-16.713,63	-25,72 years	43,47 eur/t	52.816,37	46,74%	8,14 years	113 eur/t

Slika 2. Glavni ekonomski rezultati u proizvodnji peletiranog gnojiva ribljeg mulja

Više informacija

SEA2LAND projektna stranica - https://sea2landproject.eu/

Opširnije o praktičnom sažetku

Autor: IPS Konzalting d.o.o. za poslovne usluge
Datum: Svibanj 2025

SEA2LAND projekt je suradnička inovacijska akcija (IA) koju financira EU u okviru programa Horizon 2020. Cilj projekta je pružiti rješenja koja će pomoći u prevladavanju izazova povezanih s proizvodnjom hrane, klimatskim promjenama i ponovnom uporabom otpada. Na temelju modela kružnog gospodarstva, SEA2LAND promiče proizvodnju velikih količina gnojiva u EU iz vlastitih sirovina. Očekuje se da će ovo rješenje smanjiti neravnotežu hranjivih tvari u tlu u Europi. Projekt traje od siječnja 2021. do lipnja 2025. godine. Web stranica: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 20

Assessing the Economic Viability of Organic Amendment Production as an Innovative Bio-Based Fertiliser

Main results / outcomes

The analysis considers production plants of varying capacities (800t fish, 2000t fish, and 5000t fish), showing that plant size and product output quantity significantly influence profitability and pricing. The case assumes that the raw material (fish waste) is supplied internally, eliminating purchase costs. Profitability is assessed by including all production-related expenses, and calculations are performed both with and without cost savings from avoided waste management. These financial evaluations help determine the feasibility of profit generation through organic amendment production.

Practical recommendations

Larger processing plants (e.g., 2000t or 5000t fish capacities) are more likely to achieve economic sustainability. Users should consider scaling operations where feasible to optimize profitability. Utilizing internally generated fish waste eliminates raw material purchase costs, significantly improving the economic viability of the business model. When assessing profitability, all operational, equipment, and plant costs must be included to get a realistic picture of financial performance, especially when using the cost method.

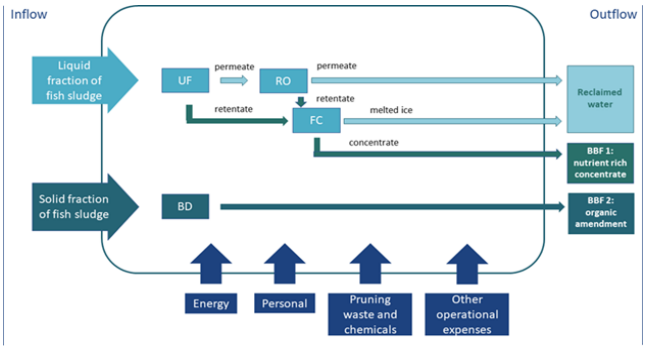

Figure 1. System boundaries considered in LCC model

	Nutrient price method			Cost method		
Organic amendment (OA)	Net profit (EBIT)	Payback period (PP)	PRICE	Net profit (EBIT)	Payback period (PP)	PRICE
Norway						
1504 t savings included	4.056,17	44,75 years	43,48 eur/t	22.244,26	8,16 years	74 eur/t
1504 t savings NOT included	-41.063,83	-4,42 years	43,48 eur/t	-22.875,74	-7,93 years	74 eur/t
3760 t savings included	36.976,68	9,48 years	43,48 eur/t	43.710,85	8,02 years	48 eur/t
3760 t savings NOT included	-75.823,32	-4,62 years	43,48 eur/t	-69.089,15	-5,07 years	48 eur/t
9400 t savings included	125.362,60	6,04 years	43,48 eur/t	86.328,16	8,78 years	33 eur/t
9400 t savings NOT included	-156.637,40	-4,84 years	43,48 eur/t	-195.671,84	-3,87 years	33 eur/t
Italy						
1504 t savings included	9.722,18	18,67 years	43,48 eur/t	22.546,81	8,05 years	65 eur/t
1504 t savings NOT included	-35.397,82	-5,13years	43,48 eur/t	-22.573,19	-8,04 years	65 eur/t
3760 t savings included	50.886,89	6,89 years	43,48 eur/t	42.722,46	8,20 years	38 eur/t
3760 t savings NOT included	-61.913,11	-5,66 years	43,48 eur/t	-70.077,54	-5,00 years	38 eur/t
9400 t savings included	160.961,85	4,71 years	43,48 eur/t	92.130,13	8,22 years	25 eur/t
9400 t savings NOT included	-121.038,15	-6,26 years	43,48 eur/t	-189.869,87	-3,99 years	25 eur/t

Figure 2. Summarized the main financial results for organic amendment production

Further information

SEA2LAND project website - https://sea2landproject.eu/

About this abstract

Authors: IPS Konzalting d.o.o. za poslovne usluge
Date: May 2025
SEA2LAND project is a collaborative Innovation Action (IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe. The project is running from January 2021 to June 2025.
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PRACTICE ABSTRACT NO. 20

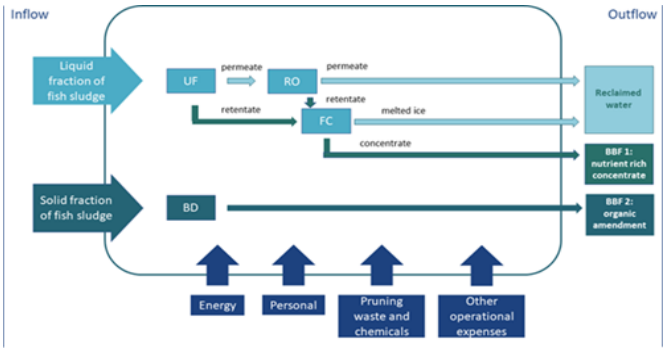
Procjena ekonomske isplativosti proizvodnje organskih poboljšivača kao inovativnog biognojiva

Glavni rezultati/ishodi

Analiza razmatra proizvodne pogone proizvodnje organskih poboljšivača tla različitih kapaciteta (800t ribe, 2000t ribe i 5000t ribe), pokazujući da veličina pogona i količina proizvedenih proizvoda značajno utječu na profitabilnost i cijene. Slučaj pretpostavlja da se ulazna sirovina (riblji otpad) dobavlja interno, čime se eliminiraju troškovi nabave. Profitabilnost se procjenjuje uključivanjem svih troškova vezanih uz proizvodnju, a izračuni se izvode sa i bez ušteda troškova od izbjegnutog gospodarenja otpadom. Ove financijske procjene pomažu u određivanju ekonomske isplativosti prilikom proizvodnje organskih poboljšivača tla dobivenih iz ribljeg otpada..

Preporuke

Veći pogoni za preradu (npr. kapaciteta 2000t ili 5000t ribe) vjerojatnije će postići ekonomsku održivost proizvodnje. Potencijalni proizvođači bi trebali razmotriti opcije povećanja proizvodne količine kako bi optimizirali profitabilnost. Korištenje interno stvorenog ribljeg otpada eliminira troškove nabave sirovina, značajno poboljšavajući ekonomsku održivost poslovnog modela. Prilikom procjene profitabilnosti trebaju se uključiti svi operativni troškovi, troškovi opreme i pogona kako bi se dobila realna slika financijskog učinka, posebno kada se koristi troškovna metoda.



Slika 1. Proizvodna shema organskog poboljšivača

	Nutrient price method			Cost method		
Organic amendment (OA)	Net profit (EBIT)	Payback period (PP)	PRICE	Net profit (EBIT)	Payback period (PP)	PRICE
Norway						
1504 t savings included	4.056,17	44,75 years	43,48 eur/t	22.244,26	8,16 years	74 eur/t
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9400 t savings NOT included	-156.637,40	-4,84 years	43,48 eur/t	-195.671,84	-3,87 years	33 eur/t
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1504 t savings included	9.722,18	18,67 years	43,48 eur/t	22.546,81	8,05 years	65 eur/t
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3760 t savings NOT included	-61.913,11	-5,66 years	43,48 eur/t	-70.077,54	-5,00 years	38 eur/t
9400 t savings included	160.961,85	4,71 years	43,48 eur/t	92.130,13	8,22 years	25 eur/t
9400 t savings NOT included	-121.038,15	-6,26 years	43,48 eur/t	-189.869,87	-3,99 years	25 eur/t

Slika 2. Sažeti glavni financijski rezultati za organske poboljšivače

Više informacija

SEA2LAND projektna stranica - https://sea2landproject.eu/

Opširnije o praktičnom sažetku

Autor: IPS Konzalting d.o.o. za poslovne usluge
Datum: Svibanj 2025

SEA2LAND projekt je suradnička inovacijska akcija (IA) koju financira EU u okviru programa Horizon 2020. Cilj projekta je pružiti rješenja koja će pomoći u prevladavanju izazova povezanih s proizvodnjom hrane, klimatskim promjenama i ponovnom uporabom otpada. Na temelju modela kružnog gospodarstva, SEA2LAND promiče proizvodnju velikih količina gnojiva u EU iz vlastitih sirovina. Očekuje se da će ovo rješenje smanjiti neravnotežu hranjivih tvari u tlu u Europi. Projekt traje od siječnja 2021. do lipnja 2025. godine. Web stranica: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 21

Business Case Assessment of Protein Fraction Production Technology for Bio-Based Fertilisers at Industrial Scale

Main results / outcomes

The Atlantic pilot demonstrates a practical and scalable method for converting fish by-products into valuable agricultural products, supporting circular economy goals through zero-waste and high-efficiency processes. It produces nutrient-rich fertilizers suitable for sustainable farming. Financially, the model shows results with an 8-year payback period and a 12.41% return on investment under favorable conditions. However, profitability depends heavily on stable product pricing and operational costs, highlighting the importance of reliable supply chains and long-term agreements. Despite significant initial investment, the production plant's environmental benefits and scalability make it a strong and viable solution.

Practical recommendations

Adopting zero-waste, high-efficiency processes and targeting markets for nutrient-rich fertilizers can enhance sustainability and market appeal. Although the model requires significant initial investment, it offers strong long-term returns, with an estimated 8-year payback period and a 12.41% ROI under favorable conditions. To ensure profitability, users should focus on stabilizing product pricing and operational costs through long-term purchase agreements and robust supply chains. Investing in proven, scalable technologies will further support the project's viability and impact.

Figure 1. Production technology - extruder

	ATLANTIC
	industrial
CAPEX in eur	10.745.000,00
OPEX in eur/y	2.722.096,75
PAYBACK in years	8,06
ENERGY EFFICIENCY in MJ/kg	4,03
TOTAL ANNUAL ENERGY CONSUMPTION in MJ	13.513.319,00
MASS EFFICIENCY in%	76,50
AMOUNT OF PRODUCTS yearly produced in t	3.351,00
AMOUNT OF RAW MATERIALS per year in t	3.600,00 t
Products	protein fraction-BBF1, protein fraction upgraded-BBF2
BBF quantity in t/year	BBF1: 753, BBF2: 2.205
BBF price in eur/t	BBF1:2.000, BBF2: 800
Description raw material	fish by-products (3.600t)
Wastes	not expected
By-product	Oil (393t/y, 2.000 eur/t)

Figure 2. Economic variables of production technology

Further information

SEA2LAND project website - https://sea2landproject.eu/

About this abstract

Authors: IPS Konzalting d.o.o. za poslovne usluge
Date: May 2025
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Website: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 21

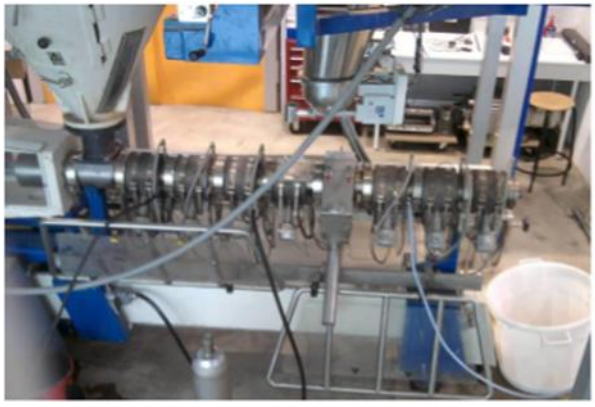
Ekonomska procjena tehnologije proizvodnje proteinskih frakcija ribljih ostataka biognojiva

Glavni rezultati/ishodi

Proizvodno postrojenje proteinskih frakcija ribljih ostataka demonstrira praktičnu tehnologiju za pretvaranje ribljih nusproizvoda u vrijedna poljoprivredna biognojiva, podržavajući ciljeve kružnog gospodarstva kroz procese bez otpada i visoke učinkovitosti. Proizvodi gnojiva bogata hranjivim tvarima prikladna za održivu poljoprivredu. Financijski gledano, model prikazuje rok povrata od 8 godina i povrat ulaganja (ROI) od 12,41% pod povoljnim uvjetima. Međutim, profitabilnost uvelike ovisi o stabilnim cijenama i operativnim troškovima, naglašavajući važnost pouzdanih opskrbnih lanaca i dugoročnih ugovora. Unatoč značajnom početnom ulaganju, ekološke prednosti i proizvodnja značajnih količina čine ga snažnim i održivim rješenjem.

Preporuke

Usvajanje visokoučinkovitih procesa bez otpada i ciljanje tržišta koja imaju potrebu za gnojivima bogata hranjivim tvarima može poboljšati održivost i tržišnu privlačnost. Iako model zahtijeva značajna početna ulaganja, ekonomska isplativost je prihvatljiva, s procijenjenim 8-godišnjim razdobljem povrata i 12,41% ROI pod povoljnim uvjetima. Kako bi osigurali profitabilnost, potencijalni ulagači bi se trebali usredotočiti na stabilizaciju cijena proizvoda i operativnih troškova putem dugoročnih ugovora o kupnji i robusnih opskrbnih lanaca. Ulaganje u dokazane, isplative tehnologije dodatno će podržati održivost i učinak projekta.



