



## **D9.4 Practice Abstracts M18**



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## Document Summary

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**Reviewer(s):** All SEA2LAND partners

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**Start date of Project:** 01-01-2021

**Duration:** 48 months

**Project coordinator:** NEIKER-INSTITUTO VASCO DE INVESTIGACION Y DESARROLLO AGRARIO SA

## Abstract

This deliverable contains the resume and contents of the 32 practice abstracts already developed under the Project's activity. 35 more are expected to be delivered in the second batch and 32 in the third batch resulting in a total of 100 practice abstracts by the end of the Project.

## Disclaimer

The views expressed, and responsibility for the content of this publication, lie solely with the authors. The European Commission /REA is not liable for any use that may be made of the information contained herein.

## Glossary

<b>ABT</b>	AQUABIOTECH LIMITED
<b>AZTI</b>	FUNDACION AZTI – AZTI FUNDAZIOA AZTI
<b>BARNA</b>	BARNA SA
<b>CATAR</b>	CENTRE REGIONAL D'INNOVATION ET DE TRANSFERT DE TECHNOLOGIE AGRORESSOURCES
<b>CAVIAR</b>	PIRINEA SL CAVIAR
<b>D</b>	Deliverable
<b>ECRI</b>	EESTI TAIMEKASVATUSE INSTITUUT
<b>EIP-AGRI</b>	European Innovation Partnership
<b>FERTINAGRO</b>	FERTINAGRO BIOTECH SL
<b>GRONN</b>	GRONN GJODSEL AS
<b>INI</b>	INICIATIVAS INNOVADORAS SAL
<b>INIA</b>	INSTITUTO DE INVESTIGACIONES AGROPECUARIAS
<b>IPS</b>	IPS KONZALTING DOO ZA POSLOVNE USLUGE
<b>ISQ</b>	INSTITUTO DE SOLDADURA E QUALIDADE
<b>M</b>	Month
<b>NEIKER</b>	INSTITUTO VASCO DE INVESTIGACIÓN Y DESARROLLO AGRARIO SA
<b>NUTRI</b>	NUTRILOOP OU
<b>PA</b>	Practice Abstract
<b>UNIVPM</b>	UNIVERSITA POLITECNICA DELLE MARCHE UNIVPM
<b>UVIC-UCC</b>	FUNDACIO UNIVERSITARIA BALMES UVIC-UCC
<b>WP</b>	WORK PACKAGE

## 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".

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 projects 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 the contact with partners, incentivise efficient knowledge exchange and disseminate 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, where the information is shared at EU level, via the EIP-AGRI 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 EIP-AGRI subgroup of innovation.

This document presents 32 PAs that have been mainly developed based on the outcomes of the deliverables and regional workshops held during the project life.

## 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.

**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)<sup>[1]</sup> 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.						
<p><b>Short summary for practitioners in english on the (final or expected) outcomes</b> (1000-1500 characters, word count – no spaces).</p> <p>This summary should at least contain the following information:</p> <ul style="list-style-type: none"> <li>- Main results/outcomes of the activity (expected or final)</li> <li>- 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?</li> </ul> <p>This summary should be as interesting as possible for farmers/end-users, using a <u>direct and easy understandable language</u> 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.</p>		Recommended	0 character(s) / 1500				
<p><b>Short summary for practitioners in native language</b></p>		Mandatory	0 character(s) / 1500				
		<span style="border: 1px solid black; padding: 2px 5px;">EIP-AGRI Common format</span> <span style="border: 1px solid black; padding: 2px 5px;">INSTRUCTIONS</span> <span style="border: 1px solid black; padding: 2px 5px;">PROJECT INFORMATION</span> <span style="border: 1px solid black; padding: 2px 5px;">PARTNERS</span> <span style="border: 1px solid black; padding: 2px 5px;">KEYWORDS</span> <span style="border: 1px solid black; padding: 2px 5px;">AUDIOVISUAL MATERIAL</span> <span style="border: 1px solid black; padding: 2px 5px;">WEBSITES</span> <span style="border: 1px solid black; padding: 2px 5px; background-color: #e0e0e0;">PA1</span> <span style="border: 1px solid black; padding: 2px 5px;">PA2</span>					

Figure 2. EIP-AGRI template for PA



### 3 Summary of Practice Abstracts

Nº	Title of the Practice Abstract	Partner	Language
1	Presentation of the project	INI	English / Spanish
2	Target groups	INI	English / Spanish
3	Mapping of European unbalance	NEIKER	English / Spanish
4	Analysis of regulations	ISQ	English / Portuguese
5	End users' requirements	FERTINAGRO	English / Spanish
6	Consumer survey	AZTI	English / Spanish
7	Agronomic value of bio-based fertilizers derived from aquaculture residues in Chile	INIA	English / Spanish
8	Biofertilizers derived from residues produced by Chilean aquaculture industry	INIA	English / Spanish
9	DAFO Analysis - Adriatic Sea	IPS	English / Croatian
10	DAFO Analysis - Atlantic Sea	IPS	English / Croatian
11	DAFO Analysis - Baltic Sea	IPS	English / Croatian
12	DAFO Analysis - Cantabrian Sea	IPS	English / Croatian
13	DAFO Analysis- Mediterranean Sea	IPS	English / Croatian
14	DAFO Analysis - North Sea	IPS	English / Croatian
15	DAFO Analysis - Needs and recommendations	IPS	English / Croatian
16	Baltic Sea case study: side-streams characterisation	NUTRI	English / Estonian
17	Baltic Sea case study: technology	NUTRI	English / Estonian
18	Side-stream of Adriatic Sea Pilot	UNIVPM	English / Italian
19	Biorefinery scheme of Adriatic Sea Pilot	UNIVPM	English / Italian
20	Fish processing side-streams characterisation	AZTI	English / Spanish
21	Prototypes of intermediate products from seafood processing side-streams	AZTI	English / Spanish

22	Prototypes of Biobased Fertilisers (BBF) from seafood processing side-streams	AZTI	English / Spanish
23	Protocol to produce algae	NEIKER	English / Spanish
24	Enzymatic hydrolysis of fish by-products for the production of BBF	BARNA	English / Spanish
25	Understanding the adding value of freshwater aquaculture by-products	CAVIAR	English / Spanish
26	Moving forward with dried fish sludge	GRONN	English / Norwegian
27	Chemical characterization of fish farming by-products: the case of Steelhead trout's by-products for the Atlantic pilot unit	CATAR	English / French
28	Thermomechanochemical fractionation of fish by-products by twin-screw extrusion for the production of biobased fertilizers: the Atlantic pilot case	CATAR	English / French
29	Aquaculture industry by-products to be valorized in the Mediterranean area	UVIC	English / Spanish
30	An innovative technological approach for the aquaculture industry by-products valorization in the Mediterranean area	UVIC	English / Spanish
31	Recirculating Aquaculture Systems (RAS): Potential test sites for effluent solids retrieval and waste valorisation for agricultural use	ABT	English
32	Evaluation of N, P and K uptake of bio-based fertilizers in pot experiments under greenhouse condition	ECRI	English

## Producing advanced bio-based fertilizers from fisheries wastes

### Main results / outcomes

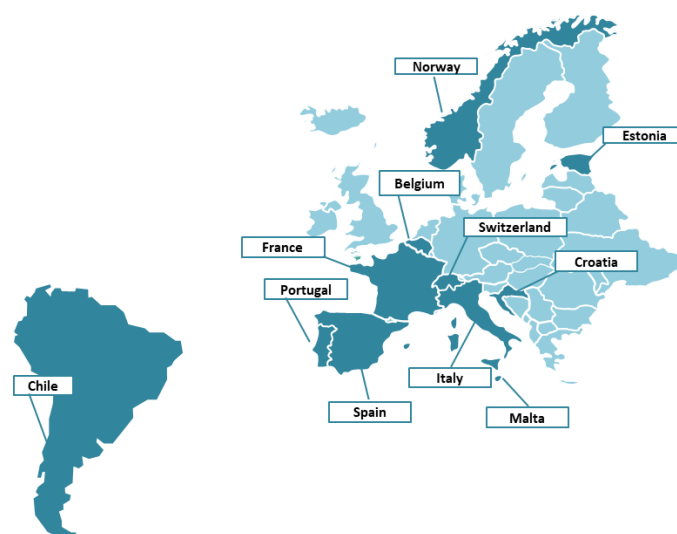
The use of BBF can reduce resource mining, pollution and greenhouse gas emission when they replace mineral fertilisers. Moreover, they can be produced from the recovery of nutrients from fish processing and aquaculture by-products. Based on the circular economy model, the EU-funded SEA2LAND project promotes 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. To test the solution, the project is producing several BBFs for local crops and conditions as well as others for exporting. Eventually, the BBFs will partially replace imported nutrients for agriculture in Europe.

### Practical recommendations

The basis of the project is the regional production of BBFs developing demonstration pilots that can be replicated throughout Europe, boosting local growth. The project proposes the implementation of 9 technologies in 7 cases in 6 areas representative of the fisheries sector. The technologies are being applied to different by-products, and they will produce several BBFs either for local crops and conditions, and others for exporting. Several organizations with close relationship with industrial sector and farmer sector are involved.

The project also relies on existing multi-actor networks to involve and engage with stakeholders. This multi-actor approach ensures that the research and deliverables are relevant to fish processing / aquaculture / fertilizer / agriculture industries.

Communication activities with stakeholders are planned to raise awareness by the agri-sector of use of BBFs, focusing on potential use, importance, potential of fish aquaculture by-products for producing BBFs.



**Fig 1:** Countries involved in the consortium (own elaboration)

### Further information

[www.sea2land.eu](http://www.sea2land.eu)

### About this abstract

**Authors:** Mirentxu Asín, Camino Fábregas, INICIATIVAS INNOVADORAS

**Date:** June 2022

**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](http://www.sea2landproject.eu)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement ID 101000496

## Producción de biofertilizantes avanzados a partir de residuos pesqueros

### Principales resultados

El uso de BBF puede reducir la extracción de recursos, la contaminación y la emisión de gases de efecto invernadero cuando sustituyen a los fertilizantes minerales. Además, pueden producirse a partir de la recuperación de nutrientes de los subproductos del procesamiento del pescado y la acuicultura. Basado en el modelo de economía circular, el proyecto SEA2LAND, financiado por la UE, promueve la producción de fertilizantes a gran escala en la UE a partir de materias primas propias. Se espera que esta solución reduzca el desequilibrio de nutrientes del suelo en Europa. Para probar la solución, el proyecto está produciendo varios BBF para cultivos y condiciones locales, así como otros para la exportación. Con el tiempo, los BBF sustituirán parcialmente los nutrientes importados para la agricultura en Europa.

### Recomendaciones prácticas

La base del proyecto es la producción regional de BBFs desarrollando pilotos de demostración que puedan ser replicados en toda Europa, impulsando el crecimiento local. El proyecto propone la aplicación de 9 tecnologías en 7 casos en 6 zonas representativas del sector pesquero. Las tecnologías se están aplicando a diferentes subproductos, y producirán varios BBFs tanto para cultivos y condiciones locales, como para la exportación. Participan varias organizaciones con estrecha relación con el sector industrial y el sector agrícola.

El proyecto también se apoya en las redes multiactores existentes para implicar y comprometer a las partes interesadas. Este enfoque multiactor garantiza que la investigación y los resultados sean relevantes para las industrias de procesamiento de pescado/acuicultura/fertilizantes/agricultura.

Se han previsto actividades de comunicación con las partes interesadas para sensibilizar al sector agrario sobre el uso de BBF, centrándose en el uso potencial, la importancia y el potencial de los subproductos de la acuicultura de pescado para producir BBF.

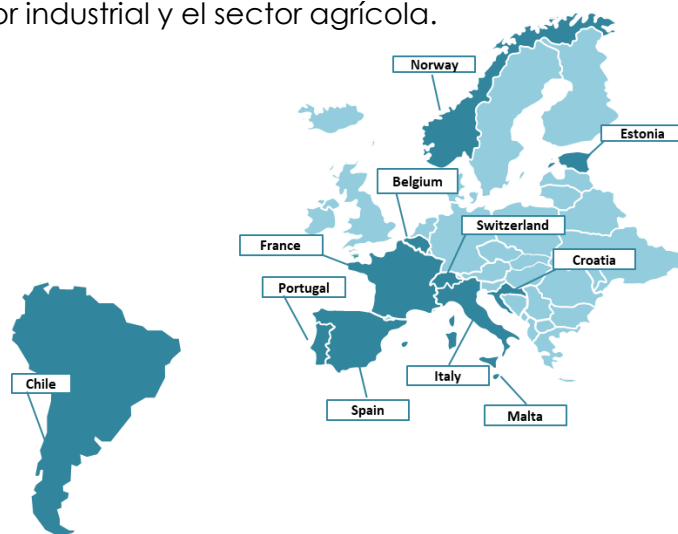


Fig. 1 Países involucrados en el consorcio (elaboración propia)

### Más información

[www.sea2land.eu](http://www.sea2land.eu)

### Acerca de este resumen

**Autores:** Mirentxu Asín, Camino Fábregas, INICIATIVAS INNOVADORAS

**Fecha:** Junio 2022

El proyecto **SEA2LAND** es una acción de innovación colaborativa (IA) financiada por la UE en el marco del programa Horizonte 2020. El proyecto tiene como objetivo proporcionar soluciones para ayudar a superar los desafíos relacionados con la producción de alimentos, el cambio climático y la reutilización de residuos. Basado en el modelo de economía circular, SEA2LAND promueve la producción de fertilizantes a gran escala en la UE a partir de materias primas propias. Se espera que esta solución reduzca el desequilibrio de nutrientes del suelo en Europa. El proyecto está en marcha desde enero de 2021 hasta diciembre de 2024.

**Sitio web:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement ID 101000496

## Stakeholders involvement

### Main results / outcomes

Several target groups have been defined to encourage their participation, generate their understanding and gain their support to reach potential customers and end-users, as well as to maximise the impact of dissemination activities.

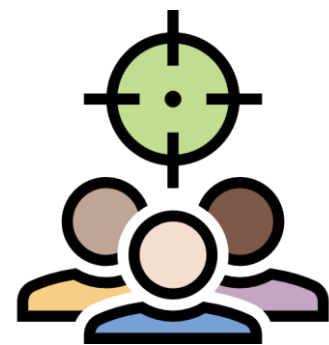
### Practical recommendations

The updated Bioeconomy Strategy aims to address global challenges, seek new ways of producing and consuming and achieve sustainability through concrete actions, one of them being the mobilisation of public and private actors in the research, demonstration and deployment of sustainable, inclusive and circular bio-based solutions.

SEA2LAND mobilises public (scientific/research/advisory services/universities) and private stakeholders (fish processing aquaculture companies, fertiliser companies, scientists/research...) for the implementation and deployment of the technologies needed to develop bio-based fertilisers. Thanks to the close relationship of some of the organisations involved in the project with the industrial and agricultural sector, it is possible to set the objectives and analyse the needs of the stakeholders.

In addition, SEA2LAND interacts with other projects and research initiatives, and working sessions with stakeholders are held. At the start of the project, a dissemination plan has been drafted to disseminate the results and findings to stakeholders. Communication activities with stakeholders have been planned to raise awareness of the agricultural sector on the use of BBF, focusing on the potential use, importance and potential of aquaculture by-products to produce BBF.

All partners interact to elaborate the Dissemination Plan aiming to create a multiplier effect by identifying and engaging relevant stakeholders to better reach potential customers and end-users.



**Fig. 1:** Target Group  
(credit FREEPIK)

### About this abstract

**Authors:** Mirentxu Asín, Camino Fábregas, INICIATIVAS INNOVADORAS

**Date:** June 2022

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**Website:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



## Participación de los stakeholders

### Principales resultados

Se han definido varios grupos objetivo para fomentar su participación, generar su comprensión y obtener su apoyo para llegar a los clientes potenciales y a los usuarios finales, así como para maximizar el impacto de las actividades de difusión.

### Recomendaciones prácticas

La Estrategia de Bioeconomía actualizada tiene como objetivo abordar los desafíos globales, buscar nuevas formas de producir y consumir y lograr la sostenibilidad a través de acciones concretas, siendo una de ellas la movilización de los actores públicos y privados en la investigación, demostración y despliegue de soluciones sostenibles, inclusivas y circulares de base biológica.

SEA2LAND moviliza a los actores públicos (servicios científicos/de investigación/de asesoramiento/universidades) y privados (empresas de acuicultura de procesamiento de pescado, empresas de fertilizantes, científicos/investigación...) para la implementación y el despliegue de las tecnologías necesarias para desarrollar fertilizantes de base biológica. Gracias a la estrecha relación de algunas de las organizaciones que participan en el proyecto con el sector industrial y agrícola, es posible fijar los objetivos y analizar las necesidades de los interesados.

Además, SEA2LAND interactúa con otros proyectos e iniciativas de investigación y se celebran sesiones de trabajo con las partes interesadas. Al inicio del proyecto, se ha elaborado un plan de difusión para dar a conocer los resultados y las conclusiones a las partes interesadas. Se han planificado actividades de comunicación con las partes interesadas para sensibilizar al sector agrícola sobre el uso de BBF, centrándose en el uso potencial, la importancia y el potencial de los subproductos de la acuicultura para producir BBF.

Todos los socios interactuarán para elaborar el Plan de Divulgación con el objetivo de crear un efecto multiplicador identificando e involucrando a las partes interesadas pertinentes para llegar mejor a los clientes potenciales y a los usuarios finales.

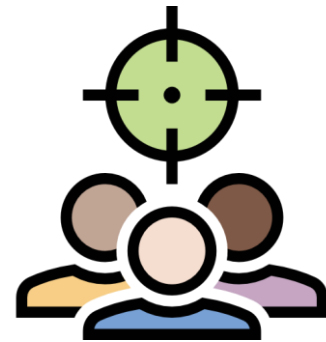


Fig. 1: Grupo objetivo  
(crédito FREEPIK)

### Acerca de este resumen

**Autores:** Mirentxu Asín, Camino Fábregas, INICIATIVAS INNOVADORAS

**Fecha:** Junio 2022

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**Sitio web:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



## Nutrient unbalance mapping

### Main results / outcomes

The main result obtained is a geographical representation, at NUTS 3 level, of the amounts of nutrient (nitrogen and phosphorus) surpluses or deficiencies in European soils. The map has been based on European and national statistics, taking into account the distribution of crops and their nutritional needs, as well as the organic fertilisers produced in each area. With this information, a nutrient balance has been carried out to obtain the deficit and surplus areas. In the same map, the main secondary flows of the European fisheries and aquaculture industries have been included in order to consider the areas where the secondary flows of these fisheries and aquaculture industries could be an important source of nutrients

### Practical recommendations

The results could help policy makers, fertiliser companies and other stakeholders to manage the differences between the different areas by optimising overall nutrient management, reducing nutrient losses and improving nutrient efficiency. Fertiliser companies, on the other hand, will be able to target specific areas for marketing and design fertilisers more appropriately and accurately

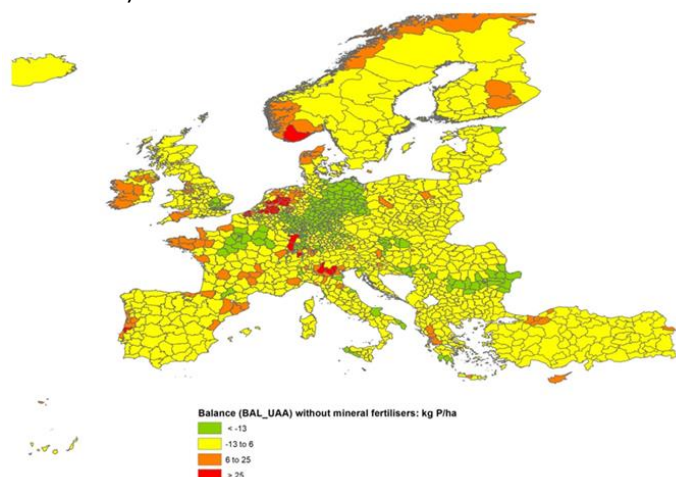


Fig 1: Total kg P/ha (own elaboration)

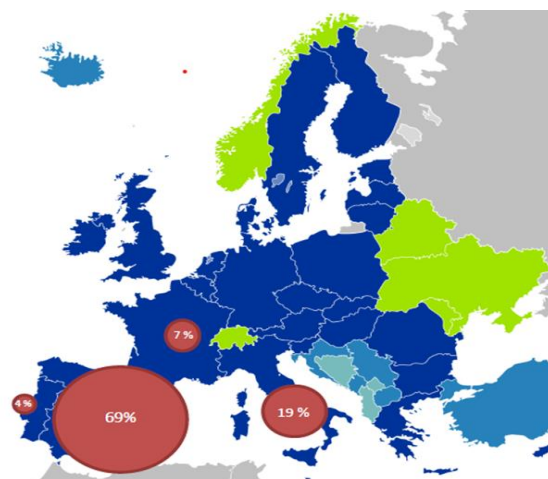


Fig. 2 Distribution of canned tuna production in Europe (STECF, 2013-2014)

### Further information

<https://ec.europa.eu/eurostat/web/agriculture/data/database>

<https://stats.oecd.org/index.aspx?queryid=79764>

Gilbert M., G. Nicolas, G. Cinardi, S. Vanwambeke, T. P. Van Boeckel, G. R. W. Wint, T. P. Robinson. 2018. Global distribution data for cattle, buffaloes, horses, sheep, goats, pigs, chickens and ducks in 2010. *Nature Scientific data*, 5:180227. doi: 10.1038/sdata.2018.227

### About this abstract

**Authors:** Ainara Artetxe, Miriam Pinto/NEIKER, Carlos Bald/AZI

**Date:** June 2022

**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.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement ID 101000496

## Mapa de desequilibrios nutricionales en los suelos de Europa

### Principales resultados

El principal resultado obtenido es una representación geográfica, a nivel NUTS 3, de las cantidades de excedentes o deficiencias de nutrientes (nitrógeno y fósforo) en los suelos de Europa. El mapa se ha basado en estadísticas europeas y nacionales, teniendo en cuenta la distribución de los cultivos y sus necesidades nutricionales, así como los abonos orgánicos producidos en cada zona. Con esta información, se ha realizado un balance de nutrientes para obtener las zonas deficitarias y excedentarias. En el mismo mapa, se han incluido los principales flujos secundarios de las industrias pesqueras y acuícolas europeas para considerar las zonas en las que los flujos secundarios de estas industrias pesqueras y acuícolas podrían ser una fuente importante de nutrientes.

