FERTIMANURE

Deliverable

Project Acronym: FERTIMANURE

Project full name: Innovative nutrient recovery from secondary sources – Production of high-added value Fertilizers' from animal MANURE

Grant Agreement No. 862849

D3.5. Report on the suitability of the FERTIMANURE end-products for organic farming

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Contributor(s)	APF, Fraunhofer, UGent, UVIC, RITTMO, UMIL, AGRI and Wageningen Research.

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Preface

This deliverable is part of the European project FERTIMANURE funded by the H2020 programme (project number 862849). The project FERTIMANURE focuses on the formulation and evaluation of bio-based fertilisers (BBFs) produced at five pilot nutrient recovery installations and tailor-made fertilisers (TMFs) as blends of BBFs and (synthetic) mineral fertilisers to meet the soil-crop specific requirements.

In the framework of FERTIMANURE WP3 (Production of Tailor-Made Fertilizers and Quality Assessment) the Task 3.6. "*International standardization and compliance with organic farming regulation*" included a thorough assessment of FERTIMANURE BBFs under the organic farming criteria. This task was developed within months 19 and 54 of the project (from July 2021 to June 2024).
This report summarises the work developed in the framework of this task including 2 tangible outputs related to this task: i) a position paper was developed "on increasing the scope of bio-based fertilisers for organic farming"; ii) 3 dossiers of the products identified were developed following the procedure established requesting the amendment of the Annex II of the Implementing Regulation 2021/1165 (see annex I.A, I.B. and I.C).
In this report a brief contextualisation of the situation of the organic farming sector in Europe is described followed by the description of the general principles and objectives that organic farming sector pursues. Derived from the identification of the list of authorised materials to be used in organic farming, we describe the procedure for the inclusion of new materials through the amendment of the Annex II of the implementing regulation 2021/1165. From the practical point of view, the alignment of FERTIMANURE approach with the organic farming general principles and objectives is evaluated and main barriers for the inclusion of FERTIMANURE BBFs are identified.

Within the Task 3.6 "*International standardization and compliance with organic farming regulation*", the task related to the assessment of the organic farming compliance is led by the University of Vic and the partners involved are Wageningen Research, RITTMO, Agri, University of Milano and University of Ghent. Additionally, we would like to acknowledge the BBF producers for revising the dossiers and distributing the position paper developed in the framework of this task: APF (NL), Fraunhofer (D), UGent (B), UVIC (ES), RITTMO (F) and UMIL (IT).

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FERTIMANURE

FERTIMANURE POSITION PAPER ON INCREASING THE SCOPE OF BIO-BASED FERTILISERS FOR ORGANIC FARMING

Organic agriculture is a farming system that sustains the health of soils, plants, animals, ecosystems and people whilst contributing to long-term food security and protect climate. Organic farming accounted for 9.2% of the EU's total 'utilised agricultural area' in 2020. However, the EU Green Deal, through the Farm to Fork Strategy, has established the ambitious target of reaching the 25% of agricultural area under organic farming and a significant increase in organic aquaculture by 2030.

Organic agriculture aims to be more environmentally friendly than conventional agriculture, being able to address sustainable development goals (economic, social, and ecological benefits). In that sense, organic agriculture has shared goals with the bioeconomy such as sustainability of food production, minimum environmental impacts with a closed farming system that effectively is recycling nutrients and designated inputs (EC/2021/1165 annex II).

The maintenance of soil fertility is paramount for organic agriculture: as no highly soluble mineral fertilisers are authorised; organic farmers aim to work in closed nutrient cycles as much as possible. In that sense, external inputs, accepted to be used in organic farming, are selected based on a strict set of criteria, with the aim to exclude any inputs that may cause harm to humans, animals, the environment, and climate, or may be in contradiction to the traditions of the sector and/or expectations by organic farmers and consumers. As a result, a limited number of fertilising products are allowed in organic production systems. In fact, nitrogen source in organic farming comes mainly from certain agricultural practices (use of leguminous crops, intercropping, etc.) and dried, composted, or digested farmyard manure and liquid excrements (Regulation 2021/1165, Annex II) rather than from effective mineral nitrogen fertilisers and other mineral nitrogen sources, which are strictly forbidden (Regulation 2018/848 annex II, 1.9.8). However, phosphorus, potassium and micronutrients sources are authorised for organic farming and can come from finite mineral sources (soft ground rock phosphate, aluminium-calcium phosphate, crude potassium salt, potassium sulphate, magnesium salts, etc.) (Regulation 2021/1165 annex II). In general terms, manure-based fertilisers, soil conditioners and nutrients from factory farming origin are strictly prohibited in organic farming. However, this last limitation does not apply to blood, bone, meat, fur or hair-based products.

To achieve the ambitious target of 25% of agricultural area under organic farming by 2030, it is necessary to provide the organic sector with options that will create the conditions that can trigger the change in EU agriculture towards the high-quality standards that EU consumers value. One major limitation of organic farming is the nutrient availability at early growth stages, since easily available mineral fertilisers cannot be applied.

FERTIMANURE project (H2020, Grant Agreement No. 862849) is proposing new circular economy strategies aiming to be aligned with current European initiatives (Circular Economy Action Plan, Farm-to-Fork Strategy, New Common Agricultural Policy, etc) producing high quality and safe fertilising products (bio-based fertilisers, BBFs) from animal manure, which is one of the most important secondary sources of nutrients that, we highly believe, can be crucial to ensure a sustainable agriculture and the future food security.

The EU has the world's largest livestock sector. Meat, milk and eggs make up 40% of the EU's agricultural value and it accounts for 48% of total EU agricultural activity, with an estimated €130bn output value annually and employment for almost 30 million people. Moreover, the trends in food demand are not expected to change during the following years. EU meat production is expected to

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reach 47.5 million tonnes by 2030, and global meat consumption is estimated to increase by an average of 1% per year between 2017 and 2030. In this context, it is important to note that 72.2% of all EU livestock is produced by very large intensive livestock farms.