Slika 1. Proizvodna tehnologija - ekstruder

	ATLANTIC
	industrial
CAPEX in eur	10.745.000,00
OPEX in eur/y	2.722.096,75
PAYBACK in years	8,06
ENERGY EFFICIENCY in MJ/kg	4,03
TOTAL ANNUAL ENERGY CONSUMPTION in MJ	13.513.319,00
MASS EFFICIENCY in%	76,50
AMOUNT OF PRODUCTS yearly produced in t	3.351,00
AMOUNT OF RAW MATERIALS per year in t	3.600,00 t
Products	protein fraction-BBF1, protein fraction upgraded-BBF2
BBF quantity in t/year	BBF1: 753, BBF2: 2.205
BBF price in eur/t	BBF1:2.000, BBF2: 800
Description raw material	fish by-products (3.600t)
Wastes	not expected
By-product	Oil (393t/y, 2.000 eur/t)

Slika 2. Ekonomske varijable proizvodnje proteinskih frakcija kao biognojiva

Više informacija

SEA2LAND projektna stranica - https://sea2landproject.eu/

Opširnije o praktičnom sažetku

Autor: IPS Konzalting d.o.o. za poslovne usluge
Datum: Svibanj 2025
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PRACTICE ABSTRACT NO. 22

Assessing the Economic Viability of Protein Fraction Production as an Innovative Bio-Based Fertiliser

Main results / outcomes

The economic assessment of producing protein fraction-based fertilizers - protein fraction (BBF1) and protein fraction upgraded (BBF2) shows that the cost-based pricing method is significantly more viable than the nutrient price method. The latter method shows that results are consistently negative in profitability across all scenarios. The cost method demonstrates a notably improved financial outlook, particularly when using own input. With BBF2 production, costs are reduced by 9–10% compared to purchased input. Additionally, the prices for both BBF1 and BBF2 remain consistent between the two countries – for example, in case studies, Norway and Italy, regardless of whether raw materials are purchased or self-supplied. These findings highlight the clear advantage of leveraging own resources and applying a cost-based pricing strategy to ensure economic feasibility.

Practical recommendations

Establishing closed-loop systems or partnerships that secure internal raw material supplies can enhance economic performance and reduce dependency on external markets. To improve profitability, producers are advised to use self-sourced materials for BBF2 production, which can reduce costs by 9–10% compared to using purchased inputs. Since BBF1 and BBF2 prices are consistent between different regions, for example, Norway and Italy, regardless of input source, producers can plan production and pricing strategies without needing to account for significant regional price variation.

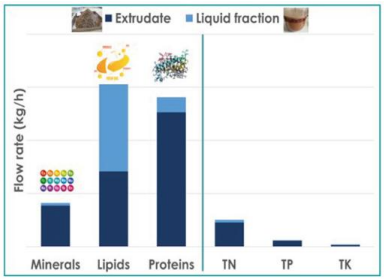

Figure 1. Flow rate distribution in the TMC processing unit

	Cost method							
Protein fraction-BBF1 and protein fraction upgraded-BBF2	BBF1 (protein fraction) PRODUCED	BBF2 (protein fraction upgraded) PRODUCED	Net profit (EBIT)	Gross margin (GM)	Return on investment	Payback period (PP)	PRICE BBF1	PRICE BBF2
Norway								
purchased input	753,00 ton/year	2.205,00 ton/year	1.324.381,01	34,51%	12,33%	8,11 years	2.300 eur/ton	955 eur/ton
own input	753,00 ton/year	2.205,00 ton/year	1.331.296,01	38,21%	12,39%	8,07 years	2.080 eur/ton	870 eur/ton
Italy								
purchased input	753,00 ton/year	2.205,00 ton/year	1.325.269,33	34,53%	12,33%	8,11 years	2.300 eur/ton	955 eur/ton
own input	753,00 ton/year	2.205,00 ton/year	1.332.184,33	38,23%	12,40%	8,07 years	2.080 eur/ton	870 eur/ton

Figure 2. Cost method main results for protein fraction-based BBFs

Further information

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PRACTICE ABSTRACT NO. 22

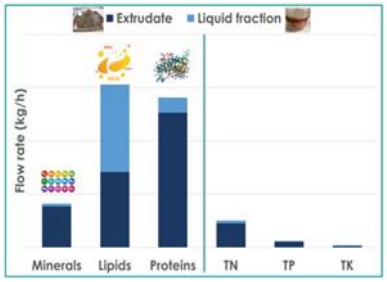
Procjena ekonomske isplativosti proizvodnje proteinske frakcije ribljih ostataka

Glavni rezultati/ishodi

Ekonomska procjena proizvodnje proteinske frakcije ribljih ostataka pokazuje da je metoda određivanja cijena na temelju troškova znatno održivija nego metoda cijene nutrijenata, što rezultira dosljedno negativnom profitabilnošću u svim scenarijima. Troškovna metoda pokazuje znatno poboljšane financijske izglede, posebno kada se koriste vlastite sirovine što smanjuje troškove za 9-10% u usporedbi s proizvodnjom koja koristi kupljene ulazne sirovine. Osim toga, prodajne cijene za proteinske frakcije ostaju dosljedne između različitih regija kao što su npr Norveška i Italija, bez obzira na izvor ulaznih sirovina. Ovi rezultati naglašavaju jasnu prednost povećanja vlastitih resursa i primjene strategije određivanja cijena koja se temelji na troškovima kako bi se osigurala ekonomska isplativost.

Preporuke

Uspostavljanje sustava „zatvorene petlje" ili partnerstva koja osiguravaju unutarnje opskrbe sirovinama mogu poboljšati ekonomske rezultate i smanjiti ovisnost o vanjskim tržištima. Za poboljšanje profitabilnosti, proizvođačima se savjetuje da koriste materijale iz vlastitih izvora za proizvodnju proteinske frakcije, što može smanjiti troškove za 9-10% u usporedbi s korištenjem kupljenih sirovina. Budući da su prodajne cijene proteinske frakcije dosljedne u različtim regijama, kao što su Norveška i Italija, bez obzira na izvor sirovina, korisnici mogu planirati proizvodnju i strategije prodajnih cijena bez potrebe za lociranjem u različitim regijama.



Slika 1. Raspodjela protoka u TMC procesnoj jedinici

	Cost method							
Protein fraction-BBF1 and protein fraction upgraded-BBF2	BBF1 (protein fraction) PRODUCED	BBF2 (protein fraction upgraded) PRODUCED	Net profit (EBIT)	Gross margin (GM)	Return on investment	Payback period (PP)	PRICE BBF1	PRICE BBF2
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Slika 2. Glavni rezultati troškovne metode za biognojiva na bazi proteina

Više informacija

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PRACTICE ABSTRACT NO. 23

SEA2LAND

AZTI
MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

Production of ingredients for the formulation of biostimulants by autolysis of rainbow trout viscera

Main results / outcomes

The optimal experimental conditions for the obtention of free amino acid-rich protein hydrolysates are pH 8, a temperature of 40 °C, a content of added water of 6.85 %, and an autolysis time of 7 hours.

Practical recommendations

The obtention of free amino acid-rich protein hydrolysates through the autolysis of rainbow trout viscera implies a reduction of the economic cost of the process comparing to the obtention of hydrolysates through enzymatic hydrolysis and also a faster process comparing to the silage.
The composition of these protein hydrolysates are suitable to use them as ingredients for the formulation of plant biostimulants, as they comply with the legislation.
The use of fish protein hydrolysates in plant biostimulants is presented as an alternative of phosphate rocks and other non-renewable mineral sources in the production of fertilizers.
Using autolysis for producing fish protein hydrolysates offers the opportunity to recirculate nutrients and can help to contribute to sustainable agricultural practices.
Fish viscera protein hydrolysates for biostimulant production seem a feasible alternative to fishmeal production in Europe, especially in areas located far from fishmeal plants.

Figure 1: rainbow trout (*Oncorhynchus mykiss*).

Figure 2: viscera of rainbow trout.

Further information

https://open-research-europe.ec.europa.eu/articles/4-141

About this abstract

Authors: Haizea Domínguez (AZTI), Bruno Iñarra (AZTI), Monica Gutierrez (AZTI) and Carlos Bald (AZTI).
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PRACTICE ABSTRACT NO. 23

SEA2LAND

AZTI
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& TECHNOLOGY ALLIANCE

Producción de ingredientes para la formulación de bioestimulantes a partir de la autólisis de vísceras de trucha arcoiris

Resultados principales

Las condiciones óptimas para conseguir hidrolizados ricos en aminoácidos libres mediante la autólisis de vísceras son pH 8, una temperatura de 40 °C, un contenido de agua añadida de 6,85% y un tiempo de autólisis de 7 horas.

Recomendaciones prácticas

La obtención de hidrolizados de proteína ricos en aminoácidos libres a través de la autólisis de vísceras de trucha supone un proceso más barato que en el caso de la hidrólisis enzimática y un proceso más rápido que el ensilado. La composición de estos hidrolizados de proteína son adecuados para usarlos como ingredietnes en la formulación de bioestimulantes para plantas, ya que cumplen con la legislación. El uso de hidrolizados de proteína de pescado en bioestimulantes para plantas se presenta como una alternativa a las rocas de fosfato y otras fuentes no renovables de minerales en la producción de fertilizantes.
El uso de la autólisis para producir hidrolizados de proteína de pescado ofrece la oportunidad de recircular estos nutrientes y puede contribuir a promover practicas de agricultura sostenible.
Los hidrolizados de vísceras de pescado para la producción de bioestimulantes parecen una alternativa viable a la producción de harinas de pescado en Europa, especialmente en áreas que se encuentran lejos de las plantas productoras de harinas.

Figura 1: trucha arcoíris(*Oncorhynchus mykiss*).

Figura 2: vísceras de trucha arcoiris.

Más información

https://open-research-europe.ec.europa.eu/articles/4-141

Acerca de este resumen

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PRACTICE ABSTRACT NO. 24

SEA2LAND

AZTI MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Production of an ingredient for the formulation of biostimulants by enzymatic hydrolysis of rainbow trout viscera

Main results / outcomes

The optimal experimental conditions to produce free amino acid-rich protein hydrolysates are pH 7, a temperature of 60 °C, at an enzyme dose of 1 % (w/w protein), diluted 1:1 with water and a hydrolysis time of 7 hours.

Practical recommendations

The obtention of free amino acid-rich protein hydrolysates through the enzymatic hydrolysis of rainbow trout viscera implies a faster process than the silage and it is also the most efficient method to hydrolyze protein using enzymes.
The composition of these protein hydrolysates are suitable to use them as ingredients for the formulation of plant biostimulants, as they comply with the legislation.
The use of fish protein hydrolysates in plant biostimulants is presented as an alternative of phosphate rocks and other non-renewable mineral sources in the production of fertilizers.
Using enzymatic hydrolysis for producing fish protein hydrolysates offers the opportunity to recirculate nutrients and can help to contribute to sustainable agricultural practices.
Fish viscera protein hydrolysates for biostimulant production seem a feasible alternative to fishmeal production in Europe, especially in areas located far from fishmeal plants.

Figure 1: rainbow trout viscera.

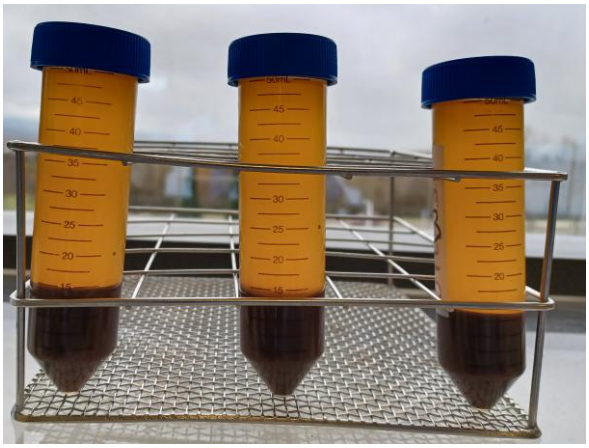

Figure 2: viscera hydrolysates obtained through enzymatic hydrolysis.

Further information

https://www.cell.com/heliyon/pdf/S2405-8440(24)03061-5.pdf

About this abstract

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PRACTICE ABSTRACT NO. 24

SEA2LAND

AZTI MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Producción de ingredientes para la formulación de bioestimulantes a partir de la hidrólisis enzimática de vísceras de trucha arcoiris

Resultados principales

Las condiciones óptimas para conseguir hidrolizados ricos en aminoácidos libres mediante la hidrólisis enzimática de vísceras son pH 7, una temperatura de 60 °C, una dosis de enzima del 1% (p/p proteína), diluido 1:1 con agua y un tiempo de hidrólisis de 7 horas.

Recomendaciones prácticas

La obtención de hidrolizados de proteína ricos en aminoácidos libres a través de la hidrólisis enzimática de vísceras de trucha supone un proceso más rápido que el ensilado y es el porceso más eficiente para hidrolizar proteína usando enzimas. La composición de estos hidrolizados de proteína son adecuados para usarlos como ingredietnes en la formulación de bioestimulantes para plantas, ya que cumplen con la legislación. El uso de hidrolizados de proteína de pescado en bioestimulantes para plantas se presenta como una alternativa a las rocas de fosfato y otras fuentes no renovables de minerales en la producción de fertilizantes. El uso de la hidrólisis enzimática para producir hidrolizados de proteína de pescado ofrece la oportunidad de recircular estos nutrientes y puede contribuir a promover practicas de agricultura sostenible. Los hidrolizados de vísceras de pescado para la producción de bioestimulantes parecen una alternativa viable a la producción de harinas de pescado en Europa, especialmente en áreas que se encuentran lejos de las plantas productoras de harinas.

Figura 1: vísceras de trucha arcoíris.