### Recomendaciones prácticas

Los resultados podrían ayudar a los responsables políticos, a las empresas de fertilizantes y a otras partes interesadas a gestionar las diferencias entre las diferentes áreas optimizando la gestión global de los nutrientes, reduciendo sus pérdidas y mejorando su eficacia. Las empresas de fertilizantes, por su parte, podrán seleccionar zonas específicas para la comercialización y el diseño de fertilizantes de forma más adecuada y precisa.

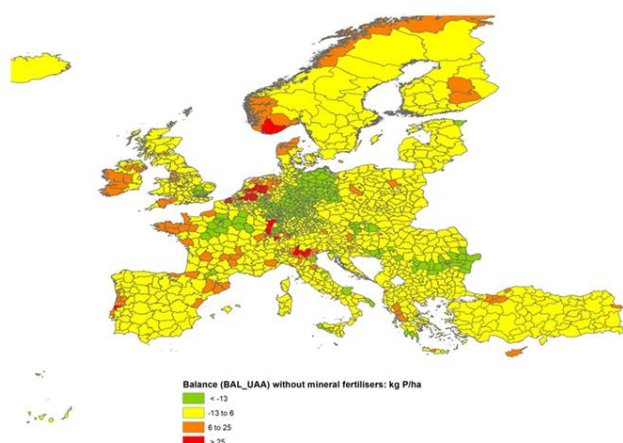


Fig. 1: Total de kg de P/ha (elaboración propia)

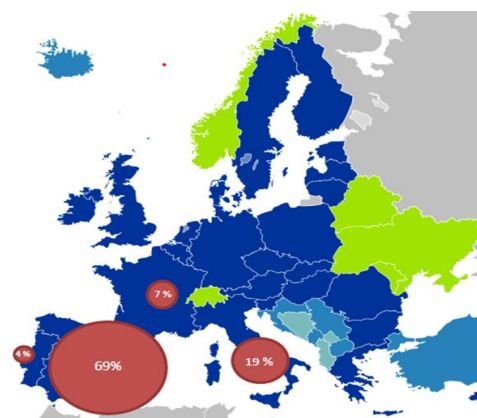


Fig. 2 Distribución de la producción de atún en conserva en Europa (CTEP, 2013-2014)

### Más información

<https://ec.europa.eu/eurostat/web/agriculture/data/database>

<https://stats.oecd.org/index.aspx?queryid=79764>

Gilbert M., G. Nicolas, G. Cinardi, S. Vanwambeke, T. P. Van Boeckel, G. R. W. Wint, T. P. Robinson. 2018. Global distribution data for cattle, buffaloes, horses, sheep, goats, pigs, chickens and ducks in 2010. Nature Scientific data, 5:180227. doi: 10.1038/sdata.2018.227

### Acerca de este resumen

**Autores:** Ainara Artetxe, Miriam Pinto/NEIKER, Carlos Bald/AZTI

**Fecha:** Junio 2022

El proyecto **SEA2LAND** es una acción de innovación colaborativa (IA) financiada por la UE en el marco del programa Horizonte 2020. El proyecto tiene como objetivo proporcionar soluciones para ayudar a superar los desafíos relacionados con la producción de alimentos, el cambio climático y la reutilización de residuos. Basado en el modelo de economía circular, SEA2LAND promueve la producción de fertilizantes a gran escala en la UE a partir de materias primas propias. Se espera que esta solución reduzca el desequilibrio de nutrientes del suelo en Europa. El proyecto está en marcha desde enero de 2021 hasta diciembre de 2024.

**Sitio web:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement ID 101000496



## Map visor on soils and fertilisers requirements and waste for the different Regions

### Main results / outcomes

An analysis was conducted on soil and fertilizer requirements and waste legal framework to support nutrient recovery to produce bio-based fertilisers (BBFs) from fish processing and aquaculture by-products, in the project's targeted Regions. The legal framework analysis was compiled in a report defined as a Map visor on soils and fertilisers requirements and waste for the different Regions and aimed to meet both the receptor and the by-product provider. The produced report also delivers an overview of the European Union (EU) legislative system with the EU institutions involved in the legislation preparation and approval.

The relevant legislation was analysed in both the European (EU countries and Norway) and Chilean contexts according to five selected categories: Waste definition and classification; Waste quantification; Waste management and disposal; Fish processing and Fertilisers. A specific legislation analysis was developed for Portugal, Spain, Croatia, France, Norway, and Chile.

### Practical recommendations

The EU legislation, directives, and regulations, apply to all EU countries via their transposition to national laws, but also Norway (an EEA member) adopted most of the identified regulations, with the exception of those addressing market issues. The identified Chilean regulations, although in a different context, address the whole value chain related to the production of bio-fertilisers from fisheries by-products.

With the gathered and organized information, it is expected that the interested parties will find it easy to identify and extract the needed conclusions from the main legislation and act accordingly. Thus, this report intends to facilitate the nutrient recovery to produce BBFs from fish processing and aquaculture by-products.

### About this abstract

**Authors:** Bruno Magalhães, Marco Estrela (ISQ)

**Date:** June 2022

**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.

**Website:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



## Mapa descritivo de requisitos para fertilizantes, solos e resíduos para diferentes regiões

### Principais resultados

Foi realizada uma análise aos requisitos de fertilizantes e solos, e ao enquadramento legal de resíduos de modo a promover a recuperação de nutrientes para a produção de fertilizantes de base biológica (FBB) com origem nos subprodutos do processamento de peixe e de aquacultura das regiões em estudo. A análise do enquadramento legal foi compilada num relatório designado como Mapa descritivo de requisitos para fertilizantes, solos e resíduos para diferentes regiões, e teve o objetivo de responder às necessidades tanto do recetor com do produtor dos subprodutos. O relatório também oferece uma ampla visão do sistema legislativo da União Europeia (UE) e das respetivas instituições envolvidas na preparação e aprovação da legislação. A legislação mais relevante foi analisada nos contextos Europeu e Chileno, de acordo com cinco categorias: Definição e Classificação de resíduos; Quantificação de resíduos; Gestão e deposição de resíduos; Processamento de peixe e Fertilizantes. Foram desenvolvidas análises de legislação específicas para Portugal, Espanha, Croácia, França, Noruega e Chile.

### Recomendações práticas

A legislação, diretivas e regulamentação da UE encontram aplicação em todos os países da EU através da sua transposição para as leis nacionais, no entanto, também a Noruega (membro da EEA) adotou grande parte da regulamentação identificada, com exceção para a regulamentação associada a questões de mercado. A regulamentação Chilena identificada cobre toda a cadeia de valor associada à produção de biofertilizantes através de subprodutos do processamento de peixe.

Espera-se que as partes interessadas considerem fácil identificar e extrair as conclusões necessárias da legislação principal e agir em conformidade. O relatório deverá facilitar a recuperação de nutrientes do processamento de peixe e dos subprodutos da aquacultura para a produção de FBB.

### Sobre este resumo

**Autores:** Bruno Magalhães, Marco Estrela (ISQ)

**Data:** Junho 2022

O projeto **SEA2LAND** é uma Ação de Inovação colaborativa (IA) financiada pela UE no âmbito do programa Horizonte 2020. O projeto visa fornecer soluções para ajudar a superar desafios relacionados à produção de alimentos, mudanças climáticas e reaproveitamento de resíduos. Com base no modelo de economia circular, a SEA2LAND promove a produção de fertilizantes em larga escala na UE a partir de matérias-primas próprias. Espera-se que esta solução reduza o desequilíbrio de nutrientes do solo na Europa. O projeto está em execução de janeiro de 2021 a dezembro de 2024.

**Sítio Web:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



## Survey on end users' requirements

### Main results / outcomes

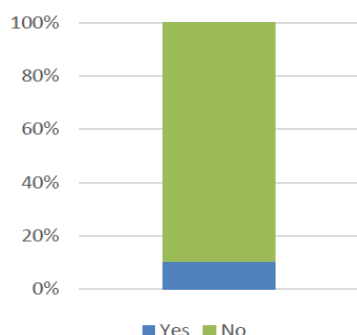
In the ambit of SEA2LAND WP2 activities, a survey was carried out to end-users in the different study regions covered by the project. This survey was intended to learn about the needs and requirements of each area in terms of fertilization in order to make the generation of the fertilizers adapted to the market's demands nowadays.

The survey consisted of a series of questions aimed at knowing the willing of the respondents to change the products they currently use for those generated from fishery or aquaculture industries' by-products, the most important aspects when choosing a fertilizer and the importance for them of the ecological footprint of the fertilizing products.

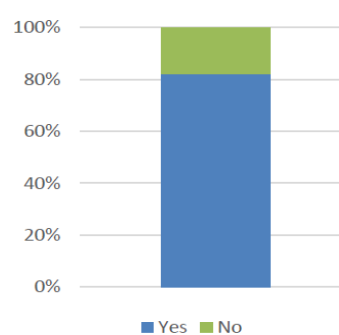
Although most of the respondents do not practice organic farming, they have awareness about the importance of this ecological footprint and sustainability. Regarding the use of by-products in the generation of fertilizers, no opposition has been detected, even though some of the surveyed people have expressed concern about the presence of potentially hazardous substances that could be present in them. However, the majority of respondents admit to be willing to introduce this fertilizers in their practices.

### Practical recommendations

Taking into account the great acceptance of end-users, it could be said that nowadays is a good time for the development of technologies that allow their exploitation. Moreover, in order to make the end user feel comfortable with this type of products and promote a circular economy strategy in the society, clear communication to explain the exhaustive controls and regulations which these products are subjected to assure they are safe and efficient is essential.



**Fig 1:** Would the use of by-products be a disadvantage for its use as fertilizer?



**Fig 2:** Would you replace the products you currently use by others obtained from by-products?

### About this abstract

**Authors:** Joaquín Romero, Carlos Fuertes (Fertinagro Biotech)

**Date:** June 2022

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## Encuesta sobre los requerimientos de los usuarios finales

### Principales resultados

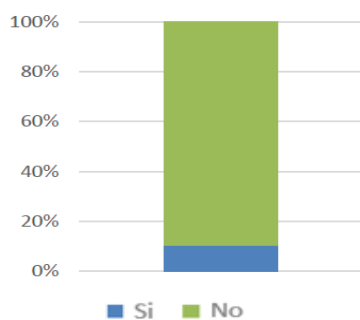
En el ámbito del WP2 del Proyecto SEA2LAND, se llevaron a cabo una serie de encuestas a distintos usuarios finales en las regiones de estudio que abarca el proyecto. Estas encuestas fueron distribuidas con el objetivo de conocer las necesidades y requerimientos de cada zona en cuanto a fertilización para adaptar la generación de los fertilizantes a las demandas actuales del mercado.

La encuesta consistía en una serie de preguntas orientadas a conocer la predisposición de los usuarios a cambiar los productos que utilizan actualmente por unos generados a partir de subproductos de la industria pesquera y acuicultura, los aspectos importantes en la elección del fertilizante y el grado de importancia que cobra la huella ecológica del producto.

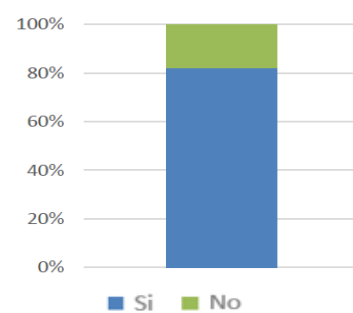
Aunque la mayoría de los encuestados no practican la agricultura ecológica, tienen conciencia sobre la importancia de la sostenibilidad y la huella ecológica. Respecto al uso de subproductos en la generación de fertilizantes, no han mostrado oposición, aunque algunos han manifestado su preocupación por la presencia de sustancias potencialmente peligrosas en ellos. Sin embargo, la mayoría de los encuestados reconoce estar dispuesto a incorporar estos fertilizantes en sus prácticas.

### Recomendaciones prácticas

Teniendo en cuenta la gran aceptación de los usuarios finales, es un buen momento para el desarrollo de tecnologías que permitan el aprovechamiento de los subproductos para generar fertilizantes. Para hacer que el usuario final se sienta cómodo con este tipo de productos y promover una estrategia de economía circular en la sociedad es fundamental una comunicación clara explicando los exhaustivos controles y regulaciones a los que son sometidos estos productos con objetivo de que sean seguros y eficientes.



**Fig 1:** ¿Considera una desventaja el uso de subproductos para formular fertilizantes?



**Fig 2:** ¿Estaría dispuesto a cambiar sus fertilizantes por unos obtenidos a partir de subproductos?

### Acerca de este resumen

**Autores:** Joaquin Romero, Carlos Fuertes (Fertinagro Biotech)

**Fecha:** Junio 2022

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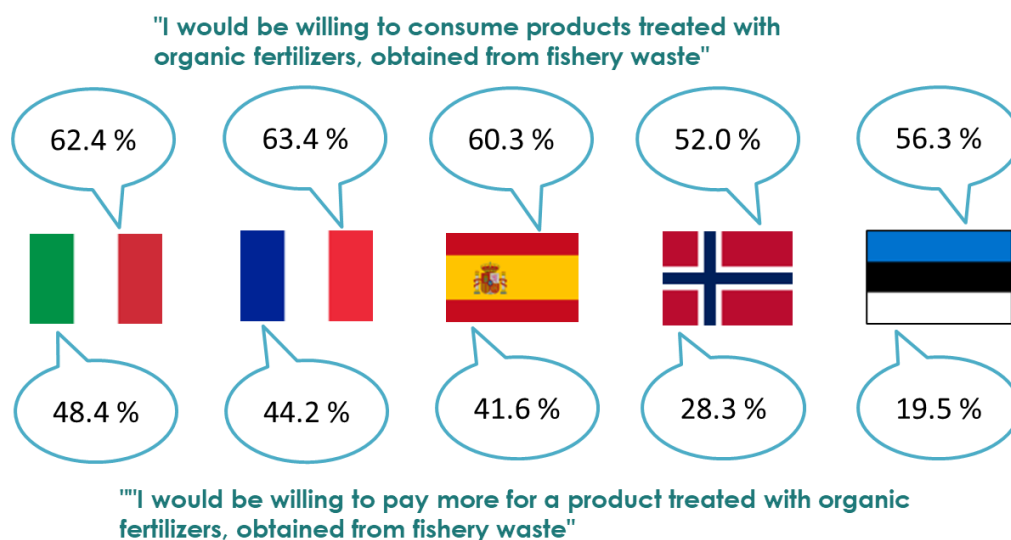
## Consumer survey: bio-fertilisers from fish by-products

### Main results / outcomes

Determining the variables that affect the acceptance of consumers and understanding the reasons of the consumers' behaviour related to food waste recycling in this way is of great importance to ensure the market uptake of biobased fertilisers (BBF) treated products. With this aim, a consumer survey was done in which a total of 1,516 online answers were obtained in the five European countries participating in the project: Spain, Italy, France, Estonia and Norway. The enquiry was designed to get information, first, on the consumer awareness and consumption habits related to plant products from organic production and their environmental consciousness, and second, on their motivations and barriers towards the consumption of products treated with fish offal derived BBF. There is an overall believe that organic fertilisers are better for the environment, healthier, and provide better quality of the products. Moreover, these appear as motivational factors common in all countries. However, not so many people, except in Norway and Estonia, recognise fish offal as a source of organic fertilisers. There is also an overall acceptance in all countries towards the consumption of products fertilised with fish derived BBF, however less people would be prone to pay more for it.

### Practical recommendations

Slightly different strategies should be considered when promoting BBF into different countries due their different perceptions and expectations. To overcome the main barriers expressed by the consumer and ensure the market uptake of these products, the main topics to cover should be an adequate transparent communication, correct labelling, demonstrate that they do not affect product safety and taste and producing them at a competitive cost that do not increase the price of the products.



### About this abstract

**Authors:** Carlos Bald/AZTI

**Date:** June 2022

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## Encuesta de consumidores: biofertilizantes de subproductos pesqueros

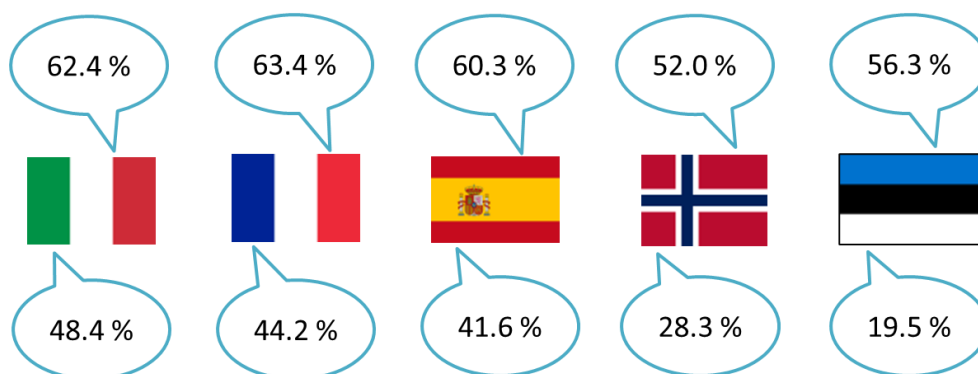
### Principales resultados

Determinar las variables que afectan a la aceptación de los consumidores y comprender las razones de su comportamiento relacionadas con el reciclaje de residuos alimentarios es de gran importancia para garantizar la aceptación en el mercado de los productos tratados con fertilizantes de base biológica (FBB). Así, se realizó una encuesta en la que se obtuvieron un total de 1.516 respuestas en los cinco países europeos socios del proyecto: España, Italia, Francia, Estonia y Noruega. Se obtuvo información sobre la conciencia del consumidor y sus hábitos de consumo relacionados con los productos vegetales de producción ecológica, sobre su conciencia ambiental y también sobre sus motivaciones y barreras hacia el consumo de productos tratados con FBB derivados de subproductos pesqueros. Existe la creencia general de que los fertilizantes orgánicos son mejores para el medio ambiente, más saludables y proporcionan productos de calidad. Estos factores motivacionales son comunes a todos los países. Sin embargo, no muchas personas, excepto en Noruega y Estonia, reconocen los subproductos de pescado como fuente de fertilizantes orgánicos. Hay una aceptación general en todos los países hacia el consumo de productos fertilizados con FBB derivados del pescado, pero menos personas pagarían más por ello.