The FERTIMANURE project will contribute to the organic sector by providing synthesized technical guidance for an adequate fertiliser supply. FERTIMANURE aims to provide relevant key information to change the paradigm about bio-based fertilising products recovered from animal manure in organic farming, demonstrating that FERTIMANURE BBFs can offer the quality and safety requirements as well as efficiently perform in agronomic and sustainability terms, bringing also benefits over the agronomic use of unprocessed manure. This will benefit both, the required increase in organic farming as well as circular economy. Nevertheless, FERTIMANURE fertilising products are mainly recovered from the manure generated in factory farming, as extensive farming does not have significant problems with manure management. Thus, considering Regulation 2018/848, nowadays it may seem complicated to integrate FERTIMANURE products in organic production systems. It is true that it would also be needed to see how the factory farming sector can be improved to guarantee relevant aspects such as animal welfare; however, FERTIMANURE project is out of this scope.

In this regard, a thoroughgoing discussion involving different key actors (organic farmers, policy makers, regulation authorities, food industry, consumers, scientific advisory bodies, etc.) is needed to reach a shared approach on the authorised use of the recovered BBFs. Considering the possibility to use nutrients recovered from animal manure (even though from factory origin) for organic farming would help to integrate recycled nutrients into organic food production closing nutrient cycles, improve nutrient uptake at early growth stages and lowering the dependency upon non-renewable and less sustainable nutrient sources.

1. FERTIMANURE bio-based fertilising products

FERTIMANURE project has installed and is operating 5 different on-farm pilots to recover a total of 18 bio-based fertilisers (BBF) from animal manure (pig, cattle, and poultry).

The definition of BBF in FERTIMANURE is the following: *Bio-based Fertilisers (BBFs) are fertilising products or a component to be used in the production of (Tailor-Made) Fertilisers that are derived from biomass-related resources. The BBFs of FERTIMANURE are "obtained through a physical, thermal/thermo-chemical, chemical, and/or biological processes for the treatment of manure or digestate that result into a change in composition due to a change in concentration of nutrients and their ratios compared to the input material(s) in order to get better marketable products providing farmers with nutrients of sufficient quality".*

Within FERTIMANURE products, 2 types of products and 3 FERTIMANURE products could show potential for being used in organic farming:

a. Organic amendments: biochar from manure, soil conditioners from manure
b. Biostimulants

Currently, the factory farm origin is the main limitation of FERTIMANURE products to be accepted in organic farming. Apart from that, there is also a barrier related to every thermal process-derived products (biochar, P-rich ashes), as organic farming does not support this kind of product applied to nitrogen rich manure due to N loses in exhaust gases. Apart from these limitations, Table 1 presents other reasons why the FERTIMANURE BBFs would not be currently accepted in organic farming.

Table 1. Categorisation of FERTIMANURE BBFs and why they are not authorised in organic farming

Product	CMC category identified in FPR	Why would not be authorised as established in (Regulation 2021/1165, Annex II)(*)

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Organic amendments: biochar from manure	CMC14	Not produced "*from plant materials*"
Organic amendments: soil conditioner from digestate	CMC5	Anaerobic digestion process requirements according to Regulation (EU) No 142/2011 (pasteurisation/ sanitisation step)
Algae derived products (biostimulants)	CMC1	Algae not "*from organic or collected in a sustainable way in accordance with point 2.4 of Part III of Annex II to Regulation (EU) 2018/848*".

(*) This is additionally to the factory farming origin limitation

In terms of product quality and safety, quality parameters of FERTIMANURE products are checked according to EU Regulation 2019/1009. Main composition of the products mentioned are given in Table 2 while safety related parameters analysed so far in different products are given in Table 3. Analysis of FERTIMANURE products have consistently been performed for more than one year on a monthly basis.

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Table 2. Main composition of FERTIMANURE BBFs obtained through different technological configurations, on fresh matter basis

Description	Type	Origin (feedstock)	Technology applied (Country)	DM (g kg^{-1})	TN (g kg^{-1})	NH_4-N (g kg^{-1})	TP (g kg^{-1})	TK (g kg^{-1})	TS (g kg^{-1})
Soil conditioner	Soil amendment; solid	Cattle slurry	Anaerobic digestion (mesophilic) (NL)	260	6.5	2.4	2.4	5.0	1.4
Biochar	Soil amendment; solid	Cattle manure	Thermo Catalytic Reforming (DE)*	996	10.1	0.14	30.4	95	2.5
Biostimulants	Biostimulant, liquid	Pig slurry	Membrane filtration coupled with algae cultivation and enzymatic hydrolysis of algae paste	65.4	4.5	n.a	40.9	1.2	0.4

*Although derived from thermal process, the TCR system includes the MAP reactor to treat exhaust gases and recycle nitrogen from it

Table 3. Safety parameters on FERTIMANURE BBFs obtained through different technological configurations

Description	Type	Origin (feedstock)	Technology applied	Zn (mg kg^{-1}DM)	Cu (mg kg^{-1}DM)	Ni (mg kg^{-1}DM)	Pb (mg kg^{-1}DM)	Cr (mg kg^{-1}DM)	Cr VI(mg kg^{-1}DM)	Hg (mg kg^{-1}DM)	As (mg kg^{-1}DM)	Cd (mg kg^{-1}DM)
Soil conditioner	Soil amendment; solid	Cattle slurry	Anaerobic digestion (mesophilic) (NL)	27.5	153.7	5.2	<5.0	6.6	n.a	<0.05	<1.0	<0.4

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Biochar	Soil amendment; solid	Cattle manure	Termo Catalytic Reforming (DE)*	358.5	51.3	6.9	1.9	11.0	0.05	0.02	0.5	0.06
Biostimulants	Biostimulant, liquid	Pig slurry	Membrane filtration coupled with algae cultivation and enzymatic hydrolysis of algae paste	<0.1	<0.1	<0.1	<0.1	<0.1	n.a	<0.1	<0.1	<0.1

*Although derived from thermal process, the TCR system includes the MAP reactor to treat exhaust gases and recycle nitrogen from it

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2. Policy-relevant information that FERTIMANURE can provide

Organic farming is defined by a set of principles and goals. The FERTIMANURE project is aligned with many of them and can thus provide valuable contributions to boost organic farming. In that sense, the following table aims to present how the work done in this project could potentially help the organic farming sector in being more competitive, sustainable and aligned with EU initiatives.