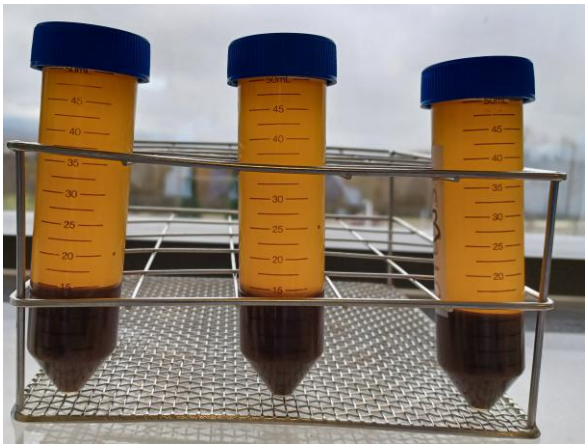

Figura 2: hidrolizados de víscera obtenidos por hidrólisis enzimática.

Más información

https://www.cell.com/heliyon/pdf/S2405-8440(24)03061-5.pdf

Acerca de este resumen

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PRACTICE ABSTRACT NO. 25

SEA2LAND

AZTI
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Production of an ingredient for the formulation of biostimulants by silage of rainbow trout viscera

Main results / outcomes

The optimum conditions for the silage of rainbow trout viscera to get free amino acid-rich protein hydrolysates are pH 4, room temperature and a silage time of 7 days.

Practical recommendations

The obtention of free amino acid-rich protein hydrolysates through the silage of rainbow trout viscera implies a process with a very low economic cost and very easy to perform comparing with enzymatic hydrolysis and autolysis.
The composition of these protein hydrolysates are suitable to use them as ingredients for the formulation of plant biostimulants, as they comply with the legislation.
The use of fish protein hydrolysates in plant biostimulants is presented as an alternative of phosphate rocks and other non-renewable mineral sources in the production of fertilizers.
Using silage for producing fish protein hydrolysates offers the opportunity to recirculate nutrients and can help to contribute to sustainable agricultural practices.
Fish viscera hydrolysates for biostimulant production seem a feasible alternative to fishmeal production in Europe, especially in areas located far from fishmeal plants.

Figure 1: rainbow trout viscera.

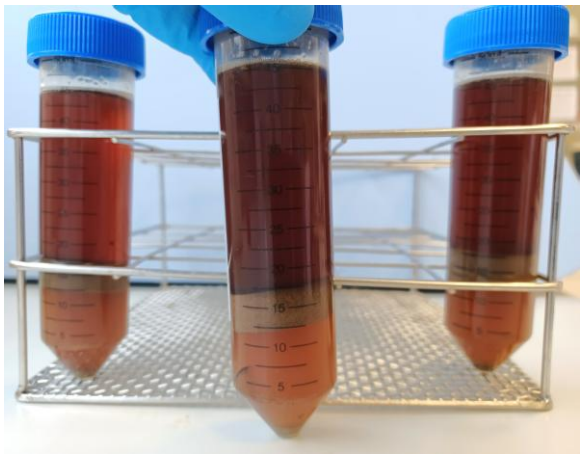

Figure 2: silage samples of viscera after 7 days.

Further information

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PRACTICE ABSTRACT NO. 25

SEA2LAND

AZTI
MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

Producción de ingredientes para la formulación de bioestimulantes a partir del ensilado de vísceras de trucha arcoiris

Resultados principales

Las condiciones óptimas para conseguir hidrolizados ricos en aminoácidos libres mediante el ensilado de vísceras de trucha arcoíriris son pH 4, temperature ambiente y un tiempo de ensillado de 7 días.

Recomendaciones prácticas

La obtención de hidrolizados de proteína ricos en aminoácidos libres a través del ensilado de vísceras de trucha supone un proceso de muy bajo coste y muy fácil de llevar a cabo comparando con la hidrólisis enzimática y la autólisis.
La composición de estos hidrolizados de proteína son adecuados para usarlos como ingredietnes en la formulación de bioestimulantes para plantas, ya que cumplen con la legislación.
El uso de hidrolizados de proteína de pescado en bioestimulantes para plantas se presenta como una alternativa a las rocas de fosfato y otras fuentes no renovables de minerales en la producción de fertilizantes.
El uso del ensilado para producir hidrolizados de proteína de pescado ofrece la oportunidad de recircular estos nutrientes y puede contribuir a promover practicas de agricultura sostenible.
Los hidrolizados de vísceras de pescado para la producción de bioestimulantes parecen una alternativa viable a la producción de harinas de pescado en Europa, especialmente en áreas que se encuentran lejos de las plantas productoras de harinas.

Figura 1: vísceras de trucha arcoíris.

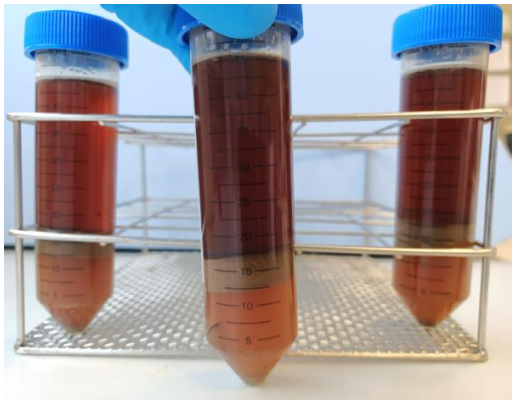

Figura 2: ensilado de vísceras después de 7 días.

Más información

https://www.cell.com/heliyon/pdf/S2405-8440(24)03061-5.pdf

Acerca de este resumen

Authors: Haizea Domínguez (AZTI), Bruno Iñarra (AZTI) Monica Gutierrez (AZTI) and Carlos Bald (AZTI).
Date: May 2025
SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe. The project is running from January 2021 to June 2025.
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PRACTICE ABSTRACT NO. 26

Industrial exploitation and replicability in EU countries

Main results / outcomes

SEA2LAND shows that fishery and aquaculture side streams can be safely transformed into high quality BBFs, closing nutrient cycles in seven EU maritime regions. Partner workshops and one to one meetings with producers, farmers and policy makers confirmed that processing technologies already recover enough nutrients while cutting waste disposal and CO_2 emissions.

From a technical perspective, stabilization, odor control, and tailor-made formulations now make it possible to produce BBFs that enhance soil health and boost crop yields. Economically, centralized collection and shared equipment help reduce production costs and EU funding programs along with carbon farming premiums, can bridge remaining financial gaps. On the regulatory side, the new Fertilising Products Regulation (EU 2019/1009) provides a clear path to CE marking. Its alignment with organic standards and REACH accelerates market entry, although national regulations still require further streamlining.

Practical recommendations

To ensure steady volumes and justify investments in advanced processing lines, it is essential to cluster biomass by pooling fish waste at the regional level. Starting with pilot fields is also key: collaborative trials with local farmers build trust, help determine application rates, and make adoption easier, with many farmers continuing using them. It is important to take full advantage of available funding to attract private investors. Clear labelling is crucial as well: obtaining CE marking along with organic or ecolabel certifications helps reassure buyers and unlock export opportunities. Finally, communicating the benefits through simple, compelling key messages helps fishermen, enterprises and growers understand the added value of this products.

Figure 1: Face-to-face interaction in Croatia

Figure 2: Agenda for the interaction in Belgium

About this abstract

Authors: Joaquín Romero, Carlos Fuertes (Fertinagro Biotech)
Date: May 2025

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PRACTICE ABSTRACT NO. 26

Explotación industrial y replicabillidad en los países de la Unión Europea

Principales resultados

SEA2LAND demuestra que los subproductos de pesca y acuicultura pueden transformarse en BBFs, cerrando los ciclos de nutrientes en regiones marítimas de la UE. Se han realizado talleres y reuniones individuales con productores, agricultores y responsables de políticas, confirmando que las tecnologías de procesamiento permiten la recuperación de nutrientes reduciendo la generación de residuos y CO2.

Desde la perspectiva técnica, la estabilización, el control de los olores y formulaciones a medida permiten producir BBFs que mejoran la salud del suelo y aumentan el rendimiento de los cultivos. Económicamente, la recogida centralizada y el uso compartido de equipos ayudan a reducir los costes de producción, y los programas de financiación junto con incentivos pueden cubrir los déficits financieros. En el plano regulatorio, el nuevo Reglamento sobre Productos Fertilizantes proporciona una vía clara hacia el marcado CE. Su alineación con las normas de agricultura ecológica y REACH acelera la entrada al mercado, aunque las regulaciones nacionales aún requieren una mayor armonización.

Recomendaciones prácticas

Para garantizar volúmenes constantes y justificar las inversiones en las líneas de procesamiento, agrupar la biomasa recopilando conjuntamente los residuos a nivel regional. También son clave los ensayos piloto con agricultores locales, que generan confianza, ajustan las dosis de aplicación y facilitan la adopción. Además, un etiquetado claro que permita obtener el marcado CE junto con certificaciones ecológicas u orgánicas ayuda a generar confianza en los compradores y a abrir oportunidades de exportación. Finalmente, comunicar los beneficios mediante mensajes clave sencillos y atractivos permite que tanto pescadores, como productores y agricultores comprendan el valor añadido de estos productos.

Figure 1: Interacción cara a cara en Croacia

Figure 2: Agenda para la interacción en Bélgica

Acerca de este resumen

Authors: Joaquín Romero, Carlos Fuertes (Fertinagro Biotech)
Date: May 2025
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PRACTICE ABSTRACT NO. 27

The economics of fishery-based by-products

Main results / outcomes

Fishery and aquaculture industries generate large volumes of by-products that were traditionally discarded. Today, these materials when properly processed can be converted into a wide variety of products.

Practical recommendations

Valorising by-products reduces disposal costs while generating high-value goods. For example, fishmeal and fish oil can be used in animal feed or aquaculture; protein hydrolysates and omega-3-rich oils have applications in food and nutraceuticals; and chitin, collagen, and gelatine are in demand in biomedical and cosmetic industries.

International examples show the potential: Norway valorises up to 76% of its by-products. France and China process fish residues into refined oils and collagen; Mexico and Chile convert shrimp and salmon waste into meal and oil; and Vietnam utilizes catfish by-products for food and feed.

For companies and farmers, investing in valorisation technologies such as enzymatic hydrolysis, oil extraction, biodiesel production, or microencapsulation can turn low-value residues into profitable products. These methods are increasingly efficient and adaptable to different production scales.

The market is growing, especially in aquaculture, functional foods, and green energy. By 2025, fishmeal from by-products could represent up to 50% of global supply. However, regulatory barriers, particularly in the EU, may limit use in human food, requiring careful compliance with safety standards.

Ultimately, valorising fishery by-products supports sustainability, generates revenue, reduces pressure on wild stocks, and minimizes waste. This shift supports a circular economy while creating new income opportunities across sectors.

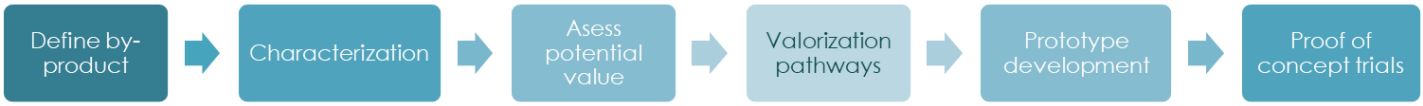

Figure 1: By-products valorization scheme

Further information

- Innovative uses of fisheries by-products. Alberto Ramírez. FAO 2013.
- Develop of Bioprocesses for the upgrading of fish by-products. Tesis Doctoral. Pedro Jesus García Moreno 2013.

About this abstract

Authors: Joaquín Romero, Carlos Fuertes (Fertinagro Biotech)
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PRACTICE ABSTRACT NO. 27

Economía de los subproductos derivados de la pesca

Principales resultados

Las industrias pesquera y acuícola generan grandes volúmenes de subproductos tradicionalmente desechados. Hoy en día, adecuadamente procesados, pueden convertirse en una gran variedad de productos.

Recomendaciones prácticas

La valorización de subproductos reduce costes de eliminación y permite generar productos de alto valor. Por ejemplo, la harina y el aceite de pescado se utilizan en piensos y acuicultura; los hidrolizados proteicos y aceites ricos en omega-3 se aplican en alimentación y nutracéuticos; y la quitina, el colágeno y la gelatina son muy demandados en las industrias biomédica y cosmética.
Ejemplos internacionales muestran su potencial: Noruega valoriza hasta el 76% de sus subproductos. Francia y China transforman residuos pesqueros en aceites refinados y colágeno; México y Chile procesan los desechos de gambas y salmón en harinas y aceites; y Vietnam aprovecha los subproductos para alimentos y piensos.
Para empresas y agricultores, invertir en tecnologías de valorización como la hidrólisis enzimática o la extracción de aceites puede transformar residuos de bajo valor en productos rentables. Estos métodos son cada vez más eficientes y adaptables a distintas escalas.
El mercado está creciendo: para 2025, la harina de pescado procedente de subproductos podría representar hasta el 50% del suministro global. Sin embargo, barreras normativas, en especial en la UE, pueden limitar su uso en alimentación humana, exigiendo un estricto cumplimiento de los estándares sanitarios.
Por último, valorizar los subproductos pesqueros promueve la sostenibilidad, genera ingresos, reduce la presión sobre los recursos pesqueros y minimiza residuos. Este cambio impulsa la economía circular creando nuevas oportunidades económicas en diversos sectores.

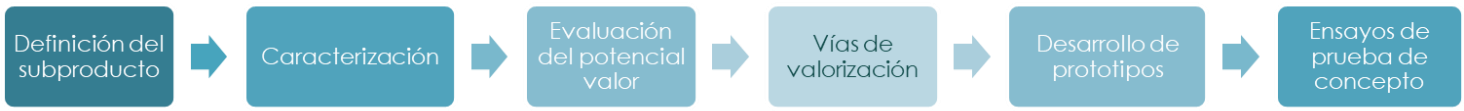

Figure 1: Esquema de valorización de subproductos

Más información

- Innovative uses of fisheries by-products. Alberto Ramírez. FAO 2013.
- Develop of Bioprocesses for the upgrading of fish by-products. Tesis Doctoral. Pedro Jesus García Moreno 2013.