### Recomendaciones prácticas

Se deben considerar estrategias ligeramente diferentes al promover FBB en diferentes países debido a sus diferentes percepciones y expectativas. Para superar las principales barreras expresadas por el consumidor y garantizar la aceptación en el mercado de estos productos, los objetivos deben ser una comunicación transparente, un etiquetado correcto, demostrar que no afectan a la seguridad y al sabor del producto y producirlos a un coste competitivo que no aumente el precio.

"Estaría dispuesto a consumir productos tratados con fertilizantes orgánicos, obtenidos a partir de residuos pesqueros"



"Estaría dispuesto a pagar más por un producto tratado con fertilizantes orgánicos, obtenidos a partir de residuos pesqueros"

### Sobre este resumen

**Autores:** Carlos Bald/AZTI

**Fecha:** Junio 2022

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# Agronomic value of bio-based fertilizers derived from aquaculture residues in Chile

## Main results / outcomes

In Chile, granitic soils are characterized by a low natural fertility, particularly available phosphorus (5 mg/kg) and organic matter (<3%). Bio-based fertilizers (BBFs) derived from residues produced by Chilean aquaculture industry could allow to improve these deficiencies and to support the establishment of pastures in a low-input agriculture system.

## Practical recommendations

In the framework of SEA2LAND project, bio-based fertilizer (BBF) produced by Chilean companies involved in aquaculture waste management were prospected. Three main BBFs were identified: 1) **Compost** elaborated from fish sludge and silage of salmon in mix with cereals straw (5.5% P<sub>2</sub>O<sub>5</sub>); 2) **Bone meal** derived from the process of salmon protein extraction (19% P<sub>2</sub>O<sub>5</sub>); and 3) **Dried fish sludge** obtained from a high-efficiency drying system (3% P<sub>2</sub>O<sub>5</sub>). In order to evaluate the agronomic value of these BBFs, a field experiment was established in Portezuelo city, Chile (36°28'30"S 72°27'40"W). The farm belongs to a smallholder farmer performing low-input and rainfed agriculture. The environment include a granitic soil with low P content (7 mg/kg of available P<sub>2</sub>O<sub>5</sub>) and Mediterranean climate with 800 mm of rain annually. The agronomic value will be evaluated in terms of their phosphorus contribution to the soil-crop system. Each BBFs was incorporated to the soil in a rate equivalent to 100 kg/ha of P<sub>2</sub>O<sub>5</sub>. Additionally, two control treatments were considered: 0 and 100 kg/ha of P<sub>2</sub>O<sub>5</sub> supplied as inorganic P (Superphosphate; 46% P<sub>2</sub>O<sub>5</sub>). Then, an alfalfa pasture was established as a test crop. The effects of BBFs on vigor of early phenological stages of the crop, biomass production, an P recovery in plant tissues will be evaluated. On the other hand, the effects on soil properties (moisture holding capacity, microbiological activity, and P content), will be also measured.



Fig 1: Establishment of experiment for determining the agronomic value of BBFs produced in Chile

## Further information

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## About this abstract

**Authors:** Luis Inostroza, Juan Hirzel, Francisco Salazar, Ma. Esperanza Sepúlveda / INIA-Chile

**Date:** June 2022

**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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# Evaluación agronómica de biofertilizantes derivados de residuos de la industria acuícola Chilena

## Principales avances / resultados

Los suelos graníticos de Chile se caracterizan por una baja fertilidad natural, especialmente de fósforo (5 mg/kg) y materia orgánica (<3%). Biofertilizantes derivados de residuos de la industria acuícola Chilena permitirían mejorar estas deficiencias y apoyar el establecimiento de praderas.

## Recomendaciones prácticas

En el marco del proyecto SEA2LAND, se realizó una prospección de biofertilizantes (BBF) elaborados en Chile por compañías ligadas al manejo de residuos de la industria acuícola. Se identificaron tres productos: 1) Compost elaborado a partir de lodos y mortalidades de salmón en mezcla con paja de cereales (5.5%  $P_2O_5$ ); 2) Harina de hueso derivada de la producción de hidrolizados proteicos de salmón (19%  $P_2O_5$ ); 3) lodo seco (3%  $P_2O_5$ ) obtenido por un proceso de secado industrial de alta eficiencia. Se estableció un experimento en el predio de un pequeño agricultor de la comuna de Portezuelo (36°28'30"S 72°27'40"O), Chile. El ambiente se caracteriza por presentar un suelo granítico con bajado contenido de P (7 mg/kg  $P_2O_5$ ) y clima Mediterráneo con 800 mm de lluvia anual. En la zona se realiza agricultura de secano con bajo uso de insumos. Se evaluará el valor agronómico de los tres BBFs en términos de su aporte de fósforo al suelo. Con cada BBF se incorporó al suelo 100 kg/ha de  $P_2O_5$ . Se incluyó dos tratamientos control: 0 y 100 kg/ha de  $P_2O_5$  aplicado como P inorgánico (superfosfato; 46%  $P_2O_5$ ). Luego, se estableció una pradera de alfalfa. Se evaluará el efecto de los BBFs en el vigor de establecimiento de la pradera, producción de biomasa y absorción de P. En el suelo se evaluará la capacidad de retención de humedad, actividad microbiológica y contenido de P en varios periodos.



Fig 1: Establecimiento de experimento para determinar el valor agronómico de biofertilizantes producidos en Chile

## Más información

<https://www.inia.cl>

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## Acerca de este resumen

**Autores:** Luis Inostroza, Juan Hirzel, Francisco Salazar, Ma. Esperanza Sepúlveda / INIA-Chile

**Fecha:** June 2022

El proyecto **SEA2LAND** es una acción colaborativa de innovación (IA) financiada por la UE en el marco del programa Horizonte 2020. El proyecto tiene como objetivo proporcionar soluciones para ayudar a superar los desafíos relacionados con la producción de alimentos, el cambio climático y la reutilización de residuos. Basado en el modelo de economía circular, SEA2LAND promueve la producción de fertilizantes a gran escala en la UE a partir de materias primas propias. Se espera que esta solución reduzca el desequilibrio de nutrientes del suelo en Europa. El proyecto se desarrollará desde enero de 2021 hasta diciembre de 2024.

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# Biofertilizers derived from residues produced by Chilean aquaculture industry

## Main results / outcomes

In the framework of SEA2LAND Project, Chilean companies involved in aquaculture waste management and biofertilizers (BBF) production were prospected. Three companies were identified: Rilesur (<https://rilesur.cl>), LANDES (<https://landes.cl>), and Circular Solutions (<https://circularsolutions.cl>).

## Practical recommendations

**Rilesur** is the most important waste treatment plant for aquaculture industry. It treats the highest proportion of fish sludge and silage (mortalities) produced by the Chilean industry. The residues are mixed with cereal straw for composting. More than 30.000 tons of compost with 5.5% of  $P_2O_5$  and 20-30% of moisture are produced annually. **Landes** is a fishing company focused on processing sea proteins for animal feeding, with more than 60 years of experience in Chile. It produces high-quality fish meal, oil and proteins based on residues from salmon processing industry. In the protein extraction process, fish bones are separated through a sieving system in order to produce a bone meal with high content of calcium phosphate (19%  $P_2O_5$ ) and 5% of moisture. Landes is introducing the bone meal to the BBF market and it is planning to build a new processing plant in order to produce 10 ton per day. **Circular Solutions** is offering a drying technology in order to give value to organic residues with high water content (fish sludge). Its objective is to promote Circular Economy, transforming the problem of fish sludge treatment in a new sustainable opportunity. The technology is able to dry fish sludge *in situ*, reducing the waste volume and negative vectors associated with this kind of material. The final product is a dry and stable powder with 3% of  $P_2O_5$  and 5% of moisture. SEA2LAND will contribute to determine the agronomic value of the BBFs previously mentioned.

**Fig 1:** Biofertilizers produced by Chilean companies involved in aquaculture waste management and biofertilizers production



## Further information

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## About this abstract

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## Biofertilizantes derivados de residuos de la industria acuícola Chilena

### Principales avances / resultados

En el marco del proyecto SEA2LAND, se realizó una prospección de compañías Chilenas ligadas al manejo de residuos de la industria acuícola y producción de biofertilizantes (BBF). Se identificaron tres: Rilesur (<https://rilesur.cl>), LANDES (<https://landes.cl>), y Circular Solutions (<https://circularsolutions.cl>).

### Recomendaciones prácticas

**Rilesur** es la planta de tratamiento de residuos de la industria acuícola más importante de Chile. Recibe una alta proporción de los lodos y mortalidades producidas por la industria. Los residuos son compostados junto con paja de cereales. Anualmente producen más de 30 mil toneladas de compost con 5.5% de  $P_2O_5$  y 20-30% de humedad. **Landes**, es una compañía pesquera procesadora de proteínas marinas para el consumo animal, con más de 60 años de experiencia. Actualmente, usa subproductos de la industria del salmón para la obtención de harina, aceite e hidrolizados proteicos. Del último, mediante un proceso de tamizaje se separan los huesos del fluido-acuoso-proteico, lo que produce una harina de hueso con alto contenido de fosfato de calcio (19%  $P_2O_5$ ) y 5% de humedad. Landes contempla la construcción de una nueva planta de proceso donde se proyecta procesar 10 toneladas diarias de hueso de salmón. **Circular Solutions**, ofrece una tecnología de secado para revalorizar residuos orgánicos húmedos, potenciando la Economía Circular y transformando el problema de tratamiento de lodos en una oportunidad. Su foco es el secado insitu, reducir el volumen y vectores contaminantes que generan los lodos, entregando como resultado un polvo seco y estable con un 3% de  $P_2O_5$  y 5% de humedad. SEA2LAND contribuirá a determinar el valor agronómico de los BBF antes descrito.

**Fig 1:** Biofertilizantes producidos por industrias que procesan residuos de la acuicultura en Chile



### Más información

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### Acerca de este resumen

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**Fecha:** Junio 2022

El proyecto **SEA2LAND** es una acción colaborativa de innovación (IA) financiada por la UE en el marco del programa Horizonte 2020. El proyecto tiene como objetivo proporcionar soluciones para ayudar a superar los desafíos relacionados con la producción de alimentos, el cambio climático y la reutilización de residuos. Basado en el modelo de economía circular, SEA2LAND promueve la producción de fertilizantes a gran escala en la UE a partir de materias primas propias. Se espera que esta solución reduzca el desequilibrio de nutrientes del suelo en Europa. El proyecto se desarrollará desde enero de 2021 hasta diciembre de 2024.

**Página web:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement ID 101000496

## SWOT analysis – Adriatic sea

### Main results / outcomes

The **Adriatic sea pilot** located in Italy will obtain bio-based fertilizers by combining methodologies based on pyrolysis and composing of mussel shells and organic fraction. Italy's agriculture is based on grains, soybeans, meat and dairy in the northern part and fruits, vegetables, olive oil, wine in the southern part. In 2018, Italy produced 0.3 million tonnes of fish with 32% of the value coming from aquaculture and 68% from fisheries. **The SWOT analysis** gave an overview of internal and external factors for Adriatic Sea pilot case.

### Practical recommendations

The main **strengths include** low or no cost of input streams for production of bio-based fertilizer, strong knowledge of technologies, reducing waste, ease of transferability and upscaling of technologies, possibility of integration into production systems, wide spectrum of products. **Weaknesses** include implementation and technology costs, low quantity of raw materials to be relevant, seasonality of fish production, difficulties in operation and logistics. **Opportunities** include creation of green jobs, possible incentives by EC, raising awareness, growing cost of conventional fertilizers and waste reduction thus reducing disposal costs. **Threats** include low awareness of the population, challenging EU and national regulations and policies, difficulties in harmonization/standardization of bio-based fertilizers as well as uncertainty in product's sustainability.



Fig 1: Adriatic sea pilot area



Fig 2: Adriatic sea (source: [freepik.com](https://www.freepik.com))

### Further information

The Adriatic sea area case - <https://sea2landproject.eu/the-adriatic-sea-case/>

### About this abstract

**Authors:** IPS Konzalting d.o.o. za poslovne usluge

**Date:** June 2022

**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.

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## SWOT analiza – Jadransko more

### Glavni rezultati/ ishodi

**Jadranski pilot** lociran u Italiji će proizvesti biognojiva kombiniranjem tehnologija baziranih na pirolizi i kompostiranju školjki i organskih ostataka. Talijanska poljoprivreda se bazira na uzgoju žitarica, soje, proizvodnji mesa i mliječnih proizvoda na sjeveru i voća, povrća, maslinovog ulja i vina na jugu. U 2018 Italija je zabilježila ulov od 0.3 milijuna tona ribe od čega 32% vrijednosti dolazi iz akvakulture i 68% iz ribarstva. **SWOT analiza** daje pregled unutarnjih i vanjskih čimbenika koji utječu na Jadranski pilot.

### Praktične preporuke

Glavne identificirane **snage** uključuju niske troškove inputa (sirovine) za proizvodnju biognojiva, dobro poznavanje tehnologija, smanjenje količine gnojiva, lakoća prenosivosti procesa i povećanja kapaciteta mogućnost implementiranja u postojeće sustave proizvodnje, širok spektar dobivenih proizvoda. **Slabosti** uključuju troškove implementacije tehnologije i upravljanja, male količine dostupnih sirovina, sezonalnost proizvodnje, problemi vezani za operativne procese i logistika. **Prilike** uključuju stvaranje novih radnih mjesta, moguće potpore od strane EK, podizanje svijesti, rast cijena umjetnih gnojiva, smanjenje količine otpada što smanjuje troškove odlaganja. **Prijetnje** uključuju nisku opća razinu poznavanja problematike, izazovi za postojeće EU i nacionalne regulative, problematike oko harmonizacije/standardizacije biognojiva i nesigurnost održivosti dobivenog proizvoda.



Fig 1: Jadransko pilot područje



Fig 2: Jadransko more (izvor: [freepik.com](https://www.freepik.com))

### Dodatne informacije

The Adriatic sea area case - <https://sea2landproject.eu/the-adriatic-sea-case/>

### O ovom sažetku

**Autori:** IPS Konzalting d.o.o. za poslovne usluge

**Datum:** Lipanj 2022.

**SEA2LAND** je projekt u sklopu Inovacijske aktivnosti (IA) financiran od strane EU u sklopu Obzor 2020 programa. Cilj projekta je pružiti rješenja koja će pomoći u savladavanju izazova povezanih s proizvodnjom hrane, klimatskim promjenama i oporabom otpada. Na temelju modela kružne ekonomije, SEA2LAND promiče proizvodnju gnojiva u EU iz vlastitih sirovina. Očekivano je da će ovo rješenje smanjiti neuravnoteženost hranivih tvari u tlu.

Projekt traje od siječnja 2021. do prosinca 2024.

**Web stranica:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



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## SWOT analysis – Atlantic sea

### Main results / outcomes

The **Atlantic sea pilot** located in France will develop an innovative combination of technologies to transform fish sludge into bio-based fertilizers. France is the largest harvester of cereals, root crops and oilseeds in the EU. In 2018, France produced 0.8 million tonnes of fish, 35% of the value came from aquaculture and 64% from fisheries, also France is the third-largest fish and seafood market in Europe. **The SWOT analysis** gave an overview of internal and external factors for Atlantic Sea pilot case.

### Practical recommendations

The main **strengths** include creating new products that are of interest for the fish processor, improving economy, quality of life and overall sustainability on a local level, minimizing GHG emissions and waste volume, preserving soil diversity, short transportation and development of innovative technology. **Weaknesses** include high investment of technology implementation, logistic difficulties including planning, operation control, space requirement and possibility of lower quality of end-products due to operation difficulties and nutrient imbalances. **Opportunities** include waste reduction, green job creation, generation of income from waste, increasing prices of non-renewable materials in creation of mineral fertilizers, efforts and incentives by EU to support circular economy. **Threats** challenging legislations and policies on EU and national level, limited knowledge of technology and product sustainability, high market cost and EU dependency on imported nutrients.



Figure 1: Atlantic sea pilot area

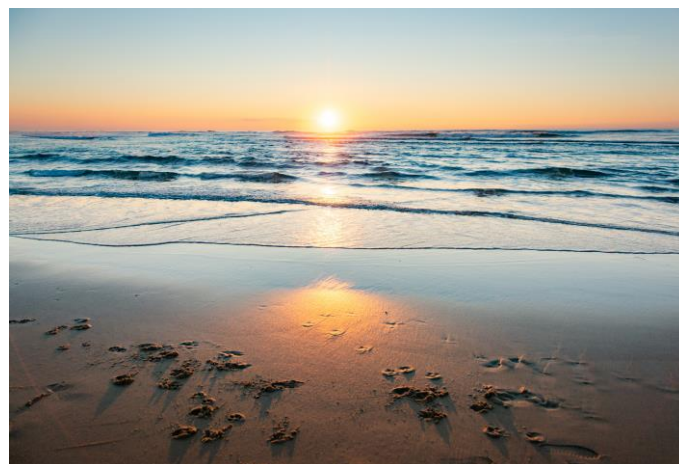


Figure 2: Atlantic sea  
(source: [freepik.com](https://www.freepik.com))

### Further information

The Atlantic Sea Area case - <https://sea2landproject.eu/the-atlantic-area/>

### About this abstract

**Authors:** IPS Konzalting d.o.o. za poslovne usluge

**Date:** June 2022

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The project is running from January 2021 to December 2024.

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## SWOT analiza – Atlantsko more

### Glavni rezultati/ishodi

**Atlantski pilot** lociran u Francuskoj će razviti inovativne kombinacije tehnologija kako bi proizveli biognojiva iz ribljeg mulja. Francuska je najveći proizvođač žitarica, gomoljastog povrća i uljarica u EU. U 2018 godini, Francuska je proizvela 0.8 milijuna tona ribe, 35% vrijednosti je iz akvakulture, a 64% vrijednosti je došlo iz ribarstva. Također Francuska ima treće najveće tržište ribe i morskih plodova od zemalja EU. **SWOT analiza** daje pregled unutarnjih i vanjskih čimbenika koji utječu na Atlantski pilot.

### Praktične preporuke

Glavne identificirane **snage** uključuju proizvodnju novih proizvoda koji su od interesa za prerađivače ribe, pozitivan učinak na ekonomiju, kvalitetu života i održivosti na lokalnoj razini, smanjujuću emisije stakleničkih plinova i količine otpada, očuvanje raznolikosti tla, kratka transportna udaljenost i razvoj inovativnih tehnologija. **Slabosti** uključuju visoka ulaganja u implementaciju tehnologija, poteškoće planiranja, proizvodnje i operacija, zahtjevi za prostorom i mogućnost proizvodnje proizvoda niže kvalitete zbog problema u proizvodnji i debalansi hraniva. **Prilike** uključuju smanjenje količine otpada, otvaranje novih radnih mjesta, zarada nastala oporabom otada, rast cijena neobnovljivih materijala korištenih za proizvodnju gnojiva, inicijative od strane EU za podupiranje kružne ekonomije. **Prijetnje** uključuju izazove za nacionalne i EU regulative, ograničena znanje vezanih za tehnologije i održivost dobivenih proizvoda i ovisnost EU o uvozu hraniva.