Table 4. How FERTIMANURE contributes to specific objectives and principles of organic farming

	Objectives and general principles of organic farming	**How FERTIMANURE contributes to the objective**
Objectives	Contributing to protection of the environment and the climate	FERTIMANURE BBFs are produced from **secondary nutrient resources**, and they are assessed in different terms such as agronomic (including mineralisation tests to assess the **efficient use of nutrients and potential nutrient losses**) and expected **environmental performances** (including the **whole life cycle of products**). Tailor Made Fertilisers (TMFs) are formulated to be efficient nutrient sources for specific crops, avoiding nutrient losses.
	Maintaining the long-term fertility of soils	Within FERTIMANURE different BBFs are produced aiming for different agricultural purposes: (i) mineral fertilisation by recovered ammonium and phosphorus products, (ii) organic soil conditioners able to improve physical structure and microbial soil functions and (iii) products specifically aimed to enhance microbial activity and soil health (biostimulants and TMF-enriched with microorganisms). By combining different FERTIMANURE BBFs, **nutrient and carbon cycles can be closed** by returning them to agricultural soils and ultimately, **soils' health can be restored,** and their **fertility improved** at long-term.
	Substantially contributing to a non-toxic environment	As detailed in section 2, **quality and safety parameters** of FERTIMANURE BBFs are aimed to be guaranteed by thoroughly assessing the analytical parameters considered in the **European Fertilising Product Regulation 2019/1009** identified as reference in terms of quality parameters for products and substances authorised to be used in organic farming (Regulation (EU) 2021/116). Additionally, **monitoring of potential antibiotic resistance genes** are being carried out within FERTIMANURE BBF production and application steps. Besides, from agronomic point of view, BBFs are expected, in general terms, to show **lower pollution risk** compared to mineral fertilisers.
	Encouraging short distribution channels and local production in the various areas of the Union	FERTIMANURE aims to obtain high quality BBFs by applying biorefinery processes **directly on farm** where they can be efficiently used or sold to fertilising industry as ingredient for their formulations. Therefore, FERTIMANURE aims to contribute towards shortening of supply and distribution chains.
General principles	The responsible use of energy and natural resources, such as water, soil, organic matter and air	FERTIMANURE aims to implement innovative integrated treatment schemes on-farm by the implementation of 5 different and complementary biorefineries. Different technologies are assessed for 3 different manures and **use of material and energy resources are being monitored and optimised** during each biorefining process to meet this principle. **Environmental sustainability assessment** is carried out for

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		each BBF obtained considering its **whole life cycle**, including its processing and application.
	The production of a wide variety of high-quality food and other agricultural and aquaculture products that respond to consumers' demand for goods that are produced via processes that do not harm the environment, human health, plant health or animal health and welfare	The **agronomic performance** of FERTIMANURE BBFs is assessed through agricultural trials performed at different scales. Fertilisation of experimental crops is done considering the characteristics of BBFs, soil characteristics and the nutrient requirements of crops avoiding nutrient loses. To achieve this tailored fertilisation plan, the **FERTIMANURE TMF nutrition tool** was developed which will be publicly available. FERTIMANURE Nutrition tool, thus, aims to supply the required amount and form of nutrients to agricultural crops. Among parameters evaluated within agricultural trials, **volume, quality and health of the crop** produced is assessed. Besides, as mentioned, environmental sustainability of the whole life cycle of FERTIMANURE BBFs is being assessed.
	The restricted use of external inputs; external inputs shall be limited to: natural or naturally-derived substances among others;	**Main feedstock** used to produce FERTIMANURE BBFs is **manure**, in different forms and origins. Manure is a **natural and renewable resource** and the recycling of its carbon and nutrients contributes significantly to close carbon and nutrient cycles, reducing the dependency upon non-renewable nutrient sources.
	The adaptation of the production process, where necessary and within the framework of this Regulation, to take account of the sanitary status, regional differences in the ecological balance, climatic and local conditions, stages of development and specific husbandry practices	Within FERTIMANURE, estimation of nutrient imbalances among livestock intensive farming regions in Europe has been performed. Additionally, FERTIMANURE is developing a **logistics tool** aimed to **appropriately manage the recycled nutrients** from those regions with surplus to those with deficit. As stated, agricultural trials are performed following the fertilisation plan given in the nutrition tool considering the status and characteristics of soils which contribute to minimise nutrient loses.

In the framework of FERTIMANURE, the following relevant data will be obtained to provide policy-relevant information to demonstrate that some of the fertilising products obtained in the project can fulfil the quality requirements needed for organic farming:

- Quality and safety check of the FERTIMANURE BBFs in line with the new Fertilising Product Regulation 2019/1009. The *Regulation EC/2021/1165 "Authorising certain products and substances for use in organic production"*, states that fertilising products authorised to be used in organic farming should be compliant with Regulation (EU) 2019/1009.
- Thorough evaluation of antibiotic resistance genes and their dynamics when the BBFs are applied.
- FERTIMANURE products will be compared in field tests with raw manure and with other commercial fertilising products.
- Sustainability assessment (LCA, LCC, sLCA) of the production processes and products to demonstrate how these can contribute to a more circular approach.