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PRACTICE ABSTRACT NO. 28

Optimized technical datasheets

Main results / outcomes

SEA2LAND has produced 13 intermediate products (IPs) and 13 bio-based fertilisers (BBFs) from fishery and fish processing side-streams in the Cantabrian, Adriatic and Baltic regions, turning them into market-ready inputs for agriculture.

These include high-value formulations such as protein hydrolysates with 4–6% total N and up to 20% free amino acids for fast foliar uptake, and solid/liquid humic extracts with more than 90% organic matter and up to 43% humic/fulvic substances. The BBFs serve diverse functions: plant biostimulants (FER1–5, UNI1), organo-mineral nutrition (FER3), soil improvers and amendments (UNI2, UNI5, VER), liming agents (UNI4), and organic pellets (BP). All products comply with EU 2019/1009 contaminant thresholds, facilitating CE-marking and organic certification. The processes valorise up to 95% of the original biomass, reducing disposal costs and replacing synthetic fertilisers in line with circular economy principles.

This creates added value across the chain: fishermen and processors generate new income streams, farmers gain access to greener nutrients and enhanced resilience, and coastal communities close nutrient loops while cutting CO_2 emissions.

Practical recommendations

- Choose the right product: apply amino acids during stress peaks, use biochar/compost blends to boost soil carbon or apply liming agent to correct acidic soils.
- Cluster raw materials and place transformation units near to ports to reduce transport and guarantee steady feedstock.
- Fast track approval: use the datasheet specs to complete conformity dossiers and Annex II checks for organic farming.
- Pilot, measure, adjust: start small, monitor yield and soil analyses, then adjust doses.

Pilot Region	IP	BBF Proposed	BBF prototypes Obtained
Cantabrian	**IP1.** Viscera protein enzymatic hydrolysate	Foliar fertiliser	**FER1.** Solid biostimulant N, AA, organic matter and humic extract. **FER2.** Liquid biostimulant N and AA.
	***IP2.** Cooking waters protein enzymatic hydrolysate	Plant biostimulant	
	IP3. Viscera protein autolysate	Plant biostimulant Foliar fertiliser	**FER3.** NPK solution with aminoacids **FER4.** Liquid biostimulant N, AA, organic matter and humic extract.
	IP4. Microalgae biomass	Plant biostimulant	**FER5** Fertilizer with humic acids.
Adriatic	**IP5.** Protein hydrolysate	Plant biostimulant	**UNI1.** Liquid biostimulant
	IP6. Biochar	Soil improver/growth media	**UNI5.** Organic soil amendment or Soil improver
	IP7. Biochar-compost composite	Soil improver/growth media	**UNI2.** Soil improver
	IP8. Mineral fraction	Liming agent	**UNI4.** Liming agent
	****IP9.** Chitin/chitosan	N-fertiliser	**UNI3.** Liquid organic fertilizer
Baltic	**IP10.** Bokashi pellet	Organic fertiliser	**BP.** Organic fertilizer bokashi pellet
	IP11. Bokashi ferment. Liquid.	Foliar fertiliser	**FS.** Biostimulant with amino and humic acids
	IP12. Vermicompost	Soil improver/growth media	**VER.** Organic soil improver/ growth media
	IP13. Fermented fish and other food wastes	Organic fertilizer, foliar fertilizer, soil improver	**BP., FS., VER.**

Figure 1: Compilating table of IPs and BBFs included in Deliverable 3.7

About this abstract

Authors: Joaquín Romero, Carlos Fuertes (Fertinagro Biotech)
Date: June 2025

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PRACTICE ABSTRACT NO. 28

Fichas técnicas de los productos optimizados

Principales resultados

SEA2LAND ha producido 13 productos intermedios (IPs) y 13 fertilizantes (BBFs) a partir de subproductos de la pesca y su procesamiento en las regiones del Cantábrico, Adriático y Báltico, transformándolos en insumos agrícolas listos para comercializar.

Estos incluyen formulaciones de alto valor, como hidrolizados proteicos con 4-6% de N total y hasta 20 % de aminoácidos libres para rápida absorción foliar, y extractos húmicos sólidos/líquidos con más de 90 % de materia orgánica y hasta 43 % de sustancias húmicas/fúlvicas. Los BBFs cumplen diversas funciones: bioestimulante, nutrición organomineral, enmiendas del suelo, enmiendas calizas y pellet orgánico. Todos cumplen con los límites de contaminantes del Reglamento UE 2019/1009, facilitando el marcado CE y la certificación ecológica. Los procesos valorizan hasta el 95 % de la biomasa, reduciendo costes de eliminación y sustituyendo fertilizantes sintéticos.

Esto genera valor añadido en toda la cadena: los pescadores y procesadores obtienen nuevos ingresos, los agricultores acceden a nutrientes más sostenibles y mayor resiliencia, y las comunidades costeras cierran ciclos de nutrientes mientras reducen emisiones de CO_2.

Recomendaciones prácticas

- Elegir el producto adecuado: aplicar aminoácidos en picos de estrés, mezclas de biochar/compost para aumentar el carbono del suelo o enmiendas calizas para corregir suelos ácidos.
- Agrupar materias primas y situar las unidades de transformación cerca de los puertos para reducir el transporte y asegurar suministro constante.
- Aprobación acelerada: uso de las fichas técnicas para completar los expedientes de conformidad y las verificaciones para agricultura ecológica.
- Probar, medir, ajustar: empezar en pequeño, monitorizar el rendimiento y el suelo y ajustar las dosis.

Pilot Region	IP	BBF Proposed	BBF prototypes Obtained
Cantabrian	**IP1.** Viscera protein enzymatic hydrolysate	Foliar fertiliser	**FER1.** Solid biostimulant N, AA, organic matter and humic extract. **FER2.** Liquid biostimulant N and AA.
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	IP12. Vermicompost	Soil improver/growth media	**VER.** Organic soil improver/ growth media
	IP13. Fermented fish and other food wastes	Organic fertilizer, foliar fertilizer, soil improver	**BP., FS., VER.**

Figura 1: Tabla recopilación de IPs y BBFs incluida en el Deliverable 3.7

Acerca de este resumen

Authors: Joaquín Romero, Carlos Fuertes (Fertinagro Biotech)
Date: May 2025
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PRACTICE ABSTRACT NO. 29

SEA2LAND

LIÈGE université Gembloux Agro-Bio Tech

Bio-based fertilisers for the food of the future
From fishery waste to growing organic broccoli in the year 2095

Main results / outcomes

An Ecotron experiment evaluated agronomic and environmental performance of broccoli production with four different **bio-based fertilisers (BBFs) compared to a synthetic fertiliser (SYN)** under a **historic reference and a future RCP8.5 climate scenario**. While SYN mostly outperformed BBFs in the reference climate, many advantages disappeared in the future climate where plants receiving BBFs had higher plant biomass and improved yield parameters compared to plants with SYN. Mechanistically, cropping systems with **BBFs benefited from enhanced microbial activity and plants had higher nitrogen use efficiency than with SYN**. While these results support BBFs as sustainable alternatives to SYN, **further research is needed to limit the yield penalties observed under the future meteorological condition**, which affected both bio-based and synthetic fertilisers, but the latter to a larger extend.

Practical recommendations

Evaluate whether **BBFs in pelleted and slurry formulations can release nutrients more slowly** and thus be more effective during seasons with more intense rain and drought events. **Fine-tuning the interactions between BBFs, crop species and rhizosphere microbes**, combined with advanced irrigation technologies, could help **further improve nutrient cycling** in the cropping system to reduce climate-induced yield losses and nutrient leaching. Importantly, the experimental outcome emphasises the **value of testing fertilisers and crop growth under future meteorological conditions** to accurately assess their long-term viability and future market potential.

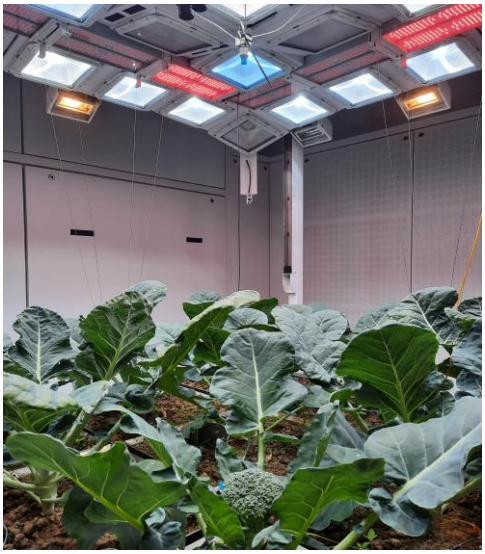

Fig. 1: Broccoli plants (*Brassica oleracea* var. *italica* cv. koros) were grown in the TERRA-Ecotron under two climate scenarios. In each climate, crop growth, nutrient dynamics and greenhouse gas emissions were assessed for four BBFs in comparison to a synthetic fertiliser (SYN).

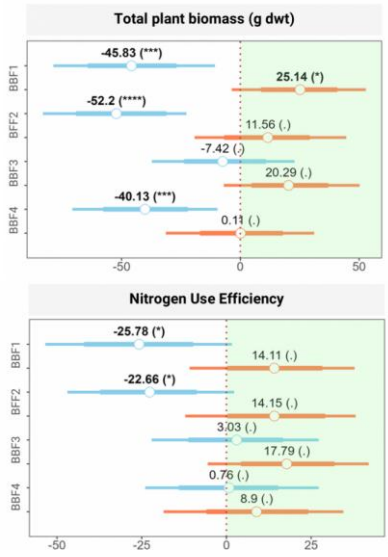

Fig. 2: Comparison of broccoli biomass (top panel) and nitrogen use efficiency (bottom panel) of each of the four BBFs in comparison to the synthetic control fertiliser (SYN). Right shift into the green area indicates larger parameter with BBF than with SYN. Blue: historic reference climate (1981-2017), orange: RCP8.5 scenario for 2095. Bold letters indicate significant shifts.

Further information

TERRA-Ecotron: www.ecotron.uliege.be | mailto: jennifer.michel@uliege.be

About this abstract

Authors: Jennifer MICHEL & Lucas BERGENHUIZEN / Gembloux Agro-Bio Tech (University of Liège)
Date: May 2025

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PRACTICE ABSTRACT NO. 29

SEA2LAND

LIÈGE université Gembloux Agro-Bio Tech

Des engrais biosourcés pour l'alimentation du futur
Des déchets de pêche à la culture de brocolis bio en 2095

Résultats principaux

Une expérience en Ecotron a évalué la performance agronomique et environnementale da la production brocoli avec quatre **engrais biosourcés (BBFs) comparés à un engrais synthétique (SYN)** dans un **climat de référence historique et un scénario climatique futur RCP8.5**. SYN a généralement surpassé les BBFs dans le climat de référence mais plusieurs avantages ont disparu dans le climat futur. Mécanistiquement, **les systèmes de culture avec BBFs ont bénéficié d'une activité microbienne accrue et les plantes ont montré une meilleure efficacité d'utilisation de l'azote qu'avec SYN**. Bien que ces résultats soutiennent les BBFs comme alternatives durables à SYN, des **recherches supplémentaires sont nécessaires pour limiter les pertes de rendement observées dans les conditions météorologiques futures**, qui ont affecté à la fois les engrais biosourcés et l'engrais synthétique, mais ce dernier dans une plus grande mesure.

Recommandations pratiques

Évaluer si les formulations de **BBFs en granulés ou en lisier libérent les nutriments plus lentement**, et ainsi sont plus efficaces lors des saisons avec des pluies et des sécheresses plus intenses. Identifier des **interactions synergétiques entre BBFs, espèce cultivée et micro-organismes rhizosphériques**, combiné à des technologies d'irrigation avancées, pourrait améliorer le système de culture pour réduire les pertes de nutriments et de rendement. Les résultats soulignent aussi l'importance de **tester les engrais et systèmes de culture dans des conditions météorologiques futures** pour évaluer leur viabilité à long terme et le potentiel de marché futur.

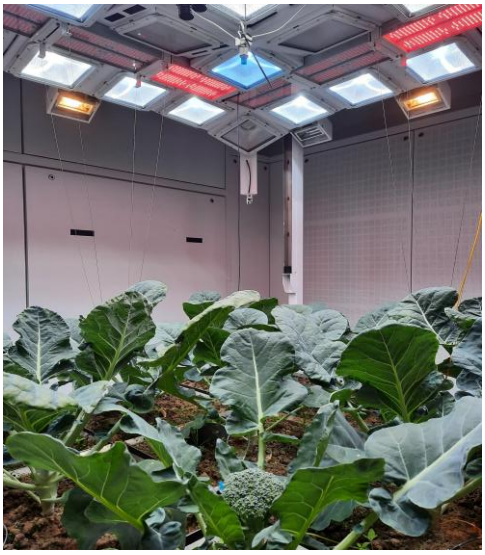

Fig. 1: Des plants de brocoli (Brassica oleracea var. italica cv. koros) cultivés dans le TERRA-Ecotron. Dans deux climats, la croissance des plants, la dynamique des nutriments et les émissions de gaz à effet de serre ont été évaluées pour quatre BBFs en comparaison avec un engrais synthétique (SYN).