Fig 1: Atlantsko pilot područje

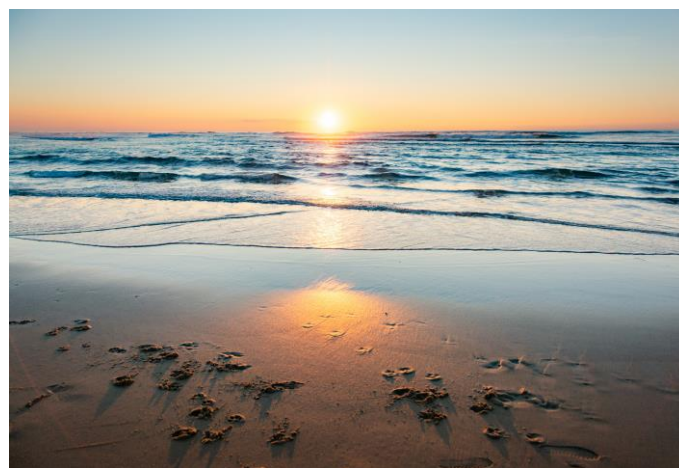


Fig 2: Atlantsko more (source: [freepik.com](https://www.freepik.com))

### Dodatne informacije

The Atlantic Sea Area case - <https://sea2landproject.eu/the-atlantic-area/>

### O ovom sažetku

**Autori:** IPS Konzalting d.o.o. za poslovne usluge

**Datum:** Lipanj 2022.

**SEA2LAND** je projekt u sklopu Inovacijske aktivnosti (IA) financiran od strane EU u sklopu Obzor 2020 programa. Cilj projekta je pružiti rješenja koja će pomoći u savladavanju izazova povezanih s proizvodnjom hrane, klimatskim promjenama i oporabom otpada. Na temelju modela kružne ekonomije, SEA2LAND promiče proizvodnju gnojiva u EU iz vlastitih sirovina. Očekivano je da će ovo rješenje smanjiti neuravnoteženost hranivih tvari u tlu.

Projekt traje od siječnja 2021. do prosinca 2024.

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## SWOT analysis – Baltic sea

### Main results / outcomes

The **Baltic sea pilot** located in Estonia will obtain foliar fertilisers and granulated compost from fish processing waste by fermentation with bokashi. In the last few years Estonian agricultural production has been focused on organic farming with more than three-fifths of the output value coming from milk, cereals, industrial crops and pigs. Fish industry was responsible for 83 thousand tonnes of total catches in 2019. **The SWOT analysis** gave an overview of internal and external factors for Baltic sea pilot case.

### Practical recommendations

The main **strengths** include numerous sustainability and environmental benefits such as enhancing and preserving soil diversity and contributions to GHG emission reduction as well as benefits to the project associated industries and the local community, agriculture producers and fish industry. **Weaknesses** include acceptance and adoption of the project and project results as well as difficulties associated with the implementation of obtained products and technology implementation and logistic costs. **Opportunities** include green job creation and income from waste sources, waste reduction and reduced disposal costs, possible incentives and investment efforts by the EC, know-how development. **Threats** include a competitive fertilizer market and competition with other waste-processing technologies, challenging the existing EU and national legislation and EU reliance on imported nutrients.

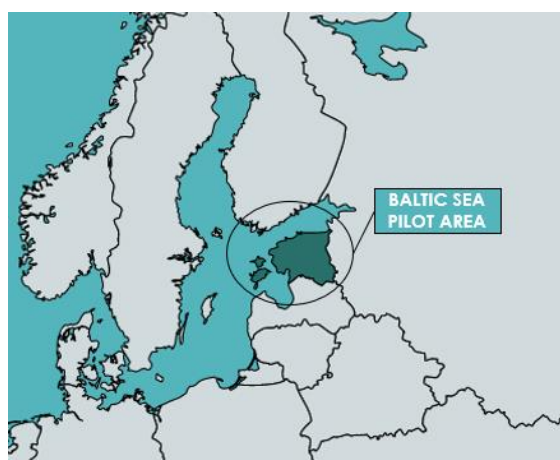


Fig 1: Baltic sea pilot area



Fig 2: Baltic Sea (source: [freepik.com](https://www.freepik.com))

### Further information

The Baltic Sea Area case - <https://sea2landproject.eu/baltic-sea-case/>

### About this abstract

**Authors:** IPS Konzalting d.o.o. za poslovne usluge

**Date:** June 2022

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## SWOT analiza – Baltičko more

### Glavni rezultati/ishodi

**Baltički pilot** koji se nalazi u Estoniji će proizvesti folijarna gnojiva i peletirani kompost iz nusproizvoda prerade ribe bokashi fermentacijom. Posljednjih godina estonijska poljoprivredna proizvodnja fokusirana je na ekološkoj poljoprivredi koju dvije trećine outputa dolazi i proizvodnje mlijeka, žitarica, industrijskih kultura i svinjskog mesa. Ribarska industrija je u 2018 postigla 83 tisuće tona ukupnog ulova u 2019 godini. **SWOT analiza** daje pregled unutarnjih i vanjskih čimbenika koji utječu na Baltički pilot.

### Praktične preporuke

Glavne identificirane **snage** uključuju brojne koristi koje doprinose održivosti i očuvanju okoliša kao očuvanje i poboljšavanje karakteristika tla i smanjenje emisija stakleničkih plinova, benefiti za industrije asocirane s projektom i lokalno stanovništvo, poljoprivrednike i ribarsku industriju. **Slabosti** uključuju prihvaćanje projekta i projektnih rezultata, poteškoće asocirane s implementacijom i korištenjem dobivenih proizvoda i tehnologije, operativni troškovi. **Prilike** uključuju otvaranje novih radnih mjesta, izvor prihoda od nusproizvoda, smanjenje količine otpada i troškova odlaganja, moguća ulaganja od strane EK, razvoj vještina. **Prijetnje** uključuju konkurentno tržište gnojiva i natjecanje s ostalim tehnologijama oporabe nusproizvoda, izazovi za postojeće EU i nacionalne regulative i legislative, ovisnost EU-a o uvoznim nutrijentima.



Figure 1: Baltičko pilot područje

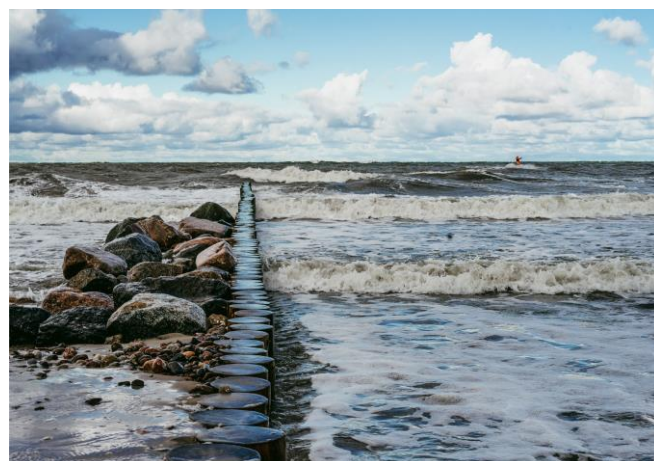


Figure 2: Baltičko more  
(izvor: [freepik.com](https://www.freepik.com))

### Dodatne informacije

The Baltic Sea Area case - <https://sea2landproject.eu/baltic-sea-case/>

### O ovom sažetku

**Autori:** IPS Konzalting d.o.o. za poslovne usluge

**Datum:** Lipanj 2022.

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## SWOT analysis – Cantabrian sea

### Main results / outcomes

The **Cantabrian sea pilot** located in Spain will obtain protein hydrolysates for fertilizer production from tuna canning waters, fish viscera, fish filleting industries, and inland aquaculture waste by using membrane technologies and enzymatic hydrolysis. Spain is the highest producer of fresh vegetables, citrus fruits, and olives in the EU. It has the biggest fishing industry in the EU and produced 1.3 million tonnes of fish in 2018 with a production of 283.000 tonnes of canned tuna. The **SWOT analysis** gave an overview of internal and external factors for the Cantabrian Sea pilot case.

### Practical recommendations

The main **strengths** include widespread applicability, possibility of integration into production systems, contributions to waste reduction, GHG emission reduction and water consumption, boost to the local economy, agriculture and fish industry. **Weaknesses** include required support of the project, technology implementation and operation costs, seasonality of input streams and lower yields than conventional types of technologies. **Opportunities** include significant waste reduction hence reduction of disposal costs, creating green jobs and income from waste sources, incentivized investments and efforts made by EC to favor BBFs over mineral fertilizers, and increased know-how development. **Threats** include low overall population awareness, hard market infiltration, difficulties being competitive within the market, EU reliance on imported nutrients and challenging existing national and EU legislation.



Fig 1: Cantabrian sea pilot area



Fig 2: Cantabrian sea (source: [freepik.com](https://www.freepik.com))

### Further information

The Cantabrian Sea Area case - <https://sea2landproject.eu/cantabrian-sea-area-case/>

### About this abstract

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**Date:** June 2022

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## SWOT analiza – Kantabrijsko more

### Glavni rezultati/ishodi

**Kantabrijski pilot** lociran u Španjolskoj će proizvesti hidrolizate proteina za proizvodnju gnojiva iz otpadnih voda nastalih konzerviranjem tuna, riblje utrobe, otpada industrije filetiranja ribe i akvakulture korištenjem membranskih tehnologija i enzimske hidrolize. Španjolska je najveći proizvođač povrća, citrusa i maslina u EU. Najveći je proizvođač ribe u EU 2018 s ukupnim iznosom proizvedene ribe od 1.3 milijuna tona, i 283.000 tona konzervirane tune. **SWOT analiza** daje pregled unutarnjih i vanjskih čimbenika koji utječu na Kantabrijski pilot.

### Praktične preporuke

Glavne identificirane **snage** uključuju široku primjenu i implementaciju u postojeća postrojenja, brojne koristi koje doprinose smanjenju količine otpada i potrošnje vode, benefiti za lokalnu ekonomiju, poljoprivrednu i ribarsku industriju. **Slabosti** uključuju potrebnu podršku i podupiranje projekta, troškovi implementacije tehnologije i operativni troškovi, sezonalnost sirovina i manji prinosi u odnosu na konvencionalne tipove tehnologija. **Prilike** uključuju značajno smanjenje količine otpada što smanjuje troškove odlaganja, otvaranje novih radnih mjesta, inicijative i ulaganja od EK zbog favoriziranja organskih gnojiva u odnosu na mineralna, razvoj vještina. **Prijetnje** uključuju nisku osviještenost populacije, teški prodor na tržište i problem oko postizanja konkurentnosti, ovisnost EU-a o uvoznim nutrijentima, izazovi za postojeće državne i EU regulative.



Fig 1: Kantabrijsko pilot područje



Fig 2: Kantabrijsko more (izvor: [freepik.com](https://www.freepik.com))

### Dodatne informacije

The Cantabrian Sea Area case - <https://sea2landproject.eu/cantabrian-sea-area-case/>

### O ovom sažetku

**Autori:** IPS Konzalting d.o.o. za poslovne usluge

**Datum:** Lipanj 2022.

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## SWOT analysis – Mediterranean sea

### Main results / outcomes

The **Mediterranean sea pilot** located in Malta will produce bio-based fertilizers from freshwater and marine aquaculture waste by combining several different recovery technologies. Malta's share of farmland recorded in 2016 was 35.5%. Main crops include potatoes, cauliflower, grapes, wheat barley, tomatoes, citrus and green peppers. Maltese aquaculture produce is almost entirely exported to EU and Asian market, with 65% of annual landings originating from tuna and dolphin fisheries. **The SWOT analysis** gave an overview of internal and external factors for Mediterranean sea pilot case.

### Practical recommendations

The main **strengths include** creation of new products and cost-benefit interest for the fish producer, contributions to GHG emission reduction, boosting local economy, minimizing waste production, possible to integrate on-site and easily operated. **Weaknesses** include requirements of networking, technology and space costs, planning and support from end-users for successful management, possible lower quality end-products and nutrient imbalances, high shipment cost of by-products from Malta. **Opportunities** include waste reduction thus reducing disposal costs, creating green jobs, know-how development, incentivizing investments and efforts by the EC, generating income from waste sources. **Threats** include low public awareness, challenging national and global policy goals, missing coherent policies, competitive fertilizer market.



Fig 1: Mediterranean sea pilot areas

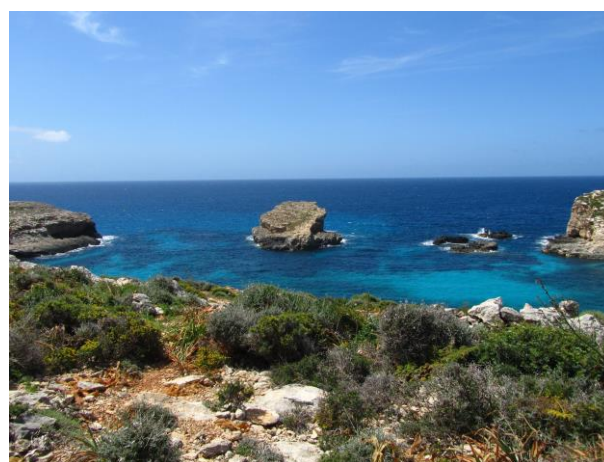


Fig 2: Mediterranean sea (source: [freepik.com](https://www.freepik.com))

### Further information

The Mediterranean Sea case - <https://sea2landproject.eu/the-mediterranean-sea-area-case/>

### About this abstract

**Authors:** IPS Konzalting d.o.o. za poslovne usluge

**Date:** June 2022

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**Website:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement ID 101000496

## SWOT analiza – Sredozemno more

### Glavni rezultati/ishodi

**Sredozemni pilot** koji se nalazi na Malti će proizvesti biognojiva iz otpadnih voda slatkovodne i morske kombiniranjem više vrsta tehnologija oporabe. Udio poljoprivrednog zemljišta Malte 2016. je iznosio 35.5%. Glavne kulture uključuju krumpir, cvjetaču, vinovu lozu, pšenicu, ječam, rajčicu, citrusu i zelenu papriku. Proizvodi Malteške akvakulture gotovo u potpunosti završi kao izvoz u zemlje EU i Aziju, 65% godišnjeg prihoda dolazi od tune i dupina. **SWOT analiza** daje pregled unutarnjih i vanjskih čimbenika koji utječu na Sredozemni pilot.

### Praktične preporuke

Glavne identificirane **snage** uključuju stvaranje novih proizvoda što stvara interes za uzgajaa ribe, doprinosi smanjenju emisije stakleničkih plinova, jačanje lokalne ekonomije, smanjenje količine otpada, mogućnosti za integriranje procesa na licu mjesta i lakoća upravljanja procesom. **Slabosti** uključuju potrebe za umrežavanjem, troškovi planiranja upravljanja i implementacije tehnologija, potrebna je podrška od krajnjih korisnika za uspjeh, moguća proizvodnja gnojiva lošije kvalitete s neuravnoteženim količinama hraniva, visok trošak transporta sirovina s Malte. **Prilike** uključuju smanjenje količine opada što smanjuje troškove odlaganja i zbrinjavanja, stvaranje novih radnih mjesta, razvoj vještina, moguća ulaganja od strane EC, stvaranje prihoda iz nusproizvoda. **Prijetnje** uključuju nisku razinu svijesti populacije, izazovi za nacionalne i globalne regulative, nedostatak istih i konkurentno tržište.



Fig 1: Sredozemna pilot područja



Fig 2: Sredozemno more (Izvor: [freepik.com](https://www.freepik.com))

### Dodatne informacije

The Mediterranean Sea case - <https://sea2landproject.eu/the-mediterranean-sea-area-case/>

### O ovom sažetku

**Autori:** IPS Konzalting d.o.o. za poslovne usluge

**Datum:** Lipanj 2022.

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Projekt traje od siječnja 2021. do prosinca 2024.

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## SWOT analysis – North sea

### Main results / outcomes

The **North sea pilot** located in Norway will obtain pelleted and liquid fertilizer by bokashi fermentation of fish sludge. Only 3.3% of the total land in Norway is farmland, the main crops produced are barley, oats, and wheat. In 2018 Norway was reported the world's seventh-largest aquaculture fish producer in the world, accounting for 80% of the total fishery production in EU-27. **The SWOT analysis** gave an overview of internal and external factors for the North Sea pilot case.

### Practical recommendations

The main **strengths** include numerous sustainability and environmental benefits such as enhancing and preserving soil diversity and contributions to GHG emission reduction, widespread applicability and transferability, benefits to the local community, fish industry, and fertilizer producers. **Weaknesses** include acceptance and adoption of the project and project results as well as difficulties associated with the implementation of obtained products, undesirable by-product characteristics, technology implementation, and operation/logistic cost. **Opportunities** include green job creation and generation of income from waste sources, waste reduction and reduction of disposal costs, requirement of better solutions for fish sludge disposal for the breeders. **Threats** include a competitive fertilizer market and competition with other waste-processing technologies, challenging national legislation and restrictions, high market infiltration cost, and difficulties in harmonization/standardization of produced fertilizers.



Fig 1: North sea pilot area



Fig 2: North sea (source: [freepik.com](https://www.freepik.com))

### Further information

The North Sea Area case - <https://sea2landproject.eu/north-sea-area-case/>

### About this abstract

**Authors:** IPS Konzalting d.o.o. za poslovne usluge

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## SWOT analiza – Sjeverno more

### Glavni rezultati/ishodi

**Pilot Sjeverno more** nalazi se u Norveškoj će proizvesti peletirano i tekuće gnojivo procesom bokashi fermentacije ribljeg mulja. Samo 3.3% ukupne površine Norveške čine poljoprivredna zemljišta, glavni usjevi su ječam, zob i pšenica. U 2018 Norveška je bila sedmi najveći svjetski proizvođač ribe u akvakulturi, i zaslužna je za 80% ukupnog uzgoja ribe od EU-27. **SWOT analiza** daje pregled unutarnjih i vanjskih čimbenika koji utječu na Sjeverni pilot.

### Praktične preporuke

Glavne identificirane **snage** uključuju brojne koristi uključuju brojne koje doprinose održivosti i očuvanju okoliša kao očuvanje i poboljšavanje karakteristika tla i smanjenje emisija stakleničkih plinova, mogućnost široke primjene, benefiti za lokalno stanovništvo, ribarsku industriju i industriju gnojiva. **Slabosti** uključuju prihvaćenost projekta i projektnih rezultata i poteškoće asocirane s implementacijom dobivenih proizvoda, nepoželjne karakteristike nusproizvoda, troškovi implementacije tehnologije i operativni troškovi. **Prilike** uključuju otvaranje novih radnih mjesta i stvaranje izvora prihoda korištenjem nusproizvoda, smanjena količina i troškovi povezani s otpadom, potreba uzgajivača ribe za boljim opcijama zbrinjavanja mulja. **Prijetnje** uključuju konkurentno tržište gnojiva, natjecanje s ostalim tehnologijama oporabe nusproizvoda, izazovi za postojeće EU i nacionalne regulative i legislative, visoki troškovi povezani s prodorom na tržište i problemi s harmonizacijom/standardizacijom proizvedenog gnojiva.



Fig 1: Sjeverno pilot područje



Fig 2: Sjeverno more (source: [freepik.com](https://www.freepik.com))

### Dodatne informacije

The North Sea Area case - <https://sea2landproject.eu/north-sea-area-case/>

### O ovom sažetku

**Autori:** IPS Konzalting d.o.o. za poslovne usluge

**Datum:** Lipanj 2022.

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Projekt traje od siječnja 2021. do prosinca 2024.

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## SWOT analysis - Development needs and recommendations to regulatory bodies

### Main results / outcomes

Taking into account **EU legislation, directives and regulations**, as well as **consumer perception** an overview of **development needs for the successful integration of new technologies** for fish by-products processing into BBFs and **recommendations to regulatory bodies**, was compiled.

### Practical recommendations



The needs for the **successful integration of new technologies** include:

- development of business plans and models,
- involvement of multiple stakeholders,
- collection of know-how from different regions,
- understanding of the legal framework and restrictions,
- set up traceability protocols,
- assessment of soil and crop needs,
- mitigation of transport and processing cost,
- understanding the possibilities of substances considered as waste.



Fig 1: Adriatic sea (source: [freepik.com](https://www.freepik.com))



**Recommendations to regulatory bodies** include:

- considering research results when deciding on new fertilizer regulations,
- compliance between EU and national regulations,
- involvement of various regulatory and certification bodies,
- demonstration of pilots,
- incentives for farmers to be more sustainable and use BBFs,
- regulations for usage in organic farming and
- incentives for fisheries to process by-products.



Fig 2: Cantabrian sea (source: [freepik.com](https://www.freepik.com))

### Further information

SEA2LAND regulatory assessment - <https://sea2landproject.eu/regulatory-assessment/>

### About this abstract

**Authors:** IPS Konzalting d.o.o.

**Date:** June 2022

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## SWOT analiza - Razvojne potrebe i preporuke regulatornim tijelima

### Glavni rezultati/ishodi

Uzimajući u obzir EU legislative, direktive i regulative zajedno sa preferencijama potrošača napravljen je pregled razvojnih potreba za uspješnu implementaciju novih tehnologija prerade nusproizvoda ribarske industrije u BBF i preporuke regulatornim tijelima.