Due to the severity of land degradation and climate change, organic farming appears to be an attractive and feasible option for farmers in the future. In addition, the growing concern for long-term soil productivity and sustainability has highlighted the need to employ techniques that reduce the negative impacts of agricultural activities on soil quality. For this reason, new strategies and appropriate policies need to be put together in

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order to develop sustainable food production, which is also one of the key objectives of EU strategies and policies.

Manure-derived products represent an effective management strategy to improve biological and chemical properties of soils. Therefore, applying the FERTIMANURE fertilising products can benefit the organic sector's environmental performance.

The application of FERTIMANURE`s products will both, increase crop production and improve soil fertility and quality. In addition, the adoption of good management practices is needed to boost the amount of carbon stored as soil organic matter by soil carbon sequestration. In this regard, FERTIMANURE`s soil amendments will contribute to maintain or even increase the amount of organic carbon stored in the soil. This fact significantly influences soil physicochemical and biological properties. Also, increasing soil organic carbon (SOC) can help to achieve ambitious global policy initiatives such as the "4 per 1000 Initiative", launched by the French agricultural sector in 2015. This policy aims to demonstrate that agricultural activities, and in particular increasing soil organic carbon sequestration, can play a crucial role in climate change mitigation while simultaneously improving food security.

Modern agriculture involves the overuse of synthetic or mineral fertilisers that have a considerable negative impact on soil, water, and air quality. In this context, phosphorous (P) rich products are highly relevant because of their origin from secondary sources compared with mineral P, which is scarce and comes from detrimental mining activities outside the EU. Hence, obtaining phosphorus from biological and renewable resources could contribute towards the independence of a finite resource.

Biostimulant products are an effective complement to crop nutrition and crop protection in organic farming, as well as being an important valorisation strategy for several types of organic wastes and by-products. Some of the organic biostimulants that are currently used in organic farming include: plant hormones, humic acids, protein hydrolysates, sea kelp, fish emulsion and others.

The use of natural biostimulants address some of the most important global agricultural challenges including those of organic farming:

- Feeding a growing population that requires yield increases and enhanced crop quality.
- Increasing plant tolerance to biotic and abiotic stresses, such as (re-)emerging diseases and pests, extreme temperatures, irregular rainfall and other stressful growing conditions related to climate change.
- Promoting quality attributes of crops, which can mean higher incomes for farmers, better storage and more nutritious food for consumers.
- Facilitating nutrient assimilation, translocation and use by the crops can prevent these nutrients from leaching or running off into neighbouring ecosystems, leading to a better use of natural resources and higher return on investment for farmers.
- Helping protect and improve soil health by fostering the development of beneficial soil microorganisms, which can lead to improved nutrient and water uptake, stress resistance and a higher resistance to erosion.

With the information provided in this position paper, FERTIMANURE project is willing to start discussing and contributing on how the Regulation 2018/848 could be adapted to acknowledge certain BBFs recovered from animal manure as authorised fertilising products for organic farming. We highly believe that this is a crucial step to move towards a more sustainable agricultural sector and contribute to future food security.

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Summary

Organic agriculture aims to be environmentally friendly and sustainable, with strict criteria for input selection to maintain soil fertility. The organic agriculture has shared goals with the bioeconomy such as sustainability of food production, minimum environmental impacts with a closed farming system that effectively is recycling nutrients and designated inputs (EC/2021/1165 annex II). In this sense, it should be noted that while mineral nitrogen fertilisers are forbidden due to their high solubility, phosphorus, potassium, and micronutrients from finite mineral sources are allowed. Reaching the 25% organic farming target by 2030 requires creating conditions to shift EU agriculture towards high-quality standards. However, a significant challenge in organic farming is the limited availability of nutrients during early growth stages due to restrictions on easily available mineral fertilisers. The FERTIMANURE project aims to support the organic sector by offering technical guidance for a sufficient fertilizer supply. It seeks to change perceptions about bio-based fertilizers from animal manure, demonstrating their quality, safety, and environmental benefits over raw manure. A thorough discussion with key stakeholders is needed to determine the appropriate use of bio-based fertilizers derived from animal manure in organic farming. Integrating these nutrients can improve soil health, nutrient uptake, and sustainability while reducing dependence on non-renewable sources.

Despite being mainly derived from factory farming, which poses limitations for organic farming acceptance, FERTIMANURE approach align with organic farming principles and goals. They contribute to environmental protection, soil fertility, non-toxic environments, and short distribution channels. The project provides policy-relevant information and data to demonstrate the suitability of its BBFs for organic farming. By utilizing manure-derived products, organic farming can enhance soil health, carbon sequestration, and nutrient cycling, aligning with EU strategies for sustainable food production. The project aims to start discussions on adapting regulations to recognize BBFs as authorized fertilizing products for organic farming, promoting sustainability and future food security.

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Content

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List of Figures

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List of Abbreviations

ECBPI	European Policy Bioeconomy Policy Initiative
EGTOP	Expert Group for Technical Advice on Organic Production
ESPP	European Sustainable Phosphorus Platform
BBF	Bio-based Fertiliser
GMOs	Genetically modified organisms
TMF	Tailor-made Fertiliser
UAA	Utilised Agricultural Area

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1. Introduction

1.1. CONTEXT OF ORGANIC FARMING IN EUROPE

The organic farming sector was originated as a response to concerns about the environmental and health impacts of conventional agricultural practices, which rely heavily on synthetic pesticides, fertilizers, and genetically modified organisms (GMOs). In this regard, organic agriculture can be described as a farming system that sustains the health of soils, plants, animals, ecosystems and people whilst contributing to long-term food security and protect climate. Therefore, this sector aims to be more environmentally friendly than conventional agriculture, being able to address sustainable development goals (economic, social, and ecological benefits).