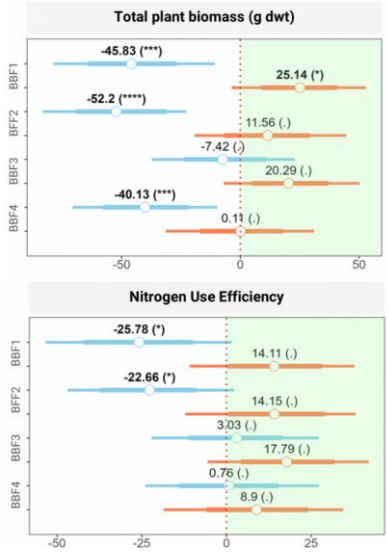

Fig. 2: Comparaison de la biomasse des brocolis (panneau supérieur) et de l'efficacité d'utilisation de l'azote (panneau inférieur) pour chacun des quatre BBFs par rapport à l'engrais synthétique de référence (SYN). Un déplacement vers la droite dans la zone verte indique un paramètre plus élevé avec les BBFs qu'avec SYN. Bleu : climat de référence historique (1981-2017), orange : scénario RCP8.5 pour 2095. Les lettres en gras indiquent des changements significatifs.

Informations complémentaires

TERRA-Ecotron: www.ecotron.uliege.be | mailto: jennifer.michel@uliege.be

À propos de cet abstract

Auteurs: Jennifer MICHEL & Lucas BERGENHUIZEN / Gembloux Agro-Bio Tech (University of Liège)
Date: Mai 2025

SEA2LAND est une action d'innovation collaborative (IA) financée par l'UE dans le cadre du programme Horizon 2020. Le projet vise à fournir des solutions pour surmonter les défis liés à la production alimentaire, au changement climatique et à la réutilisation des déchets. Basé sur le modèle de l'économie circulaire, SEA2LAND promeut la production à grande échelle d'engrais dans l'UE à partir de matières premières locales. Cette solution devrait réduire le déséquilibre des nutriments dans les sols en Europe. Le projet se déroule de janvier 2021 à juin 2025. **Site web**: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 29

SEA2LAND

LIÈGE université Gembloux Agro-Bio Tech

Biogebaseerde meststoffen voor voedsel van de toekomst
Van visserijafval naar de teelt van biologische broccoli in 2095

Belangrijkste resultaten

Een Ecotron-experiment evalueerde de agronomische en milieuprestaties van broccoli-productie met **vier verschillende biogebaseerde meststoffen (BBFs) vergeleken met een synthetische meststof (SYN)** onder een **historisch referentieklimaat en een toekomstig RCP8.5-klimaatscenario**. Hoewel SYN in het referentieklimaat over het algemeen beter presteerde dan de BBFs, verdwenen veel voordelen in het toekomstige klimaat. Op mechanistisch niveau vertoonden teeltsystemen met **BBFs een verhoogde microbiële activiteit, en planten hadden een hogere stikstofgebruiksefficiëntie dan bij SYN**. Er is echter verder onderzoek nodig om de opbrengstverliezen te beperken die werden waargenomen onder de toekomstige meteorologische omstandigheden, die zowel biogebaseerde als synthetische meststoffen beïnvloedden — zij het in sterkere mate de synthetische.

Praktische aanbevelingen

Evalueer of BBFs in **gepelleteerde en vloeibare (slurry) vorm voedingsstoffen langzamer kunnen vrijgeven** en daardoor effectiever kunnen zijn tijdens seizoenen met intensere regen- en droogteperiodes. Het verfijnen van de **interacties tussen BBFs, gewassoorten en rhizosfeer-microben**, in combinatie met geavanceerde irrigatietechnologieën, kan bijdragen aan een verbeterde nutriëntenkringloop, om klimaatgerelateerde opbrengstverliezen te beperken. De resultaten benadrukken ook het **belang van het testen van meststoffen onder toekomstige klimaatomstandigheden** om hun marktpotentieel nauwkeurig te kunnen beoordelen.

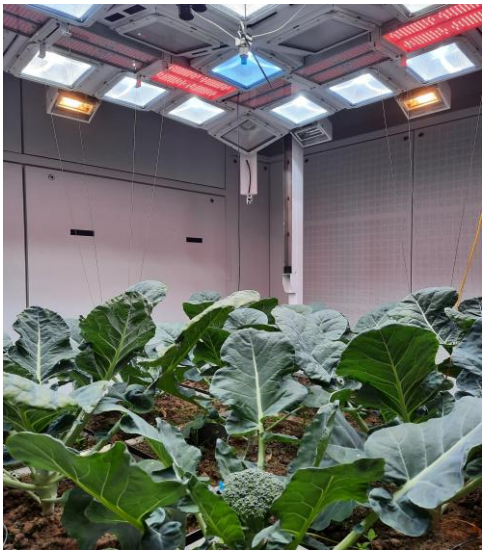

Fig. 1: Broccoli-planten (Brassica oleracea var. italica cv. koros) werden geteeld in de TERRA-Ecotron. In twee klimaats werden gewasgroei, nutriëntendynamiek en broeikasgasemissies beoordeeld voor vier BBFs in vergelijking met een synthetische meststof (SYN).

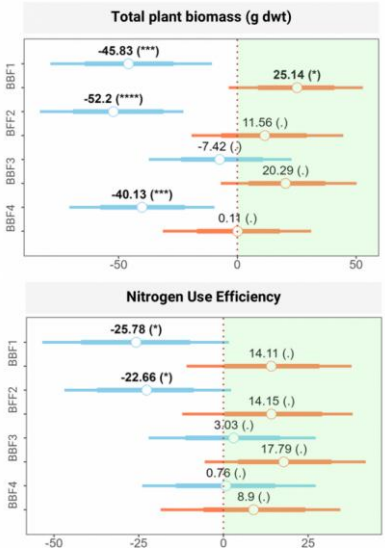

Fig. 2: Vergelijking van broccolibiomassa (bovenste paneel) en stikstofgebruiksefficiëntie (onderste paneel) van elk van de vier BBFs ten opzichte van de synthetische meststof (SYN). Een verschuiving naar rechts in het groene gebied geeft een hogere parameter aan met BBF's dan met SYN. Blauw: historisch referentieklimaat (1981-2017), oranje: RCP8.5-scenario voor 2095. Vetgedrukte letters geven significante verschuivingen aan.

Verdere informatie

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Over deze abstract

Auteurs: Jennifer MICHEL & Lucas BERGENHUIZEN / Gembloux Agro-Bio Tech (University of Liège)
Datum: Mei 2025

Het **SEA2LAND**-project is een samenwerkende innovatieactie (IA) gefinancierd door de EU in het kader van het Horizon 2020-programma. Het project beoogt oplossingen te bieden om uitdagingen op het gebied van voedselproductie, klimaatverandering en afvalhergebruik aan te pakken. Gebaseerd op het circulaire-economiemodel bevordert SEA2LAND de productie van grootschalige meststoffen in de EU uit eigen grondstoffen. Deze oplossing moet het nutriëntenonevenwicht in Europese bodems verminderen. Het project loopt van januari 2021 tot juni 2025. **Website**: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 29

SEA2LAND

LIÈGE université Gembloux Agro-Bio Tech

Biobasierte Düngemittel für die Landwirtschaft der Zukunft
Von Fischereiabfällen zum Anbau von Bio-Brokkoli im Jahr 2095

Hauptresultate

Ein Ecotron-Experiment untersuchte die agronomische und ökologische Kapazität von **vier biobasierten Düngemitteln (BBFs) im Vergleich zu einem synthetischen Dünger (SYN)** im Brokkoli-anbau unter **einem historischen Referenzklima und einem zukünftigen RCP8.5-Klimaszenario**. Während SYN im Referenzklima meist besser abschnitt als die BBFs, gingen viele Vorteile im zukünftigen Klima verloren, wo Pflanzen mit BBFs höhere Biomasse und verbesserte Ertrags-parameter im Vergleich zu Pflanzen mit SYN aufwiesen. **Mechanistisch profitierten Anbausysteme mit BBFs von einer erhöhten mikrobiellen Aktivität, und die Pflanzen zeigten eine höhere Stickstoffnutzungseffizienz**. Weitere Forschungsarbeit ist jedoch erforderlich um **Ertragsverluste unter zukünftigen Klimabedingungen zu begrenzen**, welche hier sowohl für biobasierte als auch für synthetische Düngemittel beobachtet wurden, letztere waren jedoch stärker betroffen.

Praktische Empfehlungen

Es gilt zu testen ob **BBFs in Pellet- und Slurryformulierungen Nährstoffe langsamer freisetzen** und somit in Perioden mit intensiveren Regen- und Dürreereignissen effektiver sind. Eine Optimierung der **Wechselwirkungen zwischen BBFs, Pflanzensorte und Rhizosphärenmikroben** in Kombination mit fortschrittlichen Bewässerungstechnologien kann auch zur verbesserten Nährstoffzirkulation im Anbausystem beitragen und klimabedingte Ertragsverluste reduzieren. Die experimentellen Ergebnisse unterstreichen auch die **Bedeutung des Testens von Düngemitteln unter zukünftigen Klimabedingungen** um das langfristige Marktpotenzial bewerten zu können.

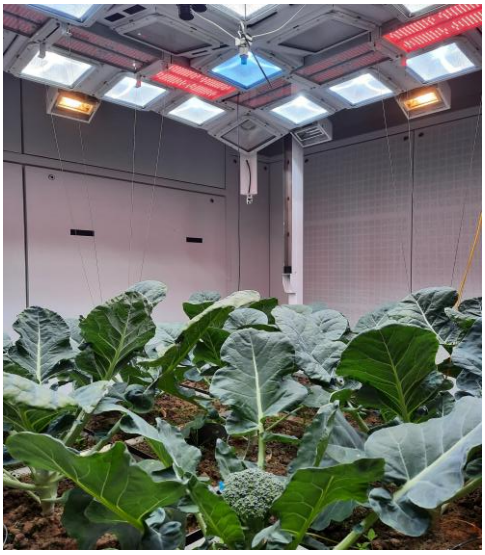

Fig. 1: Brokkoli-pflanzen (Brassica oleracea var. italica cv. koros) im TERRA-Ecotron. In zwei Klima-szenarien wurden Pflanzenwachs-tum, Nährstoff-dynamik und Treibhausgasemissi onen für vier BBFs im Vergleich zu einem synthetischen Düngemittel (SYN) getestet.

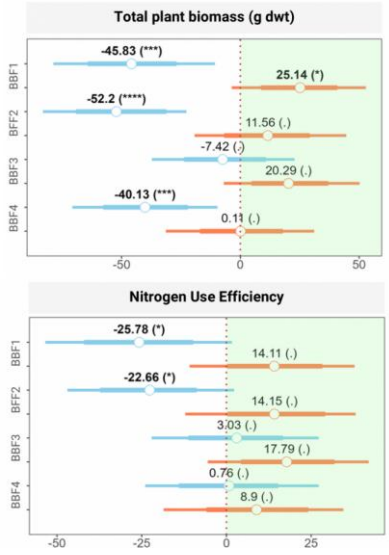

Fig. 2: Vergleich von Biomasse (oberes Diagramm) und Stickstoffnutzungs-effizienz (unteres Diagramm) für jeden der vier BBFs im Vergleich zum synthetischen Dünger (SYN). Verschiebung nach rechts in den grünen Bereich bedeutet einen höheren Parameter mit BBFs als mit SYN. Blau: historisches Referenzklima (1981-2017), orange: RCP8.5-Szenario für 2095. Fettgedruckte Buchstaben zeigen signifikante Veränderungen an.

Weitere Informationen

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Über dieses Abstract

Autoren: Jennifer MICHEL & Lucas BERGENHUIZEN / Gembloux Agro-Bio Tech (University of Liège)
Datum: Mai 2025

SEA2LAND ist eine kollaborative Innovationsmaßnahme (IA) die von der EU im Rahmen des Horizon 2020-Programms finanziert wurde. Das Projekt strebt Lösungen für die Herausforderungen in den Bereichen Lebensmittelproduktion, Klimawandel und Abfallwiederverwendung an. Basierend auf dem Modell der Kreislaufwirtschaft fördert SEA2LAND die großflächige Produktion von Düngemitteln in der EU aus eigenen Rohstoffen. Dieser Ansatz soll das Nährstoffungleichgewicht in europäischen Böden verringern. Das Projekt läuft von Januar 2021 bis Juni 2025. **Website**: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 30

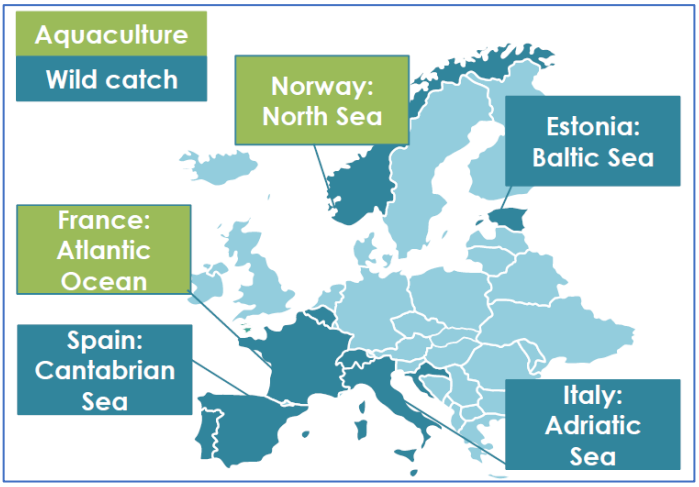
Environmental hotspots of bio-based fertilisers

Main results / outcomes

The life cycle assessment (LCA) of bio-based fertilisers (BBF) produced and field-tested in Sea2Land revealed, that both production and use phase are relevant with regard to environmental impacts. This is especially true for global warming and mineral resources use. In contrast, terrestrial acidification and eutrophication is dominated by the use phase only (i.e. field emissions). Environmental performance of BBF was in general negatively effected by transport of raw materials, energy intense drying processes, packaging and low yields in field trials.

Practical recommendations

To minimize environmental impacts of BBF, they need to be produced closely to the source of raw materials to avoid transport. During the processing of raw materials to BBF, the energy consumption of drying processes should be lowered: this can be done e.g. with innovative heat recovery processes and effective, preceding mechanical dewatering. Packaging should be minimized, reused and recycled. In general, renewable energy should be used for the production of BBF. Unnecessary processing steps (such as hydrolysis) should be avoided without evidence of improving the agronomic performance of the BBF.