### Praktične preporuke



Potrebe za uspješnu implementaciju novih tehnologija uključuju:

- razvoj poslovnih planova i modela,
- uključivanje više dionika,
- prikupljanje znanja iz različitih regija,
- razumijevanje pravnog okvira i ograničenja,
- postavljanje protokola sljedivosti,
- procjena potreba tla i usjeva,
- smanjenje troškova transporta i prerade,
- razumijevanje mogućnosti uporabe materijala koji se smatraju otpadom.



Preporuke regulatornim tijelima uključuju:

- uzimanje u obzir rezultata istraživanja prilikom odlučivanja o novim propisima vezanim za gnojiva,
- usklađenosti između EU i nacionalnih propisa,
- uključivanje raznih regulatornih i certifikacijskih nadležnih tijela,
- demonstracija pilota,
- poticanje poljoprivrednika na održivost i korištenje BBF-ova,
- propisi koji dopuštaju korištenje u ekološkoj poljoprivredi i
- poticaji u ribarstvu za preradu nusproizvoda.



Fig 1: Jadransko more (source: [freepik.com](https://www.freepik.com))



Fig 2: Kantabrijsko (source: [freepik.com](https://www.freepik.com))

### Dodatne informacije

SEA2LAND regulatory assessment - <https://sea2landproject.eu/regulatory-assessment/>

### O ovom sažetku

**Autori:** IPS Konzalting d.o.o. za poslovne usluge

**Datum:** Lipanj 2022.

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## Baltic Sea case study: side-streams characterisation

### Main results / outcomes

The raw material used in Baltic Sea case study is fish waste (i.e. salmon heads, bones, collars, cheeks, spines and bellies) coming from the fish filleting companies. These are combined with food waste coming from restaurants, tree leaves/common reed straw and ash, in order to optimize the fertilizer qualities and cost price of the final product, as well as to facilitate the functioning of the technology. Initially, fish sludge was also tested, but later excluded due to low dry matter content (0.5%). Also, the initial use of oil shale ash had to be exchanged to wood burning ash, as EU legislation does not allow the use of former in organic farming. With the help of Estonian Crop Research Institute, physico-chemical composition, contaminants and microbiology of the side-streams were analyzed. The results showed that all raw-material side streams were safe to use in organic farming, i.e. they all were within the allowed range of pathogen microorganisms, heavy-metals and pesticide residuals. They all provide complementary nutrient content for fertilizing purposes. It was also found out that tree litter is preferred over common reed straw due to its beneficial fungi and optimal C/N ratio.

### Practical recommendations

Since Baltic Sea case study uses bokashi fermentation technology, which significantly lowers the pH level of the product, adding ash was found to be beneficial for neutralizing this effect. Combining fish waste with tree leaves and restaurant waste reduces the strong unpleasant odor of the fish waste fermentation.



Side streams from the left: fish waste, tree leaves, ash, restaurant food waste



### Further information

<https://fb.watch/d6WJsQy9z8/> ; <https://nutriloop.org/>

### About this abstract

**Authors:** Nutriloop OÜ

**Date:** June 2022

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## Läänemere piloodi toormaterjalid: kalatööstuse jt. orgaaniliste jäätmete iseloomustus

### Tegevused ja tulemused

Läänemere piloodis kasutati kalatööstuse kõrvalsaadusi (lõhe pead, luud, selgroog jms.) ning toidutööstuses tekkivaid biojätmed. Lisaks uuriti tööstuses üle jääva tuha ja pilliroo ning haljastusjäätmetena kogutud puulehtede omadusi, et välja selgitada nende võimalik lisandväärtus tootmisprotsessis ja lõpptoote väetisomadustes. Algselt testiti ka kalamuda, kuid selle kasutamisest loobuti madala kuivainesisalduse tõttu (0,5 %). Samuti vahetati välja algselt kasutuses olnud põlevkivi tuhk, mis asendati puidupõletamisel ülejääva tuhaga (põlevkivi tuhk ei ole saanud Komisjoni luba mahepõllumajanduses kasutamiseks). Toormaterjalidele tehti füüsikalise-keemilised, mikrobioloogilised, patogeenide ning amino-, fulvo- ja humiinhapete analüüsid. Lisaks võeti toidujäätmetest ka pestitsiidijääkide proovid. Tulemused näitasid, et kõik toormaterjalid lisavad toitaineväärtust ning on mahepõllumajanduses kasutamiseks ohutud. Puulehtede kasutamisel leiti olevat eelis pilliroo ees kasulike seente sisaldamise tõttu ning tuhk osutus vajalikuks, et neutraliseerida fermenteerimisel madalaks muutunud pH taset.

### Praktilised soovitused

Kuna kalajäätmete fermenteerimisel tekib ebameeldiv lõhn, siis tasub neid võimalusel kombineerida teiste toidujäätmetega ning lõpp-tootesse lisada ka puulehti ja tuhka.



Kõrvalvood vasakult: kalajätmed, puulehed, tuhk, restorani toidujätmed



### Lisainfo

<https://fb.watch/d6WJsQy9z8/> ; <https://nutriloop.org/>

### Uudiskirja kohta

**Autor:** Nutriloop

**Kuupäev:** Juuni 2022

**SEA2LAND** on koostööpõhine innovatsiooniprojekt, mida rahastatakse Euroopa Liidu poolt Horizon 2020 raames. Projekti eesmärk on pakkuda lahendusi, mis aitavad ületada toidutootmise, kliimamuutuste ja jäätmete taaskasutamisega seotud väljakutseid. Ringamajanduspõhisest mudelist lähtuvalt edendab SEA2LAND Euroopa Liidu suuremahuliste väetiste tootmist kohalikust toorainest. Seeläbi loodetakse vähendada Euroopa muldades esinevat toitainete tasakaalustamatust. Projekt kestab detsembrini 2024a.

**Veebileht:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



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## Baltic Sea case study: technology for developing organic fertilizers from fish processing and other organic side-streams

### Main results / outcomes

The objective of this task is developing of a prototype technological solution for obtaining organic fertilizers, such as foliar spray, granulated ferment and vermicompost, from fish processing and other side-streams. It will provide fish waste processing solution for dispersed communities, where there is no local fish (and other bio)waste treatment facility and where transportation of the waste would not be cost efficient. The main treatment is bokashi fermentation and further developments include pelletizing, producing vermicompost and separation of liquid. Different pelletizing methods were tested to find an optimal solution that would not damage microbiology but would be strong enough for fish waste processing. As a result, extrusion together with hammer mill was found to be most suitable, also because it allows the input material to consist of up to 50 % of moisture (compared to the 5 % applicable to the matrix method). For drying the pellets, a solar-powered tumbler dryer was developed. It is an off-grid system on a trailer that uses sun power (12 (DC) volts), which capacity ranges up to 2000L per month. Another main aim has been intermediate products development and testing. Bokashi fermentation method was tested on different combinations of side-streams and optimal fertilizer formulations were studied.

### Practical recommendations

It was established that fish waste can be bokashi fermented alone as effectively as together with other types of food waste. That allows fish waste producers to start fermenting on spot, saving them from the cost of freezing or the problem with rotting.



Fig 1: Testing results for granulation methods



Fig 2: Solar-powered tumbler dryer development

### Further information

<https://fb.watch/d6WJsQy9z8/> ; <https://nutriloop.org/>

### About this abstract

**Authors:** Nutriloop OÜ

**Date:** June 2022

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## Läänemere piloot: prototüüp kalatööstuse jäätmete väärindamiseks ja orgaaniliste väetiste tootmiseks

### Tegevused ja tulemused

Läänemere piloodi eesmärk on arendada välja prototüüp tehnoloogiline lahendus kalatööstuse kõrvalsaaduste jt. biojätmete väärindamiseks orgaaniliste väetiste tootmise eesmärgil. See võiks täita kohalike kogukondade vajadust käidelda orgaanilisi-, sh kalajäätmeid, eelkõige piirkondades, kus puudub tsentraalne biojätmete käitlusvõimekus, kuid kus äravedu ei ole kasumlik ega keskkonnasäästlik. Piloodi käigus arendati välja järgmised orgaanilised väetised: graanul, vedelväetis ja vermikompost. Tootmise alustehnoloogia on kasulike bakteritega fermenteerimine, millest arendatakse edasi ülejäänud tooted. Tootearenduses uuriti erinevaid granuleerimise meetodeid, et leida võimalus, mis ei hävitaks mikrobioloogiat, kuid oleks piisavalt tugev kalajätmete käitluseks. Ekstruuder koos lisapurustajaga osutus optimaalseimaks variandiks, mh kuna see võimaldab 50 % niiskussisaldusega sisendmaterjali kasutamist. Graanulite kuivatamise eesmärgil arendati välja innovatiivne päikeseenergiaal põhinev trummel-kuivati, mis suudab kuivatada kuni 2000L kuus. Tootearenduse osas testiti erinevaid fermenteerimise variante ning sisendmaterjali kombinatsioone, et jõuda orgaaniliseks väetiseks kõige paremini sobivate retseptideni.

### Praktilised soovitusused

Testimise käigus selgus, et fermenteerimisprotsess toimus ainult kalajäätmeid sisaldava partii puhul sama efektiivselt kui kalajätmete ja teiste toidujätmete kombineerimisel. See võimaldab kalajätmete tekitajatel juba kohapeal fermenteerimisprotsessiga alustada ning seeläbi vältida jäätmete külmutamise vajadust või roiskumise ohtu.



Fig 1: Granuleerimise testide tulemused



Fig 2: Päikeseenergiaal põhineva trummel-kuivati arendus

### Lisainfo

<https://fb.watch/d6WJsQy9z8/> ; <https://nutrilooop.org/>

### Uudiskirja kohta

**Autor:** Nutrilooop OÜ

**Kuupäev:** Juuni 2022

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## Side-stream of Adriatic Sea Pilot

### Main results / outcomes

Adriatic Sea Pilot aims to create a biorefinery scheme using the leftovers from seafood (mollusc and fish) processing industries placed in Ancona (Italy) that are mainly composed of one hard fraction (shell) rich in calcium carbonate and a soft fraction (meat) rich in protein.

### Practical recommendations

CO.PE.MO produces  $1.4 \pm 0.2$  t·d<sup>-1</sup> of mollusc wastes from the processing of mussels, clams, and murex, while around 80 tons of fish wastes are disposed (viscera, bones, heads, etc) every year from a small fishery industry selling anchovies, monkfish, hake, salmon, gilthead, cuttlefish, etc. Mollusc wastes result in two different fractions that must be separated to optimize the recovery of added-value compounds: 67-85% of the total waste consists of shells and only the 15-33% corresponds to the residual meat. Shells have a low moisture content (<8%) and involve mainly calcium carbonate (more than 80% d.b.). Consequently, shells could be used as an alternative liming agent with a very low environmental footprint. This product is certainly of interest considering that the European median pH is 5.8 for Ap soil. On the other hand, the residual meat has only 19-28 % of dry matter and its organic fraction accounts for 74-89%. Concerning fish waste, their characteristics are similar to those of the organic fraction of molluscs, showing comparable amounts of dry matter and crude proteins (50.1% d.b.). These proteins can be recovered as protein hydrolysates, while the rest of the organic matter can be used to produce a compost-biochar composite. It must be noted that the metal contents were under regulation limits. Hence, BBF products obtained from these seafood leftovers are expected to accomplish legal regulations in Italy and Europe.



Fig 1: mollusc by-products



Fig 2: fish by-products

### Further information

<https://www.copemo.it/en/>

<https://www.itticadelconero.it/?lang=en>

### About this abstract

**Authors:** Università Politecnica delle Marche

**Date:** June 2022

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement ID 101000496

## Scarti del Pilota del Mare Adriatico

### Principali evidenze

Il pilota del Mare Adriatico ha come obiettivo la creazione di una bioraffineria che utilizzi gli scarti dell'industria ittica (molluschi e pesce) di Ancona (Italia). Gli scarti sono principalmente costituiti dai gusci ricchi di carbonato di calcio e una frazione umida (carne) ricca di proteine.

### Raccomandazioni pratiche

CO.PE.MO produce  $1.4 \pm 0.2$  tonnellate al giorno di rifiuti dalle lavorazioni di cozze, vongole e raguse, mentre 80 tonnellate di scarti di pesce (viscere, lische, teste, ecc) sono prodotti annualmente da una piccola pescheria che vende principalmente pesce azzurro, rana pescatrice, naselli, seppie, ecc. Lo scarto dei molluschi consiste in due frazioni che devono essere separate per ottimizzare il recupero di prodotti ad alto valore aggiunto: 67-85% del totale dello scarto sono gusci e solo il 15-33% è carne. I gusci hanno un basso contenuto d'acqua (<8%) e sono principalmente costituiti da carbonato di calcio (più del 80% sul secco). Perciò, i gusci potranno essere usati come alternativa a basso impatto ambientale dei correttivi per suoli acidi e risulteranno di interesse visto che mediamente in Europa il pH dei suoli agricoli è pari a 5.8. D'altra parte, la carne ha solo il 19-28 % di sostanza secca, di cui il 74-89% è sostanza organica. Le caratteristiche dello scarto di pesce, invece, sono simili a quelle della frazione organica dello scarto dei molluschi mostrando contenuti comparabili di sostanza secca e di proteine grezze (50.1% s.s.). Quest'ultime possono essere recuperate come idrolizzati proteici, mentre il resto della frazione organica può essere impiegata per produrre una miscela ammendante di compost e biochar. In fine è da notare che le concentrazioni di metalli pesanti riscontrate sono al di sotto dei limiti legislativi ed è quindi auspicabile che anche i BBFs ottenuti da tali scarti rispettino i Regolamenti Italiani e Europei.



Fig 1: scarto dei molluschi



Fig 2: scarto di pesce

### Ulteriori informazioni

<https://www.copemo.it> <https://www.itticadelconero.it>

### Informazioni relative

**Autori:** Università Politecnica delle Marche

**Data:** Giugno 2022

Il progetto **SEA2LAND** è un' Azione di Innovazione (AI) finanziata dalla UE all'interno del programma Horizon 2020. Il Progetto mira a trovare soluzioni che aiutino a superare le sfide legate alla produzione di cibo, al cambiamento climatico e al riuso dei rifiuti. Basandosi sui modelli dell'economia circolare, SEA2LAND promuove la produzione a larga scala di fertilizzanti, in UE, partendo dalle proprie risorse. Si prevede che questa soluzione possa ridurre le carenze di nutrienti nei suoli europei. Il progetto è attivo da Gennaio 2021 a Dicembre 2024.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement ID 101000496

## Biorefinery scheme of Adriatic Sea Pilot

### Main results / outcomes

The biorefinery of Adriatic Sea Pilot aims to valorise the different fractions from seafood processing industries placed in Ancona. To this, wet separation, enzymatic hydrolysis, chemical extraction, composting and pyrolysis are developed (Fig 1).

### Practical recommendations

Mollusc waste management requires a first separation step to split shell and organic fraction (e.g. adding water and then using a shredding pump before separating them by gravity). Once dried and milled, shells could be used as a soil liming agent. Due to high protein content in the organic fraction of mollusc and fish waste, instead, protein hydrolysates (FPH) are obtained through enzymatic hydrolysis carried out in a 100-L pilot reactor, followed by centrifugation to separate the raw FPH from the solid residue (bones, not hydrolysed substrate, etc) and by evaporation to concentrate the liquid stream. FPH could be used as a biostimulant for the agriculture sector or as high-quality N-fertiliser in combination with chitin that is previously extracted from crustacean shell. On the other hand, the solid residue could be further valorised by composting and/or pyrolysis. Biochar addition to the composting substrate would enhance the composting performance by accelerating organic waste decomposition, reducing air pollution and GHG emission, and would create a value-added product (biochar-compost blend). Active composting is performed in an adiabatic cylindrical reactor (operating volume of 100 L) with forced aeration. Maturation phase follows in a static reactor with manual turning and final sieving is performed to recycle bulking agent and obtain final mature biochar-compost composite..

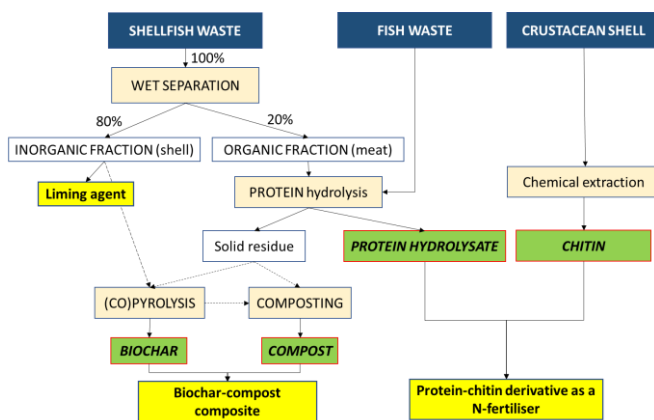


Fig 1: Biorefinery scheme

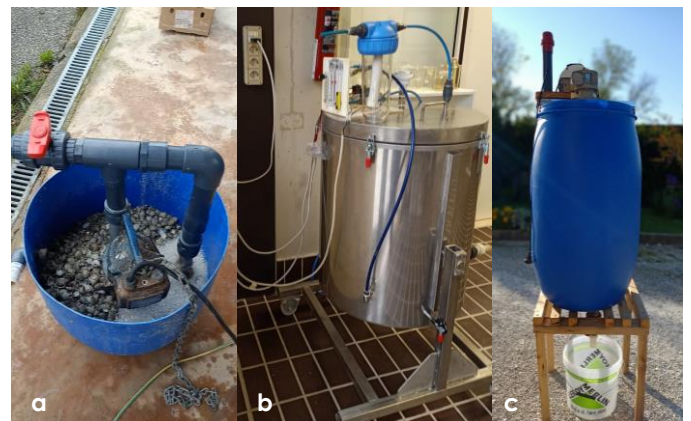


Fig 2: Shredding (a), composting (b) and hydrolysis (c) reactor

### Further information

<https://wweelab.simau.univpm.it/>

### About this abstract

**Authors:** Università Politecnica delle Marche

**Date:** June 2022

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## Bioraffineria del Pilota del Mare Adriatico

### Principali evidenze

La bioraffineria del Mare Adriatico vuole valorizzare gli scarti delle industrie ittiche di Ancona. Separazione per via umida, idrolisi enzimatica, estrazione chimica, compostaggio e pirolisi sono quindi sviluppate (Fig 1).

### Raccomandazioni pratiche

La gestione degli scarti dei molluschi richiede un primo step per separare i gusci dalla frazione Organica (es: aggiungendo acqua e impiegando una pompa tritratrice prima di separarli per gravità) I gusci essiccati e macinati trovano impiego come correttivi di pH per suoli. Visto invece l'alto contenuto di proteine nella frazione organica dei molluschi e del pesce, si ottengono gli idrolizzati proteici (FPH) da un'idrolisi enzimatica in un reattore da 100 litri seguita poi da centrifugazione per separare gli idrolizzati dal residuo solido (ossa, frazione non idrolizzata, ecc) e da evaporazione per concentrare il flusso liquido. I FPH trovano impiego come biostimolanti nel settore agricolo o come fertilizzanti di alta qualità aggiungendo la chitina, precedentemente estratta dai gusci dei crostacei. Il residuo solido è invece valorizzato con compostaggio e/o pirolisi. L'aggiunta di biochar migliora il processo accelerando la decomposizione dello scarto organico, riducendo l'inquinamento dell'aria e le emissioni di gas serra, e genera un prodotto di maggior qualità. La fase attiva del compostaggio è condotta in un reattore cilindrico adiabatico (100 L) con aerazione forzata. La maturazione avviene in un reattore statico con rivoltamenti manuali, mentre una setacciatura finale permette il riutilizzo dell'agente strutturante e ottenere una miscela matura di compost-biochar.