The organic sector in Europe is a significant and rapidly growing sector, exhibiting a gradual rise of 68% from 2012 to 2021 considering both fully converted area and area under conversion (Eurostat, 2023). Europe has a significant amount of land dedicated to organic agriculture. To put it in numbers, organic farming accounted for 9.9% of the EU's total 'utilised agricultural area' (UAA) in 2021 (Eurostat, 2023) and covered 15.9 million hectares of agricultural land. In addition, Eurostat reported over 396,000 organic producers in the European Union. These producers include farmers, livestock producers, and other agricultural enterprises engaged in organic production.

Along the last decade, organic farming increased in almost all of the EU countries: Some member states even duplicated (France, Hungary and Romania), triplicated (Croatia) or quadruplicated (Portugal) their agricultural land dedicated to organic agriculture.

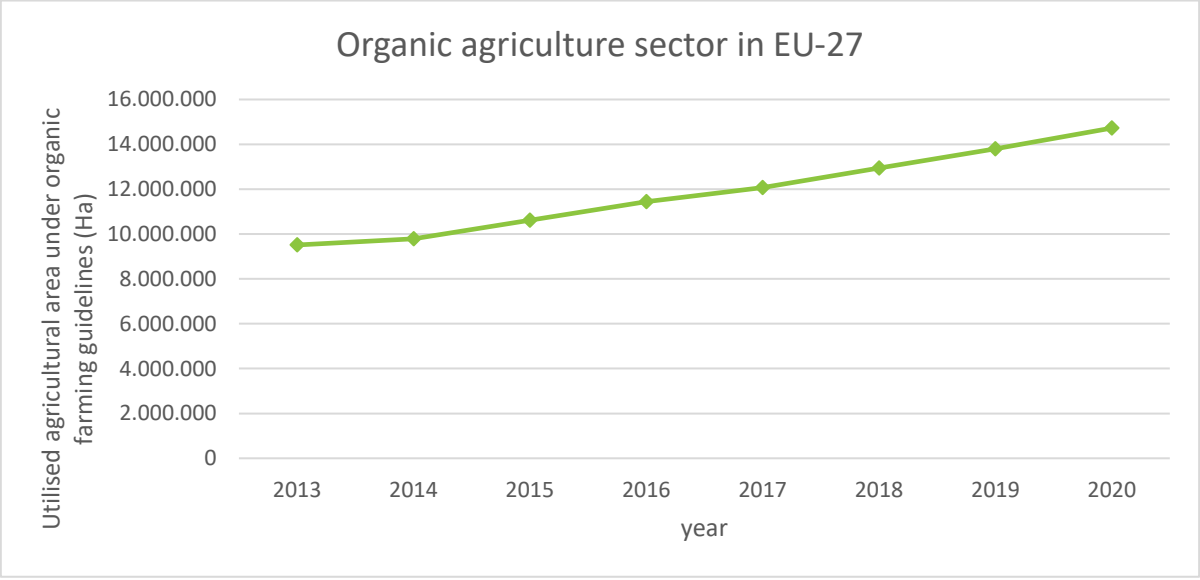

Figure 1 Increase of the utilised agricultural area under organic farming in EU-27 over the last decade

Regarding the total agricultural land dedicated to organic production, France (2.8M Ha), Spain (2.6 Ha) and Italy (2.2 Ha) stand out with more than 2 million of hectares to organic production, followed by Germany (over 1.5M Ha), Portugal (over 750.,000Ha), Czechia, Poland, Romania and Sweden with close to 500,000Ha of

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agricultural land dedicated to organic production. The map shown in Figure 2 shows the total organic area dedicated to different member states in Europe (data extracted from Eurostat dataset org_cropar, 2024).