To lower environmental impacts during the use of BBF, amounts applied should align with the effective fertilization needs e.g. determined by soil samples. Also, BBF can be combined with agro-ecological practices such cover crops, reduced soil tillage etc. to further lower environmental impacts of crop production.

Figure: Case studies in Sea2Land.

Further information

Landert, J., Vialle, C., Fabre, J.-F., Caroline, S., Teixeira, D., Monteiro, H., Bald, C., Iñarra, B., & de Baan, L. (2024, September 8). Fertilisers from fish processing and aquaculture production waste: An ecofriendly alternative for crop production? 14TH INTERNATIONAL LCA FOOD (LCA FOOD). Zenodo. https://doi.org/10.5281/zenodo.15118835

About this abstract

Authors: Jan Landert (FIBL), Laura de Baan (FiBL)
Date: June 2025

SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe.
The project is running from January 2021 to December 2024.
Website: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 30

Umweltauswirkungen bei biobasierten Düngemitteln

Wichtigste Ergebnisse / Resultate

Die Ökobilanz von biobasierten Düngemitteln (BBF), die in Sea2Land hergestellt und in der Praxis erprobt wurden, hat gezeigt, dass sowohl die Produktions- als auch die Nutzungsphase im Hinblick auf die Umweltauswirkungen relevant sind. Dies gilt insbesondere für die globale Erwärmung und den Verbrauch an mineralischen Ressourcen. Die Versauerung und Eutrophierung der Gewässer wird dagegen nur von der Nutzungsphase (d. h. von den Emissionen beim Ausbringen) dominiert. Die Umweltverträglichkeit von BBF wurde im Allgemeinen durch den Transport von Rohstoffen, energieintensive Trocknungsprozesse, die Verpackung und geringe Erträge in den Feldversuchen negativ beeinflusst.

Praktische Empfehlungen

Um die Umweltauswirkungen von BBF zu minimieren, müssen sie in der Nähe der Rohstoffquelle hergestellt werden, um Transporte zu vermeiden. Bei der Verarbeitung von Rohstoffen zu BBF sollte der Energieverbrauch von Trocknungsprozessen gesenkt werden: Dies kann z. B. durch innovative Wärmerückgewinnungsverfahren und eine effektive, vorgeschaltete mechanische Entwässerung geschehen. Verpackungen sollten minimiert, wiederverwendet und recycelt werden. Generell sollte bei der Herstellung von BBF erneuerbare Energie eingesetzt werden. Unnötige Verarbeitungs-schritte (z. B. Hydrolyse) sollten vermieden werden, wenn sie nicht nachweislich zu einer Verbesserung der agronomischen Leistung der BBF führen.

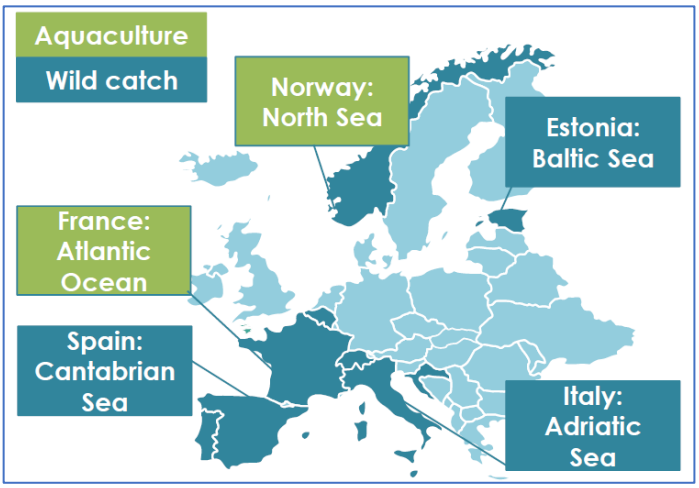

Abbildung: Fallstudien in Sea2Land

Um die Umweltauswirkungen beim Einsatz von BBF zu verringern, sollte die ausgebrachte Menge dem tatsächlichen Düngebedarf entsprechen, der z. B. Anhand von Bodenproben ermittelt wird. Außerdem können BBF mit agrarökologischen Praktiken wie Deckfrüchten, reduzierter Bodenbearbeitung usw. kombiniert werden, um die Umweltauswirkungen der Pflanzenproduktion weiter zu verringern.

Weitere Informationen

Landert, J., Vialle, C., Fabre, J.-F., Caroline, S., Teixeira, D., Monteiro, H., Bald, C., Iñarra, B., & de Baan, L. (2024, September 8). Fertilisers from fish processing and aquaculture production waste: An ecofriendly alternative for crop production? 14TH INTERNATIONAL LCA FOOD (LCA FOOD). 14. INTERNATIONAL LCA FOOD (LCA FOOD). Zenodo. https://doi.org/10.5281/zenodo.15118835

Über diese Zusammenfassung

Die Autoren: Jan Landert (FIBL), Laura de Baan (FiBL)
Datum: Juni 2025

Das Projekt **SEA2LAND** ist eine gemeinschaftliche Innovationsmaßnahme (IA), die von der EU im Rahmen des Programms Horizont 2020 finanziert wird. Das Projekt zielt darauf ab, Lösungen zur Bewältigung der Herausforderungen im Zusammenhang mit der Lebensmittelproduktion, dem Klimawandel und der Abfallwiederverwendung zu finden. Auf der Grundlage des Modells der Kreislaufwirtschaft fördert SEA2LAND die Herstellung von Düngemitteln in großem Maßstab in der EU aus eigenen Rohstoffen. Es wird erwartet, dass diese Lösung das Nährstoffungleichgewicht im Boden in Europa verringern wird.
Das Projekt läuft von Januar 2021 bis Dezember 2024.
Website: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 31

How to assess the environmental impacts of fishery-based bio fertilisers

Main results / outcomes

Life cycle assessment (LCA) is a commonly used method to assess the environmental impacts of products. Thereby, environmental impacts are expressed per "functional unit". For bio-based fertilizers (BBF), this function can be 1 kg of fertilizer, 1kg of N or P or 1kg of crops finally grown with the fertilizer. Relevant environmental impacts occur both during the production as well as during the application of fertilizer on the field and should thus both be considered for a holistic understanding of environmental impacts of bio-based fertilizers.

Practical recommendations

Relevant primary data on processes involved in BBF production need to be collected (e.g. regarding energy and material use, transport distances of input material, emissions occurring during production, N and P content of BBF, etc.). To assess the environmental impact of BBF application, agronomic data on field or pot trials are needed, showing the yield effect of the BBFs. Since the performance of BBF can be highly dependent on the site, season and crop, different trials should be included in the analysis.
Ideally, data on field emissions after fertilizer application is also collected. Alternatively, these emissions can be modelled, whereby a sensitivity analysis using different emission factors is highly recommended.

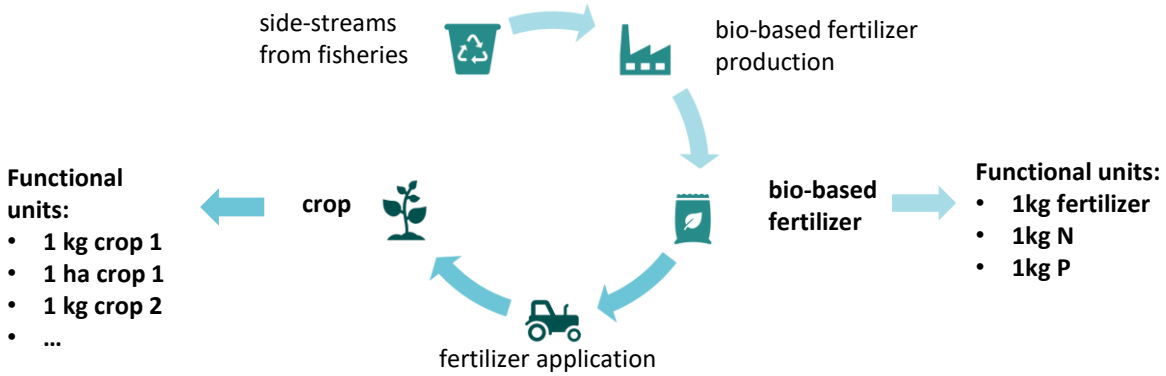

Figure: Processes to consider for an LCA of bio-based fertilizers. Environmental impacts of each step should be considered.

Further information

Landert, J. de Baan, L; Fabre, J-F; et al. (2024) What drives environmental impacts of fertilizers produced from fish wastes? Presentation at "Nutrients in Europe Research Meeting", Brussels, Belgium, 16 – 17 April 2024. https://orgprints.org/id/eprint/53240/

About this abstract

Authors: Laura de Baan (FIBL), Jan Landert (FiBL)
Date: May 2025
SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe.
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PRACTICE ABSTRACT NO. 31

Wie man die Umweltwirkungen von fischerei-basierten Bio-Düngemitteln bewertet

Wichtigste Ergebnisse

Ökobilanzen sind eine häufig verwendete Methode zur Bewertung der Umweltauswirkungen von Produkten. Dabei werden die Umweltauswirkungen pro „funktionelle Einheit" ausgedrückt. Bei biobasierten Düngemitteln (BBF) kann diese Funktionseinheit 1 kg Dünger, 1 kg N oder P oder 1 kg einer Kultur sein, welche mit dem Dünger angebautenwurde. Relevante Umweltauswirkungen treten sowohl während der Produktion als auch während der Ausbringung des Düngers auf und sollten daher für ein ganzheitliches Verständnis der Umweltauswirkungen biobasierter Düngemittel berücksichtigt werden.

Praktische Empfehlungen

Es müssen relevante Primärdaten über die an der BBF-Produktion beteiligten Prozesse erhoben werden (z. B. über den Energie- und Materialverbrauch, die Transportentfernungen der Einsatzstoffe, die bei der Produktion entstehenden Emissionen, den N- und P-Gehalt der BBF usw.). Um die Umweltauswirkungen der BBF-Anwendung zu bewerten, werden agronomische Daten aus Feld- oder Topfversuchen benötigt, die den Ertragseffekt der BBFs zeigen. Da die Leistung von BBF stark vom Standort, der Jahreszeit und der Kultur abhängig sein kann, sollten verschiedene Versuche in die Analyse einbezogen werden. Idealerweise werden auch Daten über die Feldemissionen nach der Düngerausbringung gesammelt. Alternativ können diese Emissionen modelliert werden, wobei eine Sensitivitätsanalyse mit verschiedenen Emissionsfaktoren sehr zu empfehlen ist.

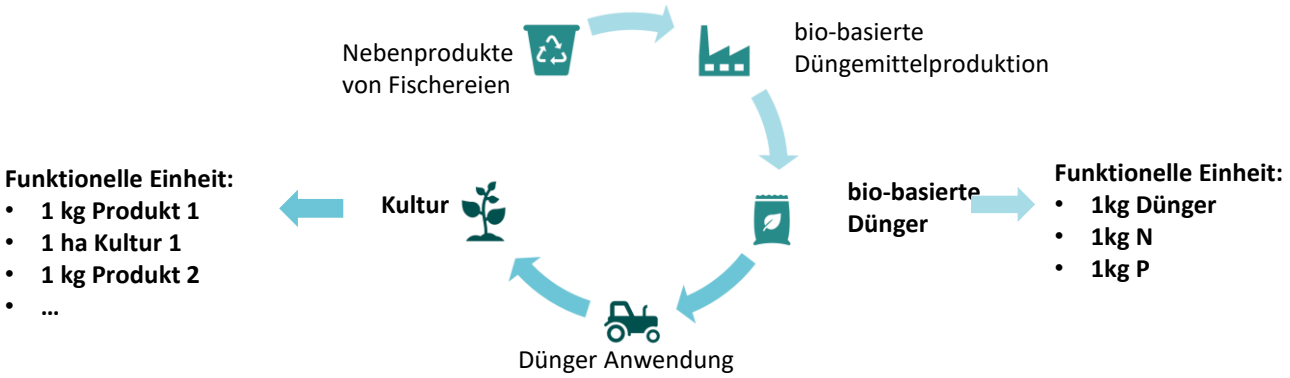

Abbildung: Prozesse, die bei einer Ökobilanz für biobasierte Düngemittel zu berücksichtigen sind. Die Umweltauswirkungen der einzelnen Schritte sollten berücksichtigt werden.

Weiterführende Informationen

Landert, J. de Baan, L; Fabre, J-F; et al. (2024) What drives environmental impacts of fertilizers produced from fish wastes? Presentation at "Nutrients in Europe Research Meeting", Brussels, Belgium, 16 – 17 April 2024. https://orgprints.org/id/eprint/53240/

Über diese Zusammenfassung

Authoren: Laura de Baan (FIBL), Jan Landert (FiBL)
Datum: May 2025
Das Projekt **SEA2LAND** ist eine kollaborative Innovationsmaßnahme (IA), die von der EU im Rahmen des Programms Horizon 2020 finanziert wird. Das Projekt zielt darauf ab, Lösungen zur Bewältigung der Herausforderungen im Zusammenhang mit der Lebensmittelproduktion, dem Klimawandel und der Abfallwiederverwendung zu finden. Auf der Grundlage des Modells der Kreislaufwirtschaft fördert SEA2LAND die Herstellung von Düngemitteln in großem Maßstab in der EU aus eigenen Rohstoffen. Diese Lösung soll das Nährstoffungleichgewicht im Boden in Europa verringern. Das Projekt läuft von Januar 2021 bis Dezember 2024.
Website: www.sea2landproject.eu

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PRACTICE ABSTRACT NO. 32

Phosphorus use efficiency of alfalfa fertilized with aquaculture derived bio-based fertilizers in an Andisol

Main results / outcomes

Dried fish sludge (DFS) bio-based fertilizer (BBF) exhibited higher alfalfa forage yield (FY) and phosphorus use efficiency (PUE) than inorganic fertilizer (triple superphosphate) in an Andisol, which demonstrates the agronomic value of aquaculture waste derived BBFs.