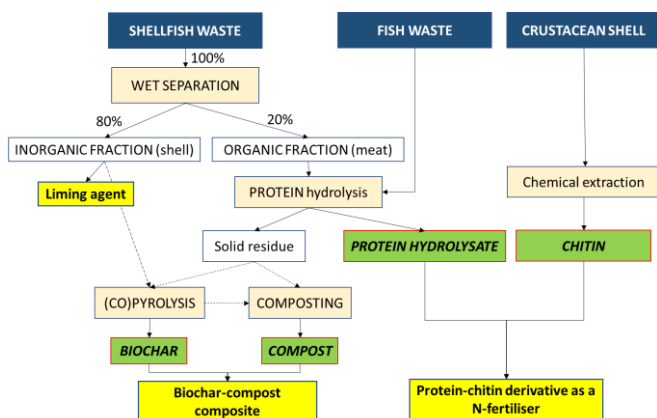


Fig 1: Schema della bioraffineria



Fig 2: Triturazione (a), compostaggio (b) e idrolisi (c)

### Ulteriori informazioni

<https://wweelab.simau.univpm.it/>

### Informazioni relative

**Autori:** Università Politecnica delle Marche

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## Fish processing side-streams characterisation

### Main results / outcomes

Side-streams of fish and shellfish processing generated in three EU Regions designed for pilot case studies were characterised. All side-streams were analysed for proximal composition. Other analytical parameters were selected following what the European and National regulations on fertilisers establishes for the target end products. Shellfish by-products from the Adriatic and side-streams from the Baltic case studies were analysed for dry matter, ash, protein, P, Mg, Na, Ca, K, chlorides (Cl<sup>-</sup>) and sulphates, and microbial pathogens (Salmonella and E. coli). Liquid side-streams were analysed for total and free amino acid content and salt concentration, while by-products with a high fat content were analysed also for fatty acid composition and parameters of fat oxidation (TBA, peroxide value and free fatty acids). All side-streams were analysed for heavy metals (Hg, Pb, As, Cd, Ni, Cu, Cr and Zn, which were found under the established legal threshold levels.

A seasonal variation in the proximal composition of fish processing by-products and a high variability in the protein concentration in the side-streams of the processing companies in the Cantabrian Region were found, which makes expect differences in the process yield in the different fractions.

The mixed side-stream from the shellfish species studied in the Adriatic area is quite homogeneous, which ensures the replicability and stability of the proposed valorisation chain. The measured protein content of the organic fraction confirms the possibility to recover protein hydrolysates from this stream.

### Practical recommendations

The observed compositional variability shall be considered when estimating the expected yields in the scaling up of the processes for obtaining biobased fertilisers from the organic fractions.



### About this abstract

**Authors:** Carlos Bald/AZTI; Corinne Andreola /UNIVPM; Marie Soone /NUTRILoop

**Date:** June 2022

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## Caracterización de subproductos del procesamiento de productos pesqueros y de acuicultura

### Principales avances y resultados

Se analizó la composición proximal de las corrientes secundarias del procesamiento de pescado y marisco generadas en tres regiones de la UE objeto de los casos piloto. Otros parámetros analíticos se seleccionaron siguiendo lo que establece la normativa europea y nacional sobre fertilizantes para los productos finales objetivo. Los subproductos de marisco del Adriático y las corrientes secundarias del caso de estudio de la región del báltico se analizaron para materia seca, cenizas, proteínas, P, Mg, Na, Ca, K, cloruros (Cl<sup>-</sup>) y sulfatos, y patógenos microbianos (*Salmonella* y *E. coli*). Los efluentes se analizaron para determinar el contenido total y de aminoácidos libres y la concentración de sal, mientras que los subproductos con un alto contenido de grasa también se analizaron para determinar la composición de ácidos grasos y los parámetros de oxidación de grasas (TBA, índice de peróxidos y ácidos grasos libres). Se analizaron todas las corrientes laterales en busca de metales pesados (Hg, Pb, As, Cd, Ni, Cu, Cr y Zn, que se encontraron por debajo de los máximos legales establecidos.

Se encontró una variación estacional en la composición proximal de los subproductos de procesamiento de pescado y una alta variabilidad en la concentración de proteínas en los efluentes de las empresas procesadoras de la Región Cantábrica, lo que hace esperar diferencias en el rendimiento del proceso en las diferentes fracciones.

La mezcla de especies de moluscos estudiadas en la zona del Adriático es bastante homogénea, lo que garantiza la replicabilidad de la cadena de valorización propuesta. El contenido de proteína medido de la fracción orgánica confirma la posibilidad de recuperar hidrolizados de proteínas de esta corriente.

### Recomendaciones prácticas

La variabilidad composicional observada se tendrá en cuenta a la hora de estimar los rendimientos esperados en el escalado de los procesos de obtención de fertilizantes de base biológica a partir de las fracciones orgánicas.



### Acerca de este resumen

**Autores:** Carlos Bald/AZTi; Corinne Andreola /UNIVPM; Marie Soone /NUTRILoop

**Fecha:** Junio 2022

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## Prototypes of intermediate products from seafood processing side-streams

### Main results/outcomes

Different Intermediate Products (IP) have been obtained from by-products of the fish processing industry as ingredients for the formulation of Biobased Fertilisers (BBF).

A product containing more than 50 g free amino acids (FAA) per 100 g dry matter, with an 80% of the solubilized protein as FAA was obtained from fish processing side-streams by enzymatic hydrolysis to be used to formulate foliar fertilisers and bio stimulants. Membrane filtration was used in the concentration process with liquid side-streams from the fish processing (Fig. 1).

Microalgae biomass with a 45% protein content was produced with selected strains replacing part of the culture medium with effluents of the fish processing companies (Fig. 2).

Bokashi fermentation trials showed that fish waste can be combined with HORECA waste and tree leaves allowing to obtain a liquid fraction to be used as foliar fertiliser. Solid left over was used to produce granulated soil improver. The resulting microbial and nutrient qualities of the IP do vary a lot and consistency of the incoming side-stream will be a challenge.

Through enzymatic hydrolysis, more than 85% of protein from the organic fraction of mollusc was also recovered as hydrolysate (15% of dry matter) for bio-stimulant application or as organic N-fertiliser after concentration and enrichment with chitin extracted from crustacean shell. Biochar from the slow-pyrolysis of hydrolysis leftovers will be used as an additive in the seafood composting producing a biochar-compost composite. Mollusc shells were separated from the organic fraction recovering a soil liming agent, with more than 80% of CaCO<sub>3</sub> content.

### Practical recommendations

To comply with EU fertilisers Regulation 2019/1009, all the side streams shall comply with the end-of-waste condition (Regulation 2008/98/CE) and shall constitute part of a fertiliser product compliant with the above mentioned regulation.

The composition of the intermediate products shall be evaluated attending to the specific requirements of the Product Function Category of the final BBF in which they will be formulated.



Fig 1: Enzymatic hydrolysis to produce foliar fertilisers



Fig 2: Production of microalgae biomass

### About this abstract

**Authors:** Carlos Bald/AZTI; Corinne Andreola (UNIVPM); Marie Soone (NUTRILoop); Miriam Pinto (NEIKER)

**Date:** June 2022

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# Prototipos de productos intermedios a partir de subproductos del procesado de pescado.

## Principales avances/ resultados

Varios productos intermedios (PI) obtenidos a partir de subproductos de la industria de procesamiento de pescado se usarán como ingredientes para la formulación de fertilizantes de base biológica (BBF).

Un producto que contiene más de 50 g de aminoácidos libres (FAA) por cada 100 g de materia seca, con un 80% de la proteína solubilizada como FAA obtenido por hidrólisis enzimática para ser utilizado en formulación de fertilizantes foliares y bioestimulantes.

Una biomasa de microalgas con un contenido proteico del 45% con cepas seleccionadas sustituyendo parte del medio de cultivo por efluentes de las empresas procesadoras de pescado (Fig. 2).

La fermentación de Bokashi conjunta de desechos de pescado con desechos de HORECA y hojas de árboles, permitió obtener una fracción líquida para ser utilizada como fertilizante foliar. El sólido sobrante se utilizó para producir un mejorador de suelo granulado.

A través de la hidrólisis enzimática, más del 85% de la proteína de la fracción orgánica de moluscos se recuperó como hidrolizado (15% de la materia seca) para aplicación en bioestimulantes o como fertilizante N orgánico enriquecido con quitina extraída de caparzones de crustáceos. El biocarbón de la pirólisis del residuo de la hidrólisis se utilizará como aditivo en compostaje. Las conchas de moluscos separadas de la fracción orgánica, con más del 80% del contenido de  $\text{CaCO}_3$  se usarán como corrector de la acidez del suelo.

## Recomendaciones prácticas

Para cumplir con el Reglamento UE sobre abonos 2019/1009, todos los subproductos deben cumplir la condición de fin de residuo (Reglamento 2008/98/CE) para formar parte de un producto fertilizante conforme con el Reglamento antes mencionado.

La composición de los productos intermedios se evaluará teniendo en cuenta los requisitos específicos de la categoría de función del producto del BBF final en el que se formularán.



**Fig 1:** Hidrólisis enzimática para producir fertilizantes foliares



**Fig 2:** Producción de biomasa de microalgas

## Acerca de este resumen

**Authors:** Carlos Bald/AZTI; Corinne Andreola (UNIVPM); Marie Soone (NUTRILoop); Miriam Pinto (NEIKER)

**Fecha:** Junio 2022

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## Prototypes of Biobased Fertilisers (BBF) from seafood processing side-streams

### Main results/outcomes

Several prototypes of Biobased Fertilisers (BBF) were produced to be analysed and tested in pot trials: Microalgae biomass produced using fish processing side-streams as growth substrate was used in the formulation of a soil nutrient to supply specific amino acids and molecules that enhance nutrients uptake providing a synergistic effect that leads to a more efficient fertilizers use. Resulting from Bokashi fermentation combining fish waste, food waste from HORECA, tree leaves and common reed litter, a liquid fertilizer and fermented solid pellets (Figure 2) were produced. Extrusion method showed the best results. From enzymatic hydrolysis of organic fraction of mollusc waste, bio stimulant products were formulated.

An organic N-fertiliser was obtained by enriching hydrolysates with chitin extracted by crustacean shell. Such blending should provide potential extra-advantages, such as improvements in disease control and plant growth, that will be assessed by pot tests. By co-composting hydrolysis leftovers and biochar, it was obtained a promising soil amendment material (biochar-compost composite), which not only can overcome the low nutrient content of biochar, but also regulate nutrient release from the compost and reduce leaching of nutrients and contaminants. Additionally, mollusc shells were mechanically treated to be used as soil liming agent for acidic soil.

### Practical recommendations

The use of tree leaves and wood ash in Bokashi fermentation of fish waste improves the performance and stability of the resulting granules.

Co-composting of biochar and left-over material from hydrolysis of organic fraction of fish waste improves the performance of the soil amendment.

BBF's must comply with Regulation (EU) 2019/1009. In addition, extended studies must be developed to establish best agricultural practices for each BBF developed.



Fig 1: Composting unit (UNIVPM)



Fig 2: Bokashi fermented fish waste granules (NUTRILoop).

### About this abstract

**Authors:** Carlos Bald/AZTI; Corinne Andreola /UNIVPM; Marie Soone /NUTRILoop; Miriam Pinto /NEIKER.

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# Prototipos de fertilizantes de base biológica a partir de subproductos de procesamiento de pescado

## Principales avances/resultados

Se produjeron varios prototipos de fertilizantes de base biológica (BBF) para ser analizados y probados en ensayos en macetas: La biomasa de microalgas producida utilizando efluentes del procesado de pescado como sustrato de crecimiento se utilizó en la formulación de un abono orgánico para suministrar aminoácidos específicos y moléculas que mejoran la absorción de nutrientes proporcionando un efecto sinérgico que conduce a un uso más eficiente de fertilizantes. Como resultado de la fermentación Bokashi que combina desechos de pescado, desechos de alimentos de HORECA, hojas de árboles y restos de caña, se produjo un fertilizante líquido y gránulos sólidos (Figura 2). El método de extrusión mostró los mejores resultados. A partir de la hidrólisis enzimática de la fracción orgánica de los residuos de moluscos, se formularon productos bioestimulantes.

Se obtuvo fertilizante nitrogenado enriqueciendo hidrolizados con quitina extraída de caparzones de crustáceos. Dicha mezcla puede proporcionar ventajas adicionales, como mejoras en el control de enfermedades y el crecimiento de las plantas, que se evaluarán mediante pruebas en macetas. Mediante el co-compostaje de residuos de hidrólisis y biocarbón, se obtuvo un prometedor material compuesto como enmienda del suelo, que no solo aumenta contenido de nutrientes del biocarbón sino que también regula la liberación de nutrientes del compost y reduce la lixiviación de nutrientes y contaminantes. Las conchas de moluscos fueron tratadas mecánicamente para ser utilizadas como agente corrector de suelos ácidos.

## Recomendaciones prácticas

El uso de hojas de árbol y cenizas de madera en la fermentación Bokashi de los desechos de pescado mejora el rendimiento y la estabilidad de los gránulos resultantes.

El co-compostaje de residuos de pescado y biocarbón mejora el rendimiento de la enmienda del suelo. Los productos finales deberán cumplir con el reglamento (EU) 2019/1009. Se realizarán estudios para determinar las mejores prácticas agrícolas para su utilización.



**Fig 1:** Unidad experimental de compostaje (UNIVPM)



**Fig 2:** gránulos de residuo de fermento Bokashi (NUTRILOOP)

## Acerca de este resumen

**Autores:** Carlos Bald/AZTI; Corinne Andreola /UNIVPM; Marie Soone /NUTRILOOP; Miriam Pinto /NEIKER.

**Fecha:** Junio 2022

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# Bioremediation of saline wastewaters from the fish canning industry using salt-tolerant microorganisms

## Main results / outcomes

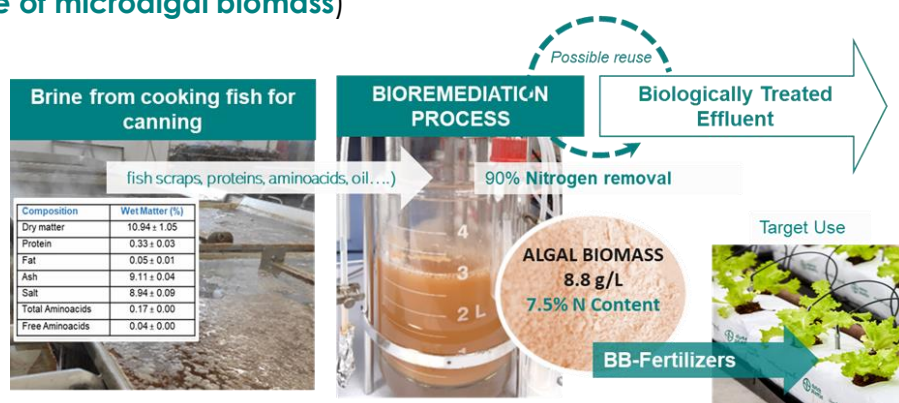
The saline wastewater (brine) generated by the tuna canning industry was used as a culture medium to grow non-photosynthetic marine microalgae. The bioprocess yielded 8.5 g/L of a nitrogen-enriched biomass (7.5% total N) in only three days. Microorganisms was able to remove more than 90% of organic nitrogen (amino acids and proteins) present in the brine.

## Practical recommendations

The brine generated in the fish processing industry contains high concentrations of organic matter. To meet environmental legislation, brines require to be treated prior to disposal. High salinity and suspended solids are the major challenge for their management. Biological treatment of these brines using salt-tolerant microalgae is considered a sustainable and cost-effective option compared to other currently available technologies. The major advantages of this approach are:

- Effective removal of organic matter and improved quality of effluent (**Bioremediation**)
- Nutrient capture and recycling in algal biomass with commercial interest (**Circular Bioeconomy**). The microorganism used is naturally present in coastal ecosystems and has a well-recognized market value as DHA source with a wide range of emerging applications.
- Enhanced productivity of algal culture (in terms of protein production) and cost-reduction of the culture process: saving water and nutrients (**Advantage for the algal industry**)
- Potential value of algal biomass as novel bio-based fertilizer which would drive nutrients to crop production (**Emergent use of microalgal biomass**)

**Fig 1:** Diagram that show the biological treatment of brines from fish canning industry using microalgae with potential value for agriculture use.



## Further information

<https://www.frontiersin.org/articles/10.3389/fenvs.2021.689580/full>

<https://www.sciencedirect.com/science/article/abs/pii/S0167779921002067>

<https://water2return.eu/commercial-outcomes/>

## About this abstract

**Authors:** Mirian Pinto Tobalina, Iratxe Urreta, Sonia Suarez, Susana Virgel, Itziar Orozco- Neiker

**Date:** June 2022

**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](http://www.sea2landproject.eu)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement ID 101000496

## Biorremediación de efluentes salinos generados por la industria conservera de pescado empleando microorganismos marinos

### Resultados

La salmuera residual generada por una conservera de atún se empleó como medio de cultivo para producir microalgas marinas no fotosintéticas. Con una duración de tres días, el bioproceso permitió obtener 8.5 g/L de biomasa algal con alto contenido en nitrógeno (7.5%). Se logró además eliminar más del 90% de N orgánico (aminoácidos y proteínas) presente en la salmuera.

### Recomendaciones prácticas

Las salmueras que genera la industria conservera durante la cocción de pescado contienen altas concentraciones de materia orgánica. Para cumplir con la legislación ambiental actual, deben ser tratadas antes de su vertido. Su elevado contenido salino y presencia de sólidos en suspensión dificultan el uso de las tecnologías de tratamiento actualmente disponibles. Como alternativa, la biorremediación con microalgas halo-tolerantes se muestra como una opción sostenible que ofrece los siguientes beneficios:

- Reducción de la carga orgánica y mejora de la calidad del efluente (**Bioremediación**)
- Reciclaje de nutrientes en biomasa algal con valor comercial (**Bioeconomía Circular**). Se ha usado una especie natural de ecosistemas costeros que cuenta con mercado como fuente vegana de Omega 3, además de diversas aplicaciones emergentes.
- Incremento de productividad del cultivo de algas y reducción de costes del proceso: ahorro en agua y nutrientes (**Ventaja para la industria de algas**)
- Valor potencial de la biomasa de algas como nuevo Fertilizante de Base Biológica: permitiría canalizar los nutrientes desde industria pesquera hacia agricultura (**Uso emergente de biomasa de microalgas**)

**Fig 1:** Diagrama que muestra el tratamiento biológico de las salmueras de la industria conservera de pescado utilizando microalgas con valor potencial para uso agrícola.



### Más información

<https://www.frontiersin.org/articles/10.3389/fenvs.2021.689580/full>  
<https://www.sciencedirect.com/science/article/abs/pii/S0167779921002067>  
<https://water2return.eu/commercial-outcomes/>

### Acerca de este resumen

**Autores:** Miriam Pinto Tobalina, Iratxe Urreta, Sonia Suarez/ NEIKER

**Fecha:** Junio 2022

El proyecto **SEA2LAND** es una acción colaborativa de innovación financiada por la UE en el marco del programa Horizonte 2020. El proyecto tiene como objetivo proporcionar soluciones para ayudar a superar los desafíos relacionados con la producción de alimentos, el cambio climático y la reutilización de residuos. Basado en el modelo de economía circular, SEA2LAND promueve la producción de fertilizantes a gran escala en la UE a partir de materias primas propias. Se espera que esta solución reduzca el desequilibrio de nutrientes del suelo en Europa. El proyecto se desarrollará desde enero de 2021 hasta diciembre de 2024.

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## Enzymatic hydrolysis of fish by-products for the production of BBF

### Main results / outcomes

Viscera obtained from fish processing, in this particular case from rainbow trout *Oncorhynchus mykissarco*, will be used to obtain an intermediate product to be integrated in the formulation of bio-based fertilizers (BBF).

Enzymatic hydrolyzation of the viscera has been achieved to obtain a protein concentrate with a high percentage of free amino acids and a minimum amount of fat and sodium.

For this purpose, the enzymatic reaction variables such as: enzyme type, concentration, reaction time, pH and temperature have been optimized.

### Practical recommendations

To obtain a good final product, it is essential to keep the viscera under the cold chain (+4°C) until processing, minimizing as much as possible the time until processing. This will avoid protein and fat degradation and the appearance of undesirable odors associated with the appearance of ammonia compounds or biogenic amines.

A previous degreasing of the raw material will be necessary to improve the enzymatic hydrolysis yield and to guarantee a protein concentrate with the lowest possible fat content. It is preferable to carry out this defatting operation by physical operations.