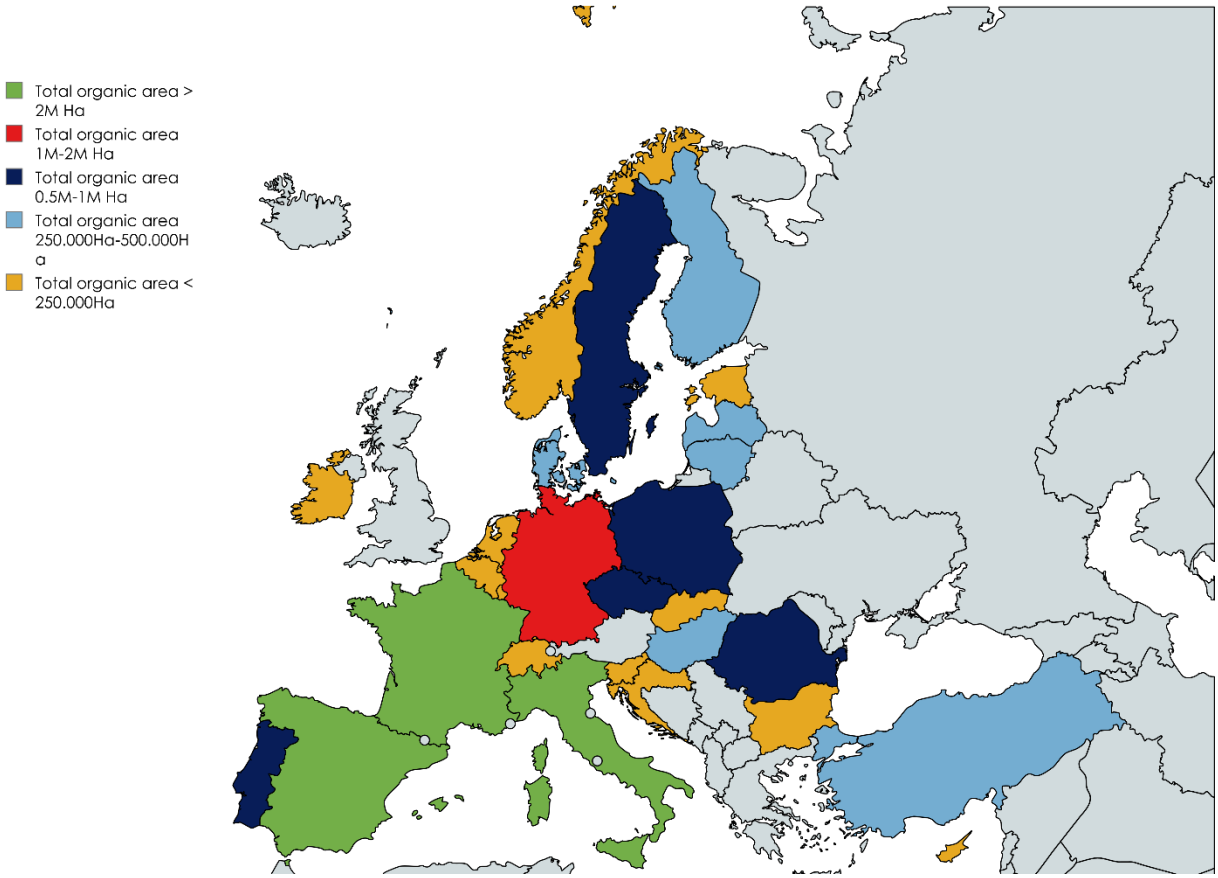

Figure 2 Total agricultural area under organic farming in different member states in Europe (data extracted from Eurostat dataset org_cropar, 2024).

As it was mentioned before, at European context, almost 10% of its total agricultural land is dedicated to organic agriculture. Moreover, countries such as Austria, Sweden, and Estonia have particularly high proportions of organic agricultural land (over 20% of their agricultural lands). Figure 3 shows the shares of organic land farm areas within total UAA in European Countries. All in all, organic agriculture is expected to increase even more sharply in the coming years as the EU Green Deal, through the Farm to Fork Strategy, has established the ambitious target of reaching the 25% of agricultural area under organic farming and a significant increase in organic aquaculture by 2030.

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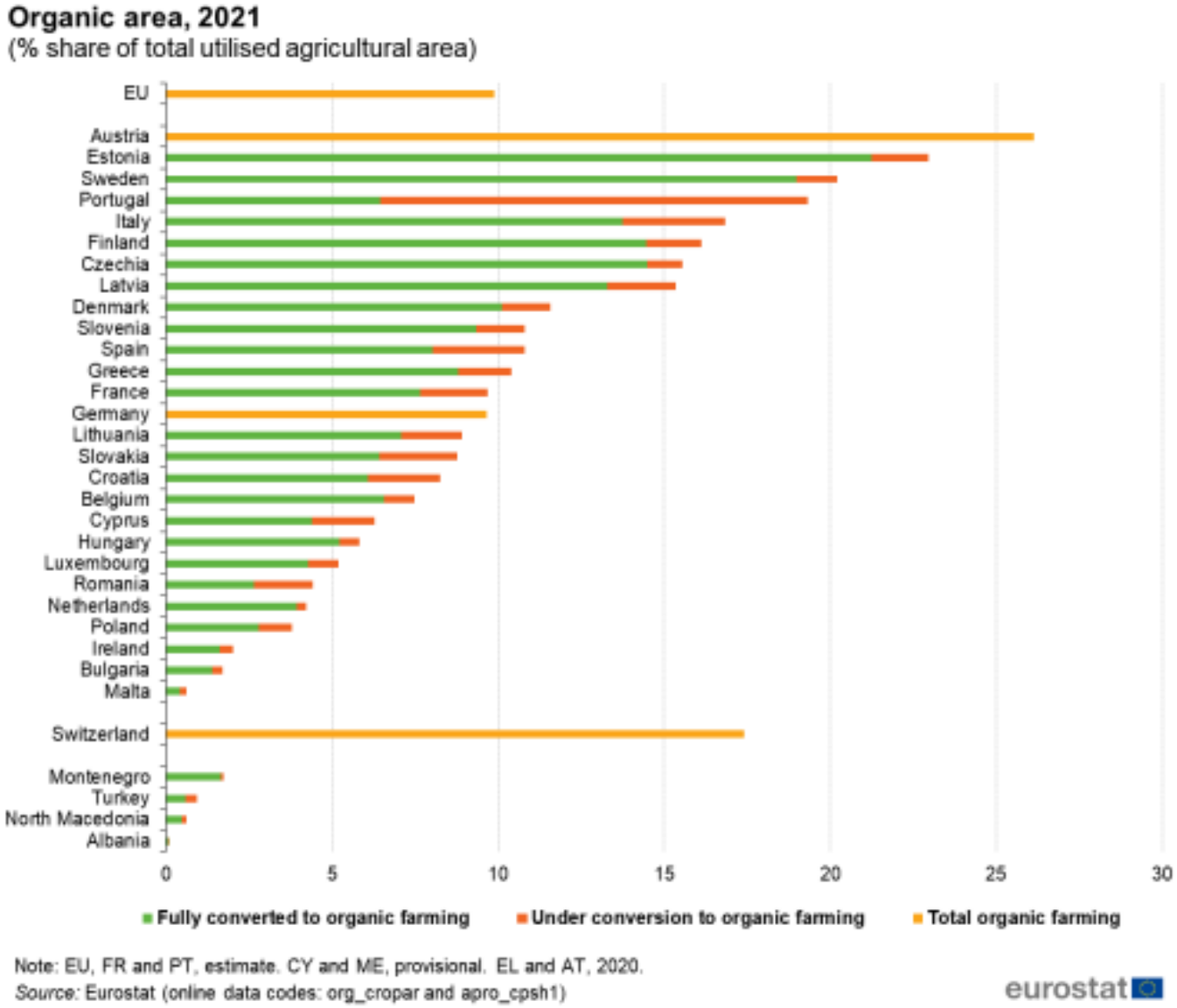

Figure 3 Share of the total utilised agricultural area under organic farming in different member states, in percentages (figure by Eurostat, 2023)

Economic figures:

The organic market in Europe has experienced rapid growth in recent years. According to the World of Organic Agriculture (Willer et al., 2023), in 2021, the organic market in Europe grew to 54.5 billion euros (European Union: 46.7 billion euros), making it the largest organic market globally. Germany, France, and Italy are the leading consumers of organic products in Europe (Figure 3).