Practical recommendations

Five fertilizer treatments were tested in a field experiment: Composted fish sludge (CFS), fish bone meal (FBM), dried fish sludge (DFS) and two control treatments (No-P and inorganic-P). The phosphorus use efficiency (PUE=ΔFY/ ΔP) corresponds to the increase in FY by units of P-fertilizer added. In this work, the PUE varied across harvests from 2.3 (H2) to 8.0 kg FY/kg P. The Total PUE throughout the experimental period was 18.5 kg FY kg P-1. The DFS treatment achieved the highest PUE and FY values across harvests (Figure 1). The CFS treatment affect negatively the FY and PUE of alfalfa. Results demonstrated that BBFs have great agronomic value and can improve the productivity of Alfalfa, which is the most important forage crop worldwide and has particularly high phosphorus requirements due to its role in biological nitrogen fixation.

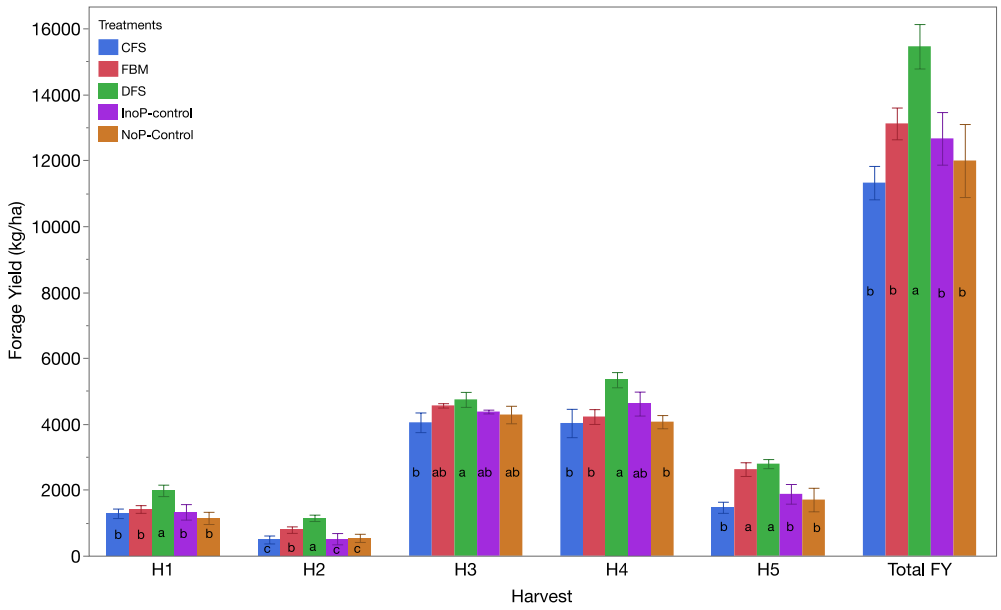

Figure 1: Forge yield of alfalfa grown in Andisol soil and fertilized with 100 kg/ha of P2O5 using three BBFs derived from aquaculture wastes and two control treatments (No-P and inorganic-P). The inorganic –P was triple superphosphate and BBFs treatments were: Composted fish sludge (CFS), fish bone meal (FBM) and dried fish sludge (DFS). FY and PUE was measured in five harvests (H1 to H5).

Further information

www.inia.cl and linostroza@inia.cl

About this abstract

Authors: Luis Inostroza, Juan Hirzel, and Francisco Salazar/ INIA-Chile
Date: May 2025
SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe. The project is running from January 2021 to June 2025.
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PRACTICE ABSTRACT NO. 32

Eficiencia en el uso del fósforo de alfalfa fertilizada con biofertilizantes de la industria acuícola en suelo Andisol

Resultado principal

El biofertilizante lodo seco (DFS) mostró una producción de forraje (FY) y eficiencia en el uso del fósforo (PUE) mayor que un fertilizante inorgánico (superfosfato triple) en un suelo Andisol, lo que demuestra el valor agronómico de BBFs derivados de desechos de la industria acuícola.

Recomendaciones prácticas

Se evaluaron cinco tratamientos de fertilización en un ensayo de campo: lodo compostado (CFS), harina de hueso de pescado (FBM), lodo seco (DFS) y dos tratamientos control (No-P y P-inorgánico). La eficiencia en el uso del fósforo (PUE=ΔFY/ ΔP) corresponde al incremento en FY por unidad de P agregado por el fertilizante. En este trabajo, la PUE varió entre cosechas desde 2.3 (H2) a 8.0 kg FY/kg P. La PUE total, obtenida en todo el periodo experimental fue 18.5 kg FY/kg P. El tratamiento DFS logró la mayor PUE y FY en todas las cosechas (Figura 1). El tratamiento CFS afectó negativamente el FY y PUE de alfalfa. Los resultados demuestran que los BBFs tienen un alto valor agronómico y pueden mejorar la productividad de alfalfa en suelo Andisol. La alfalfa es la especie forrajera más importante a nivel global y presenta altos requerimientos de P debido al rol que este juega en el proceso de fijación de nitrógeno.

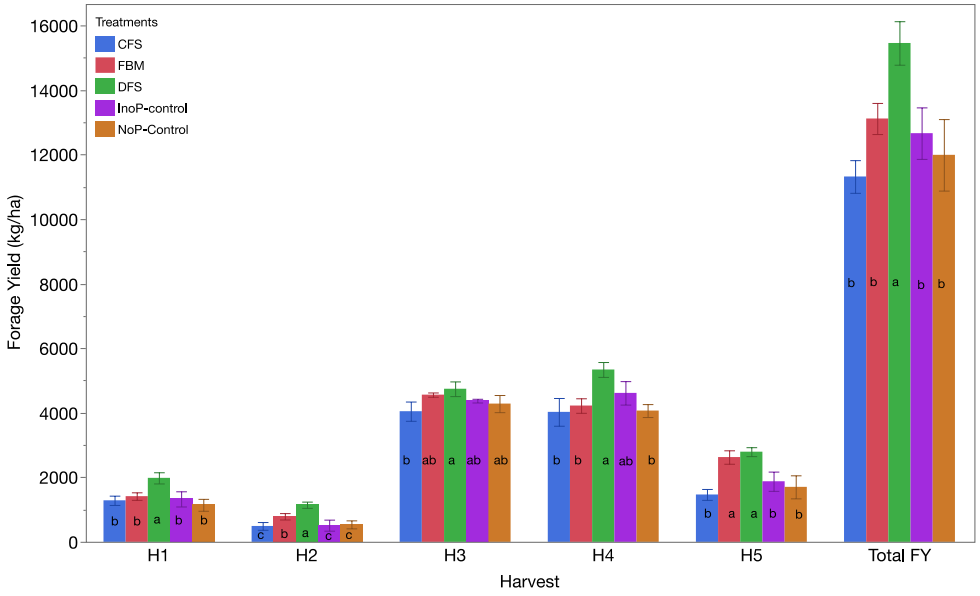

Figura 1: Rendimiento de forraje de alfalfa cultivada en suelo Andisol y fertilizada con 100 kg/ha de P2O5 con tres BBFs derivados de la industria acuícola y dos tratamientos control (No-P y P-inorgánico). El tratamiento P-inorgánico fue superfosfato triple y los BBFs fueron: lodo compostado (CFS), harina de hueso de pescado (FBM) y lodo seco (DFS). FY se evaluó en cinco cosechas (H1 a H5).

Información adicional

www.inia.cl and linostroza@inia.cl

Acerca de este resumen

Authors: Luis Inostroza, Juan Hirzel, and Francisco Salazar/ INIA-Chile
Date: May 2025
SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe. The project is running from January 2021 to June 2025.
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PRACTICE ABSTRACT NO. 33

A Decision Support System framework for using fishery-based bio fertilizers

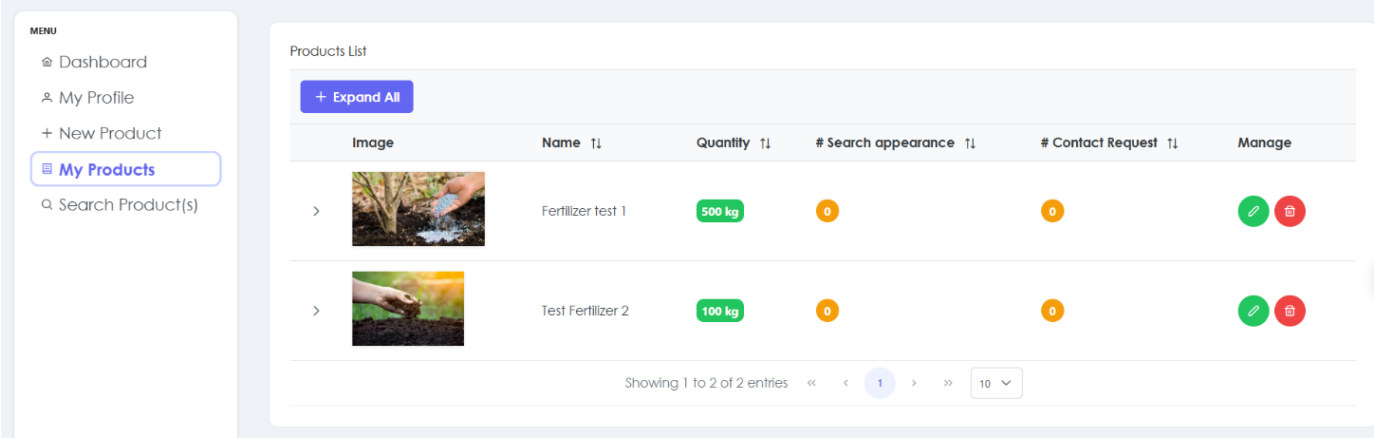
Main results / outcomes

To support more sustainable agricultural practices and improve decision-making in fishery-based bio fertilizers usage, it was developed a web-based Decision Support System (DSS) tailored specifically for the selection of biofertilizers. This platform serves as a practical tool that helps farmers, agronomists, and agricultural advisors choose the most appropriate biofertilizers based on multiple parameters and characteristics of the fertilizers.

The system was designed with ease of use in mind, allowing users to input key data such as fertilization practices. Based on this information, the platform can generate customized recommendations by analyzing a comprehensive database of fishery-based biofertilizers.

To ensure the recommendations are both scientifically grounded and practically applicable, the platform incorporates a robust decision-making engine. This engine assess the suitability of various biofertilizer options, considering multiple factors of the different fertilizers in the database. The results are presented clearly, offering users a ranked list of biofertilizers.

In essence, this platform can become an essential tool in promoting the adoption of biofertilizers, reducing dependency on chemical inputs, and supporting more resilient and environmentally responsible farming systems.



Practical recommendations

This DSS web platform serves as a practical, science-based tool to promote sustainable agriculture by guiding users in selecting the right biofertilizers tailored to their unique farming conditions. Its adoption can lead to improved soil health, reduced dependency on chemical fertilizers, and better crop yields.

Further information

https://sea2land.sid-isq.com/

About this abstract

Authors: André Carvalho, Guilherme Covas, Manuel Carreiras (ISQ)
Date: June 2025

SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change, and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from its own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe.

The project is running from January 2021 to December 2024.

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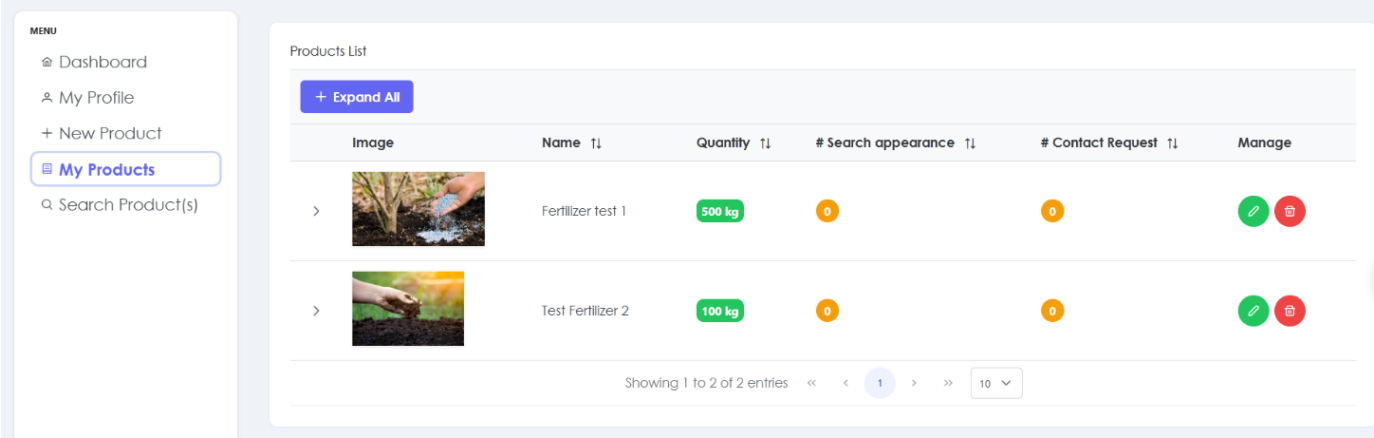
PRACTICE ABSTRACT NO. 33

Uma estrutura de Sistema de Apoio à Decisão para o uso de biofertilizantes à base de produtos da pesca

Principais resultados / conclusões

Para apoyar prácticas agrícolas más sostenibles y mejorar la toma de decisiones en el uso de biofertilizantes derivados de la pesca, se desarrolló un Sistema de Apoyo a la Toma de Decisiones (DSS) basado en la web, diseñado específicamente para la selección de biofertilizantes. Esta plataforma funciona como una herramienta práctica que ayuda a agricultores, agrónomos y asesores agrícolas a elegir los biofertilizantes más adecuados, basándose en múltiples parámetros y características de los fertilizantes.El sistema fue diseñado pensando en la facilidad de uso, permitiendo a los usuarios ingresar datos clave como las prácticas de fertilización. A partir de esta información, la plataforma puede generar recomendaciones personalizadas, analizando una base de datos integral de biofertilizantes de origen pesquero.Para garantizar que las recomendaciones estén científicamente fundamentadas y sean aplicables en la práctica, la plataforma incorpora un motor de toma de decisiones robusto, que evalúa la idoneidad de diversas opciones de biofertilizantes, considerando múltiples factores presentes en la base de datos. Los resultados se presentan de forma clara, ofreciendo a los usuarios una lista clasificada de biofertilizantes.En esencia, esta plataforma puede convertirse en una herramienta esencial para promover la adopción de biofertilizantes, reducir la dependencia de insumos químicos y apoyar sistemas agrícolas más resilientes y respetuosos con el medio ambiente.