**Fig 1:** Minced viscera



**Fig 2:** Enzimatic Hydrolysis

### About this abstract

**Authors:** Iñaki Aramburu, BARNA, SA

**Date:** June 2022

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### Principales avances / resultados

Se utilizarán vísceras obtenidas del procesamiento de pescado, en este caso concreto a partir de trucha arco iris *Oncorhynchus mykissarco*, para la obtención de un producto intermedio a integrar en la formulación de fertilizantes de base biológica (BBF).

Se ha conseguido hidrolizar enzimáticamente las vísceras para obtener un concentrado protéico con alto porcentaje de aminoácidos libres y una cantidad mínima de grasa y sodio.

Para ello se han optimizado las variables de la reacción enzimática como son: tipo de enzimas, concentración, tiempo de reacción, pH y temperatura.

### Recomendaciones prácticas

Para conseguir un buen producto final es indispensable mantener las vísceras bajo la cadena de frío (+4°C) hasta su procesado, minimizando en la medida de lo posible el tiempo hasta el procesado. Esto evitará la degradación protéica y la aparición de olores indeseables asociados a la aparición de compuestos amoniacales o aminas biogénicas.

Será necesario realizar un desengrasado previo de la materia prima para mejorar el rendimiento de la hidrólisis enzimática y garantizar un concentrado protéico con el menor contenido en grasa posible. Es preferible realizar esta operación de desengrasado mediante operaciones físicas.



Fig 1: Vísceras trituradas



Fig 2: Reacción de hidrólisis

### Acerca de este resumen

**Autores:** Iñaki Aramburu, BARNA SA

**Fecha:** Junio 2022

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**Website:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



# Understanding the adding value of freshwater aquaculture by-products

## Main results / outcomes

CAVIAR PIRINEA has made available an extended catalogue of sidestreams from their 4 aquaculture plants, however all of them are routinely sent to waste managers and none of them is valorised for economic purposes. The present project has already successfully revealed that within a production scenario of 3.100 T fish/year (i.e., rainbow trout (*O. mykiss*) and sturgeon (*Arcipenser sp.*)) and 1.902 T of processed products, 69 m<sup>3</sup> fish sludge, 96 T fish viscera and 200 T of non-conforming fish /year could respectively be valued through some newly developed technique under SEA2LAND. Likewise, CAVIAR PIRINEA is learning that increased productivity as derived from intensification in aquaculture/fish processing practices also leads to subsequent huge, albeit recoverable, production of multiple industrial organic byproducts.

## Practical recommendations

One of the most important practical recommendation from the company is “to compile every expectations from the research and agriculture partners involved to adopt realistic guides on future profitable valorisation oportunities for industrial implementation”. Likewise, Aquaculture production companies should keep open minded and intensively collaborating on sidestreams supplies (every nature and/or format) with research institutions, to jointly define the most suitable tailored made solution on sludge or fish by-product transformation or nutrients recovering/binding/transportation condition, required for each specific production scenario.



Fig 1: Synthesis of partner's facilities and products.

Fig 2: Fish sludge and viscera by-products from aquaculture and processing activities.

## Further information

CAVIAR PIRINEA <https://caviarpirinea.com/quienes-somos/#lmasD>

## About this abstract

**Authors:** Diego Mendiola PhD. & Beatriz Rodríguez / CAVIAR PIRINEA SLU

**Date:** June 2022

**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.

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# Comprendiendo el valor añadido de los subproductos de la acuicultura de agua dulce

## Principales avances / resultados

CAVIAR PIRINEA ha puesto a disposición un amplio catálogo de sub-productos de sus 4 plantas acuícolas, actualmente todos ellos son gestionados rutinariamente por empresas de residuos y ninguno se valoriza con fines económicos. El proyecto ya ha revelado con éxito que en un escenario productivo de 3.100 T peces/año (trucha arcoíris (*O. mykiss*) y esturión (*Arcipenser sp.*)) y 1.902 T de producto procesado/año (principalmente, pescados, filete, hueva y caviar), más de 69 m<sup>3</sup> de lodo, 96 T de vísceras y 200 T de pescado no conforme/año podrían ser valorados a través de las técnicas en desarrollo de SEA2LAND. Del mismo modo, el socio CAVIAR PIRINEA está adquiriendo conocimientos con los que entender cómo los aumentos de productividad derivado de la intensificación en prácticas de acuicultura y procesamiento, también conduce a producciones de subproducto con gran potencial revalorizable.

## Recomendaciones prácticas

La empresa recomienda ser capaces de "recopilar todas las expectativas posibles de los socios de investigación involucrados y adoptar guías realistas de mejores oportunidades sobre valorización rentable e implementable en la actividad industrial. Asimismo, las empresas de producción acuícola deben mantener una situación de mente abierta y colaboración intensa con los sectores de la revalorización secundaria y la investigación para definir soluciones a medida en lodos y pescados de transformación y/o formulación y recuperación de nutrientes para cada caso de escenario productivo.



Fig 1: Síntesis de las instalaciones y productos de los socios.



Fig 2: Subproductos de lodos y vísceras de pescado procedentes de la acuicultura y las actividades de transformación.

## Más información

CAVIAR PIRINEA <https://caviarpirinea.com/quienes-somos/#lmasD>

## Acerca de este resumen

**Autores:** Diego Mendiola PhD. & Beatriz Rodríguez / CAVIAR PIRINEA SLU

**Fecha:** Junio 2022

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## Moving forward with dried fish sludge

### Main results / outcomes

In Norway the only available and processable sludge from fish farming effluent is in the dried form (90 % dry matter), today available in approx. 1000 tonnes/year. In agreement with the other parties in our group we have decided to make two pelleted products from dried sludge.

**A.** Pure pelleted fish sludge only. **B** A new organic fertiliser formulated with fish sludge as part.

### Practical recommendations

From our tests with the treatment of raw fish sludge we have seen that bokashi treatment has not been successful. In fact natural bacteria develop in sludge (2% dry matter) and brings a natural pH drop. This may be caused by the fact that the sludge is continually produced, and during subsequent storage, bacteria colonise the sludge and lower the pH. These bacteria may originate from the fish farm itself. If bokashi were to be applied in fish farming sludge treatment, one may have to dose it continually as the sludge is produced. This is beyond the scope of our study. Therefore we have moved forward with the ready available source we have got hold of, which is dried sludge, and made two alternative fertilisers. We have produced 200 kilos of each and sent samples as requested. The rest is stored for the coming growing field tests.



**A.** Pelleted fish sludge from dried sludge



**B.** Pelleted new organic fertiliser with fish sludge

### Further information

We have composed a fully organic fertiliser B, with our best knowledge of plant nutrition.

Expected content of **B** is 10 % N, 2.2 % P, 5.6 % K, 4.0 % S, 5.5 % Ca and 0.4 % Mg

Expected content of **A** is 6 % N, 3.5 % P, 5.0 % Ca, 0.1 % Mg and 0.5 % S

### About this abstract

**Authors:** Grønn Gjødsel Lars Evju and Tommy C. Olsen

**Date:** June 2022

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## Går videre med fiskeslam

### Resultater

I Norge er det eneste tilgjengelige og bearbeidbare slam fra oppdrettsavløp på tørket form (90 % tørrstoff), i dag tilgjengelig i ca. 1000 tonn/år. I samråd med de andre deltakerne i vår gruppe har vi laget to pelleterte produkter av dette tørkede slammet. **A.** Kun rent pelletert fiskeslam. **B.** En ny organisk gjødsel fullt formulert med fiskeslam som en av råvarene.

### Anbefalinger

Fra våre tester med behandling av rått fiskeslam har vi sett at bokashibehandling ikke har vært vellykket. Faktisk tar naturlige bakterier kontrollen i slam (2 % tørrstoff) og gir en naturlig lav pH. Dette kan være forårsaket av at slammet produseres kontinuerlig, og under påfølgende lagring koloniserer bakteriene slammet og senker pH. Disse spesifikke bakteriene kan stamme fra selve oppdrettsanlegget. Dersom bokashi skulle vært brukt i oppdrettslam-behandling, kan man bli nødt til å dosere det kontinuerlig, etter hvert som slammet produseres. Dette er utenfor rammen av vår studie. Derfor har vi gått videre med den eneste ferdige tilgjengelige kilden vi har fått tak i, som er tørket slam, og laget to alternative gjødselprodukter. Vi har produsert 200 kilo av hver og sendt prøver etter forespørsel. Resten er til vekstprøvene.



A. Pelletert fiskeslam fra tørket slam



B. Pelletert organisk gjødsel med fiskeslam som ingrediens

### Ytterligere informasjon

Vi har komponert en 100 % organisk gjødsel B, med vår beste kunnskap om plantencæring. Forventet innhold i B er 10 % N, 2.2 % P, 5.6 % K, 4.0 % S, 5.5 % Ca og 0.4 % Mg  
Forventet innhold i A, pelletert fiskeslam er 6 % N, 3.5 % P, 5.0 % Ca, 0.1 % Mg, og 0.5 % S

### Om dette sammendraget

**Skrevet av:** Grønn Gjødsel Lars Evju og Tommy C. Olsen

**Dato:** Juni 2022

**SEA2LAND** prosjektet er en samarbeidende Innovation Action (IA) finansiert av EU innenfor rammen av Horisont 2020-programmet. Prosjektet har som mål å gi løsninger for å bidra til å overkomme utfordringer knyttet til matproduksjon, klimaendringer og gjenbruk av avfall. Basert på den sirkulære økonomimodellen fremmer SEA2LAND produksjon av storskala gjødsel i EU fra egne råvarer. Denne løsningen forventes å redusere ubalansen i jordens næringsstoffer i Europa. Prosjektet pågår fra januar 2021 til desember 2024.

**Nettadresse:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



## Chemical characterization of fish farming by-products: the case of Steelhead trout's by-products for the Atlantic pilot unit

### Main results / outcomes

According to France Agrimer, in 2018, the volumes of by-products generated in France on the fisheries and fish farming sectors were 152,561 tons/year, including 15,000 tons in the Atlantic region. Among the species, salmonids (excluding salmon) were produced to the tune of 34,564 tons at the national level, 96% of which were rainbow trout. Their processing generates 15,392 tons of by-products, representing about 50%/production whose main ways of valorization are currently those of animal feed and petfood. This species was chosen as a study model to propose, thanks to the Sea2Land project, a joint valorization of proteins in the form of bio-based fertilizers (BBF) and lipids for higher value-added applications. This double valorization is made possible through the use of a thermomechanicochemical transformation process (TMC) by twin-screw extrusion. It would be extendable to any species of fish, produced on the Atlantic coast.

### Practical recommendations

According to the France Agrimer 2018 report, the estimated ratio on the main salmonid by-products (excluding salmon) is 53/32/15 viscera/bones+flesh/heads. In this case of study, the ratio of by-products from the Ispéguy fish farm is 38/28/34. The determination of the chemical composition of the 3 types of by-products (n=3) validates the development of a joint protein/lipid valorization process.



Fig 1: Fish Farming by-products (Steelhead trout)

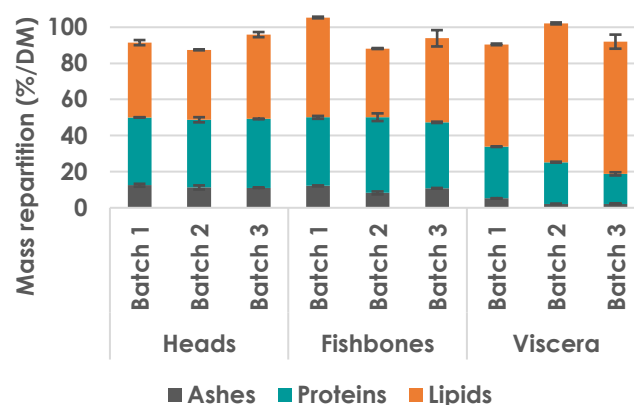


Fig 2: Chemical composition of Steelhead trout's by-products

### Supplementary information

Evaluation des ressources en biomasse aquatique disponibles en France – co-produits et sous-produits – Volumes 1&2 – 2021- France Agrimer.

Ahuja, I. *et al*, Fish and fish waste-based fertilizers in organing farming – With status in Norway: A review. *Waste Management* 115 (2020) 95-112.

### About this abstract

**Authors:** Candy Laure & Raynaud Christine / CATAR

**Date:** June 2022

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## Caractérisation chimique de co-produits de pisciculture: cas de la truite arc-en-ciel pour l'unité pilote Atlantique

### Résultats principaux

Selon France Agrimer, en 2018, les volumes de co-produits générés en France sur les filières pêche et pisciculture étaient de 152 561 tonnes/an, dont 15 000 tonnes pour la région Atlantique. Parmi les espèces, les salmonidés (hors-saumons) étaient produits à hauteur de 34 564 tonnes au niveau national, dont 96% de truite arc-en-ciel. Leur transformation génère 15 392 tonnes de co-produits, soit environ 50%/production dont les voies principales de valorisation sont actuellement celles de l'alimentation animale et du petfood. Cette espèce a été choisie comme modèle d'étude pour proposer, grâce au projet Sea2Land, une valorisation conjointe des protéines sous forme d'engrais biosourcé (BBF) et des lipides pour des applications à plus haute valeur ajoutée. Cette double valorisation est rendue possible via l'utilisation d'un procédé de transformation thermomécano-chimique (TMC) par extrusion bi-vis. Elle serait extrapolable à toute espèce de poisson, produite sur la façade Atlantique.

### Recommandations pratiques

Selon le rapport France Agrimer 2018, le ratio estimé sur les principaux co-produits de salmonidés (hors-saumons) est de 53/32/15 viscères/arêtes+chair/têtes. Dans ce cas d'étude, la répartition des co-produits de la pisciculture Ispéguy est de 38/28/34. La composition chimique des 3 types de co-produits (n=3) valide le développement d'un procédé de valorisation conjointe protéines/lipides.



Fig 1: Co-produits de pisciculture (truites arc-en-ciel)

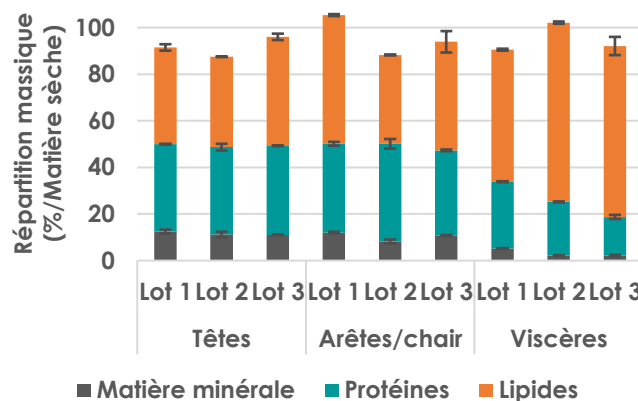


Fig 2: Composition chimique des co-produits de truite arc-en-ciel

### Informations complémentaires

Evaluation des ressources en biomasse aquatique disponibles en France – co-produits et sous-produits – Volumes 1&2 – 2021- France Agrimer.

Ahuja, I. *et al*, Fish and fish waste-based fertilizers in organing farming – With status in Norway: A review. Waste Management 115 (2020) 95-112.

### A propos de ce résumé

**Auteurs:** Candy Laure & Raynaud Christine / CATAR

**Date:** Juin 2022

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](http://www.sea2landproject.eu)



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## Thermomechanochemical fractionation of fish by-products by twin-screw extrusion for the production of biobased fertilizers: the Atlantic pilot case

### Main results / outcomes

Thermomechanochemical (TMC) fractionation by twin-screw extrusion is a versatile and compact process, working at low liquid/solid ratios and able to provide simultaneously solid and liquid fractions. The use of TMC process for fertilizers production from fish by-products is an innovative approach which makes it possible to recover not only fertilizers (proteic fractions) but also highly valuable lipids to reach a Zero-waste process. TMC process has been developed during the Sea2Land project to transform fish byproducts in the presence of enzymes into bio-based fertilizers (BBF).

### Practical recommendations

The process scheme implemented in the Atlantic Area includes the following technological units: (i) Grinding technologies, (ii) Continuous TMC fractionation by twin-screw extrusion / Enzymatic Hydrolysis, (iii) Downstream processing (separation technologies, concentration). All these technologies are combined to recover products with agronomic value and to find a specific valorization for lipids. Trials were achieved using an Evolum HT53 (Clextal) at a feeding rate of 150-200 kg/hr in by-product *i.e.* heads and fishbones from Steelhead trout. Working at 200 kg/h (65 kg/hr DM), the complete process provides 89 kg/hr solid BBF (25 kg/h DM ; 57% Proteins/DM), 129 kg/hr aqueous proteic hydrolysate (16 kg/h DM ; 61% Proteins/DM) and 24 kg/hr lipids.



Fig 1: Evolum HT53 (Clextal) twin screw extruder



Fig 2: Example of extrusion screw profile

### Further information

"Extrusion" in Green Food Processing Techniques: Preservation, Transformation and Extraction, Publisher: Elsevier (2019) DOI: [10.1016/B978-0-12-815353-6.00010-0](https://doi.org/10.1016/B978-0-12-815353-6.00010-0)

"Twin-Screw Extrusion: A Key Technology for the Biorefinery" in Biomass Extrusion and Reaction Technologies: Principles to Practices and Future Potential, ACS Symposium Series (2018) / DOI: [10.1021/bk-2018-1304.ch002](https://doi.org/10.1021/bk-2018-1304.ch002)

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## Fractionnement thermomécanochimique des co-produits de la mer par extrusion bi-vis pour la production d'engrais biosourcé : Cas de l'unité pilote Atlantique

### Résultats principaux

Le fractionnement thermomécanochimique (TMC) par extrusion bi-vis peut être considéré comme un procédé versatile et compact, opérant à de faibles ratios liquide/solide et capable de produire des fractions solides et liquides. L'utilisation du procédé TMC pour la production d'engrais (BBF) à partir de co-produits de la mer représente une approche innovante qui rend possible, non seulement la production de fertilisants (fractions protéiques) mais aussi celle de lipides à haute valeur ajoutée afin d'atteindre un procédé Zéro-déchets. Le procédé TMC a été développé durant le projet Sea2Land pour transformer, les co-produits de la mer, en présence d'enzymes, en engrais biosourcés (BBF's).

### Recommandations pratiques

Le schéma du procédé mis en œuvre en zone Atlantique inclut les unités technologiques suivantes : (i) Broyage, (ii) Fractionnement TMC continu par extrusion bi-vis / Hydrolyse enzymatique, (iii) Post-traitements (technologies séparatives et de concentration). Ces technologies ont été combinées pour la récupération simultanée de fertilisants et de lipides selon les conditions opératoires suivantes : co-produits = têtes et arêtes de truite arc-en-ciel, extrudeur bi-vis Evolum HT53 (Clextal), débit d'entrée en co-produits = 150-200 kg/h. Pour un débit de 200 kg/h (65 kg/h MS), le procédé conduit à 89 kg/h en BBF solide (25 kg/h MS ; 57% Protéines/MS), 129 kg/h en hydrolysate protéique aqueux (16 kg/h MS ; 61% Protéines/MS) et 24 kg/h lipides.