European consumers are increasingly willing to pay a premium for organic products (Willer et al., 2023), due to concerns about food safety, environmental sustainability, and animal welfare (Jaeger et al., 2023; Sica and Franco, 2024). This consumer demand drives the growth of the organic market and incentivizes farmers to transition to organic production methods.

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The organic sector also contributes to employment in rural areas. While specific data on employment in the organic sector may vary by country, organic farming tends to be more labor-intensive than conventional farming, which can create employment opportunities, particularly in small-scale and diversified farming operations. Additionally, positive health effects related to higher satisfaction of organic farmers (Orsini et al., 2018).

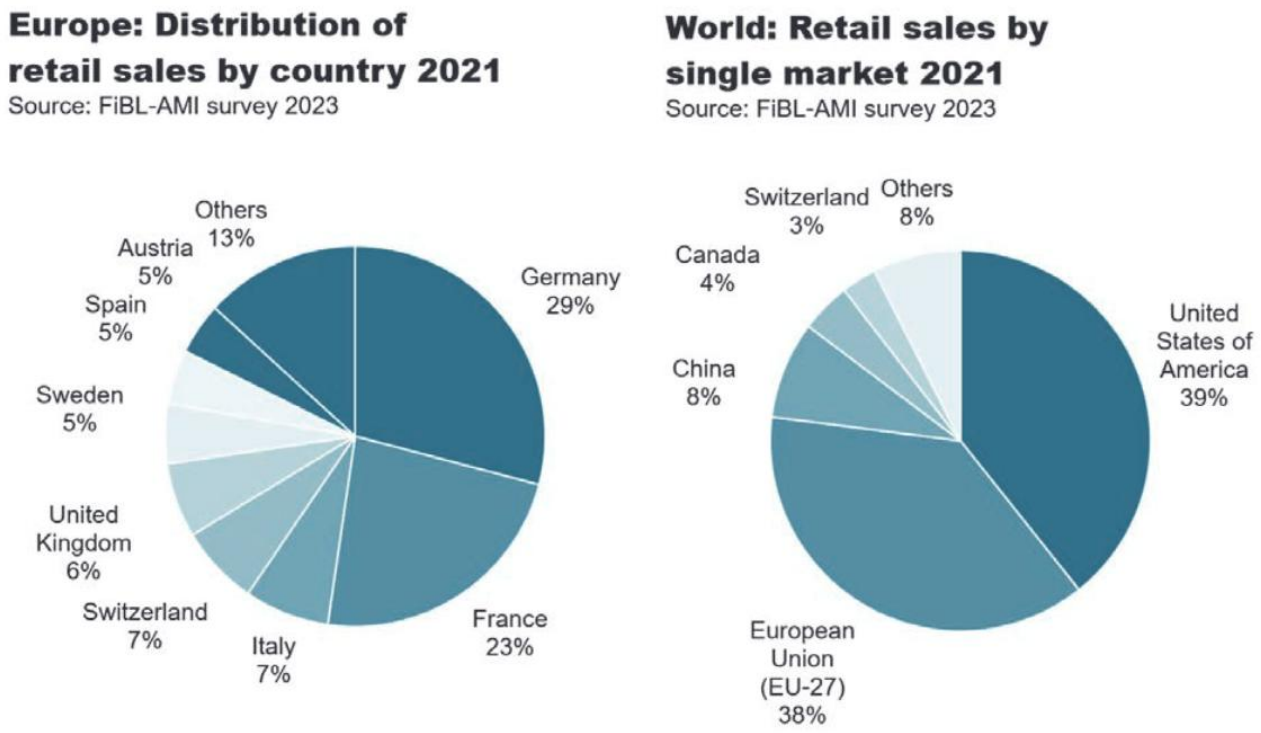

Figure 4 Distribution of retail sales by European country and by single market worldwide 2021, extracted from The World of Organic Agriculture Statistics and Emerging Trends (FIBL and IFOAM, 2023).

1.2. PRINCIPLES AND OBJECTIVES OF ORGANIC FARMING

In the European Union (EU) there were developed and established specific regulations governing organic farming sector and the labelling of organic products. These regulations aim to ensure the integrity of organic production methods, promote consumer confidence in organic products, and facilitate the free movement of organic goods within the EU. The primary regulatory framework for organic farming in Europe is the EU Organic Regulation (Regulation (EU) 2018/848 on organic production and labelling of organic products), which repealed the previous regulation (EC) No 834/2007. This regulation depicts the production, processing, and distribution stages of organic products, including imports from third countries. This regulation also outlines the fundamental principles of organic farming which are key for the development of implementing regulations on specific topics related to organic production, such as the Implementing Regulation (EU) 2021/1165 authorising certain products and substances for use in organic production and establishing their lists, object of this document.

The next set of points summarise the most relevant aspects related to organic farming general principles outlined in the Articles 5 and 6 of the Regulation (EU) 2018/848.