Recomendações práticas

Esta plataforma web do DSS funciona como uma ferramenta prática e baseada em evidências científicas para promover a agricultura sustentável, orientando os usuários na seleção dos biofertilizantes mais adequados às suas condições agrícolas específicas. Sua adoção pode levar à melhoria da saúde do solo, redução da dependência de fertilizantes químicos e melhores rendimentos das colheitas.

Informações adicionais

https://sea2land.sid-isq.com/

Sobre este resumo

Authors: André Carvalho, Guilherme Covas, Manuel Carreiras (ISQ)
Date: June 2025
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PRACTICE ABSTRACT NO. 34

Inventory of stakeholder

Main Results/ Outcomes

The Inventory of stakeholder groups is a strategic document for detecting different stakeholders (research institutions, external sector-related parties, agricultural producers, business chambers, etc.) and more importantly, analyzing the effect that these stakeholders have on the SEA2LAND project. To understand the stakeholders opinion about the ongoing changing business environment focused on bio-based value chains and products, 1st brainstorm sessions were organized in the next partner participating countries France, Italy, Spain, Belgium, Croatia, Portugal, Malta, Chile (CELAC region), Estonia, Switzerland and Norway.

Brainstorming sessions in Spain , Italy and Estonia

Practical recommendations

In general, addressing the key challenges identified by stakeholders across regions will be essential for the successful adoption of BBFs. To improve economic viability, strategies for reducing production costs and demonstrating long-term benefits to farmers should be prioritized. Clear regulatory frameworks, including certification standards and safe handling protocols, are crucial to overcoming market barriers. Nutrient consistency and soil health monitoring will help build trust in BBFs, while tailored solutions for specific agricultural needs can drive regional adoption.

Closing knowledge gaps through targeted educational campaigns and practical workshops will enable farmers to integrate BBFs confidently. Strengthening cross-sector collaboration—between agriculture, research, policy, and industry—is vital for optimizing production and addressing logistical challenges. Furthermore, expanding distribution networks and developing region-specific business models will facilitate market access.

Lastly, continuous engagement with stakeholders is key. Regular feedback and iterative adjustments will ensure the project stays aligned with stakeholder needs, fostering long-term success and scalability of BBFs.

About this abstract

Authors: Miriam Pinto Tobalina, Natalija Vugrin
Date: June 2025

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PRACTICE ABSTRACT NO. 34

Inventario de grupos de interés

Principales conclusiones

El inventario de grupos de interés es un documento estratégico para detectar a los diferentes actores involucrados (instituciones de investigación, partes externas relacionadas con el sector, productores agrícolas, cámaras de comercio, etc.) y, más importante aún, analizar el efecto que estos actores tienen en el proyecto SEA2LAND. Para comprender la opinión de los grupos de interés sobre el entorno empresarial cambiante, enfocado en cadenas de valor y productos de base biológica, se organizaron primeras sesiones de lluvia de ideas en los siguientes países participantes: Francia, Italia, España, Bélgica, Croacia, Portugal, Malta, Chile (región CELAC), Estonia, Suiza y Noruega.

Sesiones de lluvia de ideas en España, Italia y Estonia

Recomendaciones prácticas

En general, abordar los principales desafíos identificados por los grupos de interés en las distintas regiones será esencial para la adopción exitosa de los fertilizantes de base biológica (BBFs, por sus siglas en inglés). Para mejorar la viabilidad económica, se deben priorizar estrategias para reducir los costos de producción y demostrar los beneficios a largo plazo para los agricultores.

Marcos regulatorios claros, que incluyan estándares de certificación y protocolos de manejo seguro, son cruciales para superar las barreras del mercado. La consistencia de nutrientes y el monitoreo de la salud del suelo ayudarán a generar confianza en los BBFs, mientras que soluciones adaptadas a necesidades agrícolas específicas pueden impulsar su adopción a nivel regional.

Cerrar las brechas de conocimiento mediante campañas educativas específicas y talleres prácticos permitirá a los agricultores integrar los BBFs con confianza. Fortalecer la colaboración entre sectores —agricultura, investigación, políticas públicas e industria— es vital para optimizar la producción y abordar desafíos logísticos.

Además, expandir las redes de distribución y desarrollar modelos de negocio adaptados a cada región facilitará el acceso al mercado.

Por último, el compromiso continuo con los grupos de interés es clave. La retroalimentación regular y los ajustes iterativos asegurarán que el proyecto se mantenga alineado con las necesidades de las partes interesadas, fomentando el éxito a largo plazo y la escalabilidad de los BBFs.

Acerca de este resumen

Authors: Miriam Pinto Tobalina, Natalija Vugrin
Date: June 2025

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PRACTICE ABSTRACT NO. 35

Future evolution of the produced fertilisers effectiveness

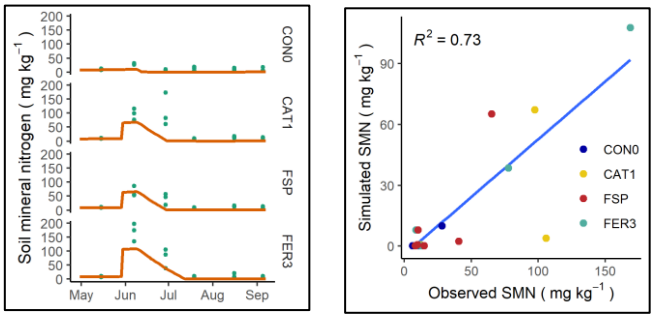
Main Results/ Outcomes

The DNDC model, a simulation tool designed to analyze nitrogen biogeochemistry within agricultural ecosystems, was utilized at five experimental locations throughout Europe to evaluate the impact of bio-based fertilizers (BBFs) on soil nitrogen dynamics. The model demonstrated varying levels of accuracy depending on the site. These results underscore the significance of site-specific calibration and the necessity for better model parameterization to improve predictive accuracy.

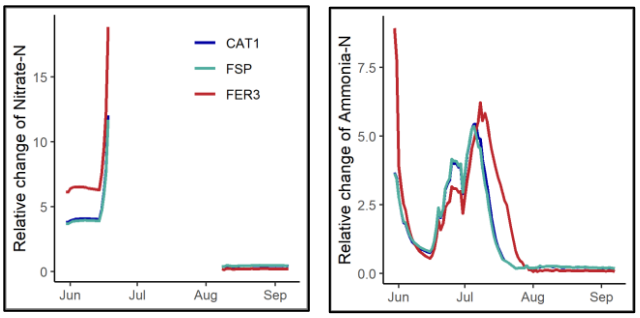
In all five countries, the DNDC model consistently predicted a swift rise in NO_3-N following fertilization, which was then followed by a seasonal decrease. The magnitude and timing of these changes were affected by initial soil conditions, the type of fertilizer used, and local climate factors.

Furthermore, the DNDC model indicated significantly higher emissions of NH_3, N_2O, and NO in fertilized treatments compared to unfertilized ones across all five experimental sites.

The effectiveness of the produced fertilizers was assessed under extreme weather conditions, including higher temperatures, more intense droughts or heavy rainfall, and varying atmospheric CO_2 levels. In such extreme weather scenarios, the amount of mineralized nitrogen increased, resulting in higher simulated emissions of nitrogen gases, and potential N-loss due to leaching.



Comparison of measured (dots) and simulated (line) soil mineral nitrogen (as a sum of NO_3-N and NH_4-N) at 10 cm depth plotted as a function of time on the left-hand side figure for the Apelsvoll experimental site.



Comparison of the dynamics of relative changes in simulated soil NO_3-N and NH_4-N content for the three BBFs, calculated with the unfertilized treatment set as the reference value at Jogeva experimental site.

Practical recommendations

To improve the effectiveness of the DNDC model, it is recommended to incorporate high-resolution environmental data alongside current soil monitoring systems. Additionally, further refinement of soil parameters is necessary, and a specialized DNDC module should be developed for bio-based fertilizers. These actions will enhance the comprehension of short-term dynamics and site-specific differences in soil properties, climate, and management strategies. Furthermore, for the modeling process to succeed, it is crucial that samples are consistently collected, processed, and analyzed, with results being delivered in a timely manner.

While the reliability of the models has its limitations, simulations related to soil nitrogen dynamics and nitrogen fluxes have highlighted the significance of selecting the fertilizer type that corresponds to specific climates and the optimal timing for fertilizer applications to minimize the potential loss of nutrients.

About this abstract

Authors: Iva Zivanovic, Astrid Solvåg Nesse, Csilla Farkas

Date: June 2025

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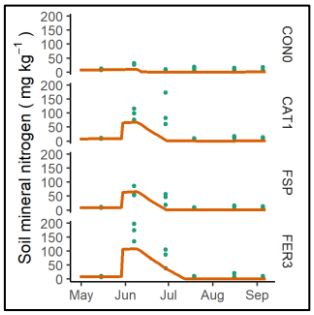
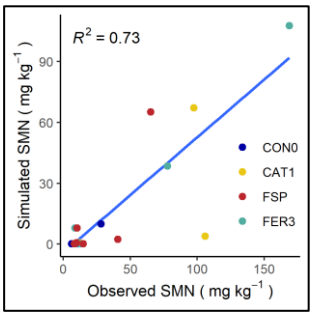
PRACTICE ABSTRACT NO. 35

Fremtidig utvikling av effektiviteten til de produserte gjødselmidlene

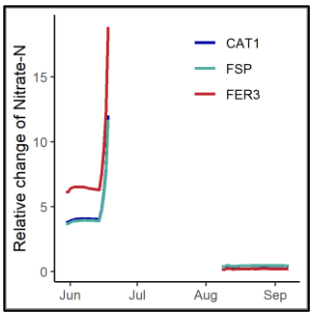
Hovedresultater / Utfall

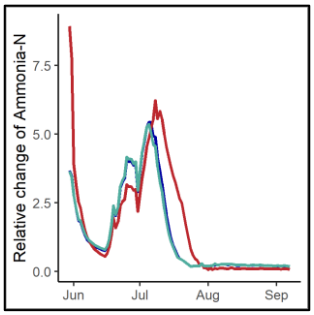
DNDC-modellen, et simuleringsverktøy utviklet for å analysere nitrogenets biogeokjemi i jordbruksøkosystemer, ble brukt ved fem forsøkssteder over hele Europa for å evaluere effekten av biobaserte gjødselmidler (BBFs) på nitrogenets dynamikk i jorden. Modellen viste varierende grad av nøyaktighet avhengig av stedet. Disse resultatene understreker viktigheten av stedsspesifikk kalibrering og behovet for bedre parameterisering av modellen for å forbedre den prediktive nøyaktigheten.I alle de fem landene forutså DNDC-modellen konsekvent en rask økning i NO_3-N etter gjødsling, etterfulgt av en sesongmessig nedgang. Omfanget og tidspunktet for disse endringene ble påvirket av opprinnelige jordforhold, typen gjødsel som ble brukt, og lokale klimafaktorer.Videre indikerte DNDC-modellen betydelig høyere utslipp av NH_3, N_2O og NO i gjødslede behandlinger sammenlignet med ugjødslede behandlinger ved alle fem forsøkssteder.Effektiviteten til de produserte gjødselmidlene ble vurdert under ekstreme værforhold, inkludert høyere temperaturer, mer intense tørkeperioder eller kraftig nedbør, samt varierende nivåer av atmosfærisk CO_2. Under slike ekstreme værscenarier økte mengden mineralisert nitrogen, noe som resulterte i høyere simulerte utslipp av nitrogenholdige gasser og potensiell N-tap på grunn av utvasking.





Sammenligning av målte (prikker) og simulerte (linje) verdier for mineralsk nitrogen i jord (som summen av NO_3-N og NH_4-N) i 10 cm dybde, plottet som en funksjon av tid i figuren til venstre for forsøksfeltet på Apelsvoll.





Sammenligning av dynamikken i relative endringer i simulert innhold av NO_3-N og NH_4-N i jord for de tre biobaserte gjødselmidlene (BBFs), beregnet med den ugjødslede behandlingen som referanseverdi ved forsøksfeltet i Jõgeva.

Praktiske anbefalinger

For å forbedre effektiviteten til DNDC-modellen anbefales det å integrere høyoppløselige miljødata sammen med eksisterende overvåkingssystemer for jord. I tillegg er det nødvendig med videre forbedring av jordparametere, og det bør utvikles en spesialisert DNDC-modul for biobaserte gjødselmidler. Disse tiltakene vil styrke forståelsen av kortsiktige dynamikker og stedsspesifikke forskjeller i jordegenskaper, klima og forvaltningsstrategier.Videre er det avgjørende for modelleringen at prøver samles inn, behandles og analyseres på en konsekvent måte, og at resultatene leveres innen rimelig tid.Selv om påliteligheten til modellene har sine begrensninger, har simuleringer knyttet til nitrogenets dynamikk i jord og nitrogenflukser fremhevet viktigheten av å velge riktig gjødseltype tilpasset spesifikke klimaforhold, samt optimal tidspunkt for gjødselanvendelse for å minimere potensielt næringstap.Preguntar a ChatGPT

Om dette sammendraget

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The project is running from January 2021 to June 2025.
Website: www.sea2landproject.eu

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