Fig 1: Extrudeur bi-vis Evolum HT53 (Clextal)



Fig 2: Exemple de profil de vis en extrusion

### Informations complémentaires

"Extrusion" in Green Food Processing Techniques: Preservation, Transformation and Extraction, Publisher: Elsevier (2019) DOI: [10.1016/B978-0-12-815353-6.00010-0](https://doi.org/10.1016/B978-0-12-815353-6.00010-0)

"Twin-Screw Extrusion: A Key Technology for the Biorefinery" in Biomass Extrusion and Reaction Technologies: Principles to Practices and Future Potential, ACS Symposium Series (2018) / DOI: [10.1021/bk-2018-1304.ch002](https://doi.org/10.1021/bk-2018-1304.ch002)

### A propos de ce résumé

**Auteurs:** Candy Laure & Raynaud Christine / CATAR

**Date:** Juin 2022

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](http://www.sea2landproject.eu)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement ID 101000496

# Aquaculture industry by-products to be valorized in the Mediterranean area

## Main results / outcomes

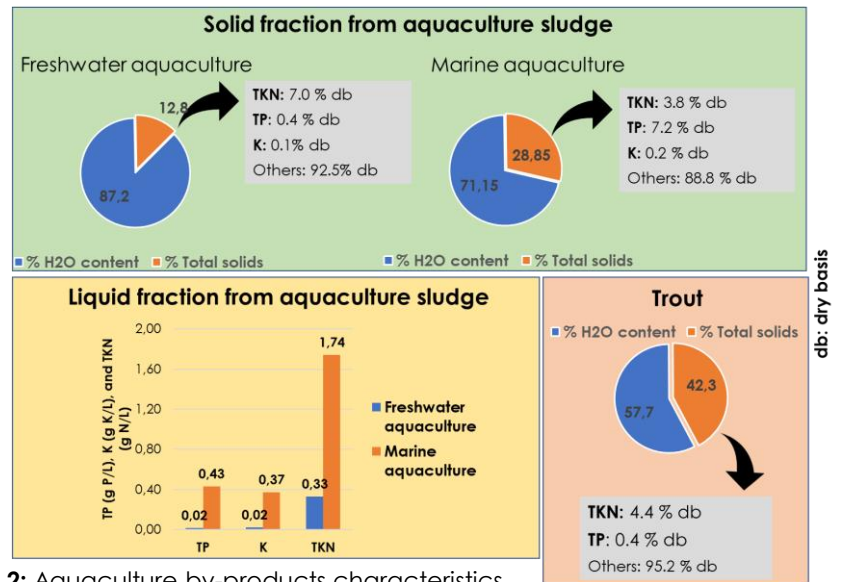
Several by-products such as dead fishes, transformation remains, animals unfit for consumption, and fish sludge are generated by the aquaculture industry. In the framework of the SEA2LAND project, sludge produced from marine and freshwater aquaculture systems is being valorized by a portfolio of technologies to recover nutrients. Moreover, dead fish is being valorized as a co-substrate during the treatment of the solid fraction from freshwater aquaculture sludge. The marine aquaculture sludge is collected from a recirculating system for the production of the Sole specie, whereas sludge produced in the wastewater treatment plant from Trout processing is used in the case of the freshwater system. The solid fraction of freshwater sludge contains around 7.0% TKN, 0.4% TP, and 0.1% K on a dry basis. For marine sludge, TP is the nutrient found in the highest content in the solid fraction (~7.2%), whereas TKN and K account for 3.8% and 0.2% on a dry basis, respectively. Regarding the liquid fraction, marine aquaculture sludge presents higher concentrations of TKN, TP, and K (1.74, 0.43, and 0.37 in g/L, respectively) than freshwater sludge (0.33 g N/L, 0.02 g TP/L, and 0.02 g K/L). The use of trout as a co-substrate is also interesting because this by-product presents high organic matter content, as well as valuable nutrients that could be recovered such as N (4.4% TKN) and P (0.4% TP) on a dry basis.

## Practical recommendations

The physicochemical characterization shows that aquaculture by-products contain nutrients to be recovered for the production of bio-based fertilizers (BBF). The potential application of these BBF could reduce the costs associated with sludge management, bringing a new market opportunity for the aquaculture sector.



**Fig 1:** Aquaculture by-products (A: dead fish; and B: sludge from marine aquaculture system)



**Fig 2:** Aquaculture by-products characteristics

## About this abstract

**Authors:** BETA Technological Centre (University of Vic- Central University of Catalonia)

**Date:** June 2022

**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](http://www.sea2landproject.eu)



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# Subproductos de la industria acuícola para valorizar en el Área Mediterránea

## Principales resultados

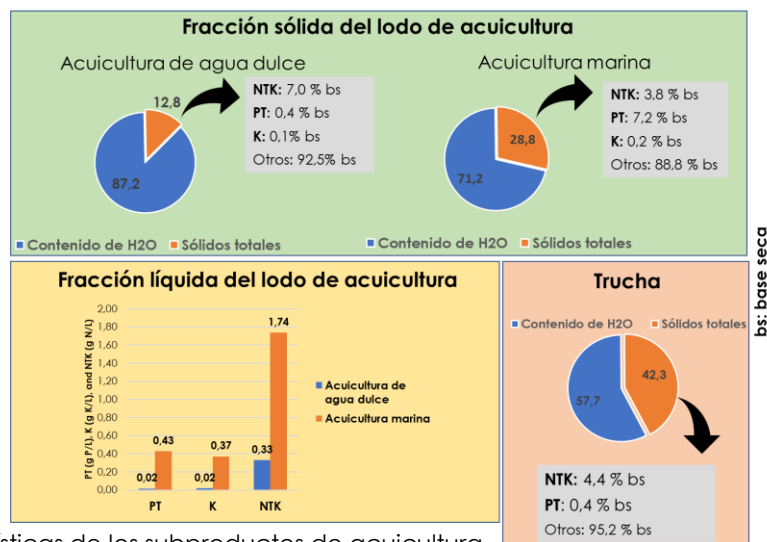
La acuicultura genera subproductos tales como peces muertos o no aptos para el consumo, restos de la transformación y lodos. En el proyecto SEA2LAND los lodos procedentes de un sistema de recirculación para la cría de lenguado en acuicultura marina y, los lodos generados en una planta de tratamiento de aguas residuales instalada en una industria acuícola de agua dulce están siendo valorizados mediante un conjunto de tecnologías enfocadas en recuperar nutrientes para la producción de biofertilizantes (BBF). En el caso de la acuicultura de agua dulce, durante la valorización de la fracción sólida se están utilizando además peces muertos como cosustrato. La fracción sólida de los lodos de acuicultura de agua dulce contiene alrededor de 7,0% NTK, 0,4% PT y 0,1% K (en base seca). En la fracción sólida del lodo marino, el fósforo es el nutriente que se detecta en mayor concentración (~7,2% PT), mientras que el NTK y el K representan el 3,8 % y el 0,2 % en base seca, respectivamente. En cuanto a la fracción líquida, los lodos de acuicultura marina presentan mayores concentraciones de nutrientes (1,74 g N/L, 0,43 g PT/L y 0,37 g K/L) que los lodos de acuicultura de agua dulce (0,33 g N/L, 0,02 g PT/L y 0,02 g K/L). La valorización de la trucha como cosustrato también es interesante ya que este subproducto presenta un alto contenido en materia orgánica y nutrientes (4.4% NTK y 0.4% PT en base seca).

## Recomendaciones prácticas

La caracterización fisicoquímica muestra que los subproductos de la acuicultura contienen nutrientes de interés con potencial para la producción de BBF. La valorización de estos subproductos para la producción de BBF podría reducir los costes asociados a la gestión de lodos, creando una nueva oportunidad de mercado para la acuicultura.



**Fig 1:** Subproductos de la acuicultura (A: animal muerto; y B: lodo proveniente de Sistema de acuicultura marina)



**Fig 2:** Características de los subproductos de acuicultura

## Sobre este resumen práctico

**Autores:** Centro Tecnológico BETA (Universitat de Vic – Universitat Central de Catalunya)

**Data:** Junio 2022

El proyecto **SEA2LAND** es una Acción de Innovación colaborativa (IA) financiada por la UE en el marco del programa Horizonte 2020. El proyecto tiene como objetivo proporcionar soluciones que contribuyan a superar los desafíos relacionados con la producción de alimentos, el cambio climático y la reutilización de residuos. Basado en el modelo de economía circular, SEA2LAND promueve la producción de fertilizantes a gran escala en la UE a partir de materias primas propias. Se espera que esta solución reduzca el desequilibrio de nutrientes del suelo en Europa. El período de ejecución del proyecto es desde Enero de 2021 hasta Diciembre de 2024.

**Página web:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement ID 101000496

# An innovative technological approach for the aquaculture industry by-products valorization in the Mediterranean area

## Main results / outcomes

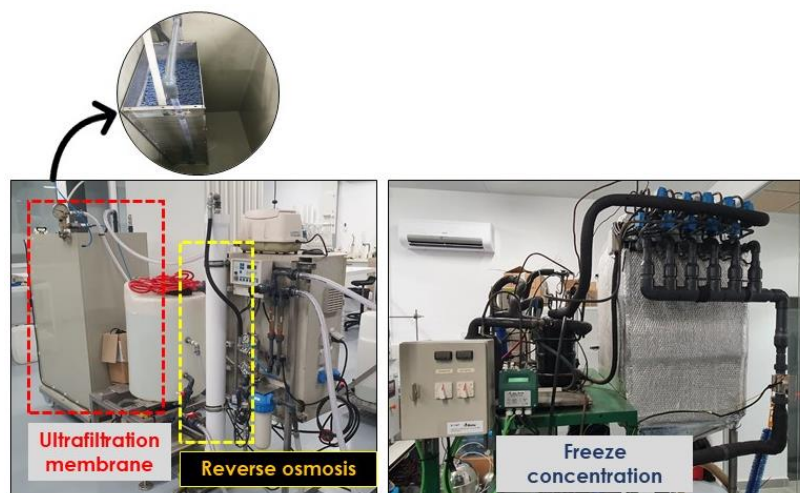
An innovative technological approach is being evaluated for the valorization of aquaculture by-products (fish sludge and dead fishes). The sludge is separated into solid and liquid fractions. Solid fraction valorization is conducted by applying the biodrying process, aiming to reduce the water content and obtain a nutrient-rich biodried product to be used as an organic amendment. It is also expected the combustion of this product to recover phosphorus from the ashes to produce phosphoric acid. The feasibility of recovering the volatilized ammonia during the biodrying to produce ammonium salts will be also evaluated in the project. Besides, in the case of freshwater aquaculture, dead Trout is used as co-substrate in the biodrying process. The liquid fraction from sludge is being valorized by using several concentration processes. The approach in use, and also validated at the pilot-scale, consists of an ultrafiltration (UF) system to separate solid particles present in the liquid fraction. The permeate produced by UF passes through the reverse osmosis (RO) system to concentrate the nutrients. The RO concentrate generated is subsequently processed in a Freeze Concentration (FC) unit, where the water is crystallized, and the nutrients are recovered in a nutrient-rich concentrate product. Moreover, a high-quality RO permeate with potential to be reused in the aquaculture industry facilities is also produced.

## Practical recommendations

The technological approach used in the project evidences the feasibility of recovering the nutrients from dead fishes and the sludge produced in the aquaculture sector. Hence, the technical solution proposed is considered a promising option for the production of bio-based fertilizers from aquaculture by-products.



**Fig 1:** Biodrying pilot unit for the valorization of fish sludge and dead fish



**Fig 2:** Technologies applied for the liquid fraction valorization

## About this abstract

**Authors:** BETA Technological Centre (University of Vic- Central University of Catalonia)

**Date:** June 2022

**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.

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# Un enfoque tecnológico innovador para la valorización de subproductos de la industria acuícola en el área mediterránea

## Principales resultados

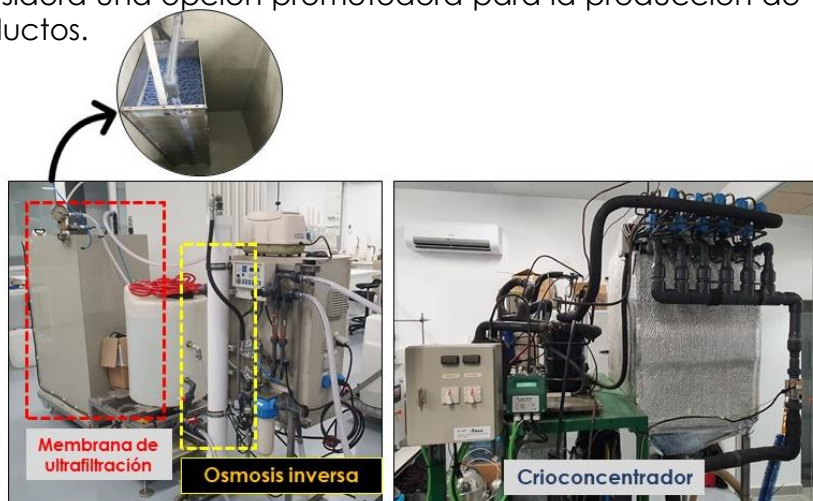
Un sistema tecnológico innovador está siendo evaluado para la valorización de subproductos generados en acuicultura (lodos y peces muertos). La fracción sólida del lodo es valorizada mediante biosecado, cuyo objetivo es reducir el contenido en agua y generar un producto rico en nutrientes para ser utilizado como enmienda orgánica. También se espera producir ácido fosfórico a partir del fósforo presente en las cenizas resultantes de la combustión del producto de biosecado, y recuperar el nitrógeno volatilizado durante el biosecado para producir sales de amonio. En el caso de la acuicultura de agua dulce, además de los lodos se utiliza como co-substrato peces muertos (trucha) durante el biosecado. La fracción líquida de los lodos está siendo valorizada mediante varios procesos de concentración. El enfoque aplicado, validado a escala piloto, consiste en un sistema de ultrafiltración (UF) para eliminar las partículas sólidas. El permeado producido mediante UF es tratado en un sistema de ósmosis inversa (OI) para concentrar los nutrientes. El concentrado de OI generado se procesa posteriormente en una unidad de crioconcentración (FC), donde el agua es cristalizada y los nutrientes se recuperan en un producto concentrado rico en nutrientes. Adicionalmente, se produce un permeado de OI de alta calidad con potencial para ser reutilizado en las instalaciones de la industria acuícola.

## Recomendaciones prácticas

Las tecnologías utilizadas en el proyecto SEA2LAND evidencian la viabilidad de recuperar los nutrientes de los lodos y peces muertos generados en la industria acuícola. Por lo tanto, la solución tecnológica propuesta se considera una opción prometedora para la producción de biofertilizantes a partir de estos subproductos.



**Fig 1:** Piloto de biosecado para la valorización de la fracción sólida



**Fig 2:** Tecnologías aplicadas para la valorización de la fracción líquida

## Sobre este resumen práctico

**Autores:** Centro Tecnológico BETA (Universitat de Vic – Universitat Central de Catalunya)

**Fecha:** Junio 2022

El proyecto **SEA2LAND** es una Acción de Innovación colaborativa (IA) financiada por la UE en el marco del programa Horizonte 2020. El proyecto tiene como objetivo proporcionar soluciones que contribuyan a superar los desafíos relacionados con la producción de alimentos, el cambio climático y la reutilización de residuos. Basado en el modelo de economía circular, SEA2LAND promueve la producción de fertilizantes a gran escala en la UE a partir de materias primas propias. Se espera que esta solución reduzca el desequilibrio de nutrientes del suelo en Europa.

El período de ejecución del proyecto es desde Enero de 2021 hasta Diciembre de 2024.

**Página web:** [www.sea2landproject.eu](http://www.sea2landproject.eu)



## Recirculating Aquaculture Systems (RAS): Potential test sites for effluent solids retrieval and waste valorisation for agricultural use

### Main results / outcomes

RAS production systems re-use 85-95% of rearing water in constant circulation, thus technologies for collection and rapid removal of waste products are essential to prevent the accumulation of toxic metabolites. Suspended solids and dissolved nutrients originate from uneaten feed, metabolism (faeces), micro-algae and bacteria, and correspond to ~17-25% of the feed input.

Turbulence of water turnover in RAS is a challenge for solids collection as it causes the disintegration of large particles into smaller fractions which are more difficult and time consuming to settle and remove. Additionally, for the smooth operation of the best practice mechanical filtration (drum filters) the backwashing of the filter dilutes the outputted suspended solids concentration while increasing discharge volume. Very low concentration of dry matter (0.7-6.3g TSS/L) evidenced that it is not viable to use sludge directly from the drum filter. Coagulants can increase settlement rates but reduces valorisation potential as phosphorus will become tightly bonded and unavailable for uptake in agricultural settings.

### Practical recommendations

Settlement and filtration increases complexity and costs for producers. There is a need for technological solutions that primarily dewater sludge (70-80% solids) to support low-cost transport to biodrying facilities integrate seamlessly with daily operation procedures. Sea2Land project provides optimal opportunity to explore these options and ensure relevance to aquafarmers



**Fig 1:** RAS as a closed system provides opportunities for wastes valorisation in an already high-tech environment, but space and operator time are at a premium.



**Fig 2:** Vacuum filtration can achieve needed TSS in pre-concentration small scale for shipping, but is labour and time intensive

### Further information

Johansen, et al. (2019) Innovative methodologies for reusing aquaculture side streams [\(Link\)](#)

### About this abstract

**Authors:** Dannie O'Brien, Giovanni Marco Cusimano, Freya Robinson, Tamás Bardócz

**Date:** May 2022

**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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## Evaluation of N, P and K uptake of bio-based fertilizers in pot experiments under greenhouse condition

### Main results / outcomes

The specific objective of this experiment is to evaluate the uptake of plant nutrients (N, P and K) from bio-based fertilizers from fish and aquaculture by-products. Based on the results of pot tests, 5–6 promising bio-based fertilizers will be selected for further field trials.

### Practical recommendations

Bio-based products can significantly contribute to plant nutrition. However, their effects are not always as predictable as those of mineral fertilizers. The new bio-based fertilizers from fish processing and aquaculture byproducts developed in WP3 and WP4 are tested under controlled conditions. Pot trials will be set up in greenhouse conditions to determine the fraction of N, P and K from bio-based fertilizers that plants can uptake. Chemical analyzes of bio-based fertilizers by UGENT are performed before pot testing. ECRI will carry out pot experiments to measure N effect, FiBL-CH will carry out pot experiments on P and K effects. The amount of nutrients (N, P and K) available to the plant is estimated using bio-based fertilizers in an amount that ensures an optimal supply of nutrients if all were available. All other macro- and micronutrients except N, P and K are added in sufficient quantities for optimal plant growth. Nutrients uptake from bio-based fertilizers is compared to unfertilized control and treatment with mineral fertilizers, where nutrients are assumed to be 100% available.



**Fig 1:** Pot experiment with spring wheat (*Triticum aestivum* L.) (NIBIO)



**Fig 2:** Pot experiment with Italian ryegrass (*Lolium multiflorum* L.) grown in the climate chamber for three weeks.) (FiBL-CH).

### About this abstract

**Authors:** Liina Edesi and Tiina Talve, Estonian Crop Research Institute

**Date:** June 2022

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## Potikatsed biopõhistest väetistest N, P ja K omastamise hindamiseks kasvuhoonetingimustes

### Peamised tulemused/väljund

Potikatse eesmärgiks on hinnata taimetoitelemntide (N, P ja K) omastamist kalatööstuse ja vesiviljelisuse kõrvalsaadustest toodetud biopõhistest väetistest. Potikatsete tulemuste põhjal valitakse välja 5–6 perspektiivset biopõhist väetist, mida uuritakse täiendavalt põldkatsetes.

### Praktilised soovitused

Biopõhised tooted võivad oluliselt kaasa aidata taimede toitumisele. Nende mõju ei ole aga alati nii prognoositav kui mineraalväetiste puhul.

Projekti tööpakettide WP3 ja WP4 raames kalatööstuse ja vesiviljelisuse kõrvalsaadustest välja töötatud biopõhiseid väetiseid testitakse kontrollitud tingimustes. Kasvuhoonetingimustes viiakse läbi potikatsed, et määrata kindlaks biopõhistes väetistes sisalduva lämmastiku, fosfori ja kaaliumi hulk, mida taimed on võimelised omastama.

Biopõhiste väetiste keemilised analüüsid tehakse enne potikatsete läbiviimist UGENT-s. ECRI viib läbi potikatsed N omastamise hindamiseks, FIBL-CH aga P ja K omastamise hindamiseks.

Biopõhistest väetistest taimele kättesaadavate toitainete (N, P ja K) koguste hindamiseks kasutatakse katses biopõhiseid väetusaineid koguses, mis tagaks taimede optimaalse toitainetega varustatuse, kui kõik toitainete (N, P ja K) oleksid omastatavad.

Kõiki teisi makro- ja mikroelemente lisatakse taimede optimaalseks kasvuks vajalikus koguses. Toitainete omastamist biopõhistest väetistest võrreldakse väetamata ja mineraalväetistega väetatud katsevariandiga, mille puhul eeldatakse, et toitained on 100% kättesaadavad.



**Foto 1:** Potikatse suvinisuga (*Triticum aestivum* L.) (NIBIO)



**Foto 2:** Potikatse itaalia raiheinaga (*Lolium multifolium* L.), kasvatatud kolm nädalat kliimakambris (FIBL-CH).

### Info abstrakti kohta

**Autorid:** Liina Edesi ja Tiina Talve, Eesti Taimekasvatuse Instituut

**Kuupäev:** Juuni, 2022

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](http://www.sea2landproject.eu)



# SEA2LAND



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