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- Soil Health: Organic farming prioritizes soil health as the foundation of agricultural productivity. Practices such as crop rotation, cover cropping, and the use of organic fertilizers (e.g., compost, manure) help maintain soil fertility, structure, and microbial diversity.
- Natural Inputs: Organic farmers avoid the use of synthetic pesticides, herbicides, and fertilizers, relying instead on natural methods to manage pests, weeds, and diseases. This includes techniques like crop diversification, biological pest control, and the use of natural predators.
- Biodiversity: Organic farming promotes biodiversity by creating habitats for beneficial insects, birds, and other wildlife. Crop diversity, hedgerows, and buffer zones help support natural ecosystems, pollinators, and soil organisms.
- No GMOs: Organic farming prohibits the use of genetically modified organisms (GMOs) in crop production, emphasizing the preservation of traditional and heirloom varieties and promoting seed sovereignty.
- Animal Welfare: Organic livestock farming emphasizes the humane treatment of animals, providing access to outdoor grazing areas, natural feed, and avoiding the routine use of antibiotics and growth hormones. Livestock are raised in conditions that allow for natural behavior and minimize stress.
- Sustainable Practices: Organic farming practices aim to minimize environmental impacts, conserve resources, and reduce greenhouse gas emissions. This includes practices such as water conservation, energy efficiency, and carbon sequestration through organic matter management.

In summary, the general principles of organic farming revolve around producing healthy, nutritious food in harmony with nature, while respecting the natural environment, promoting biodiversity, and supporting the well-being of farmers, consumers, and communities. That includes minimizing the use of external resources (including synthetic inputs) and promoting environmental sustainability, animal welfare and ultimately the resilience of European farming sector.

As mentioned, organic farmers aim to work in closed nutrient cycles as much as possible and rely on natural sources of nutrients to maintain soil fertility and support plant growth. In that sense, external inputs, accepted to be used in organic farming, are selected based on a strict set of criteria, with the aim to exclude any inputs that may cause harm to humans, animals, the environment, and climate, or may be in contradiction to the general principles and objectives of the sector and/or expectations by organic farmers and consumers.

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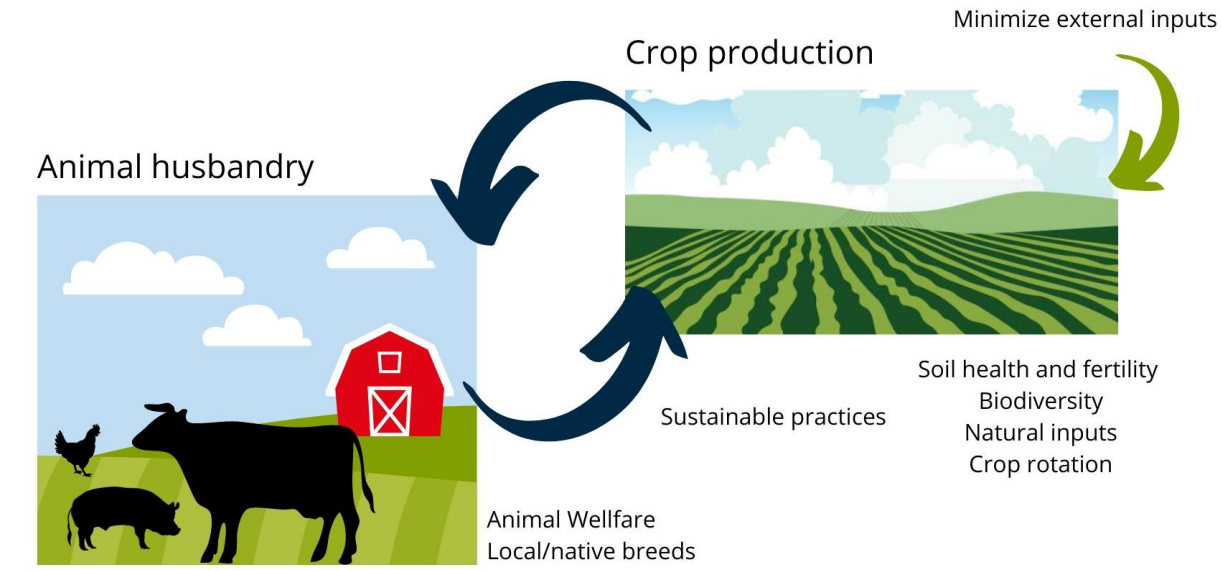

Figure 5 Visualization of organic farming principles in animal husbandry, crop production and their inter-connection

In general terms, nutrients sources, and particularly nitrogen, comes mainly from certain agricultural practices (use of leguminous crops, intercropping, cover crops, mulches, etc.) as well as the use of compost, manure, rock minerals, and biofertilizers. These nutrient sources provide essential elements like nitrogen, phosphorus, potassium, and micronutrients, while minimizing reliance on synthetic fertilizers. Hence, a limited number of fertilising products are allowed in organic production systems (Regulation 2021/1165, Annex II).

In this line, the article 5 of Regulation 2018/848 mentions the principle to restrict the use of external inputs; and the need of an appropriate management when the external input is used. In this article, the point (g) specifies that when mineral fertilisers are used, they must be low solubility mineral fertilisers. Moreover, in the Annex II, in the part referred to the plant production rules, the point 1.9.8 specifically forbids the use of mineral nitrogen fertilisers. However, phosphorus, potassium and micronutrients sources are authorised for organic farming and can come from finite mineral sources (soft ground rock phosphate, aluminium-calcium phosphate, crude potassium salt, potassium sulphate, magnesium salts, etc.) (Regulation 2021/1165 annex II).

Organic farming emphasizes the use of renewable resources clearly aligning with the European Bioeconomy Action Plan. Manure is, in fact, specifically mentioned in its different forms in the Annex II: dried, composted, or digested farmyard manure and liquid excrements. Nevertheless, in general terms, manure-based fertilisers, soil conditioners and nutrients from factory farming origin are strictly prohibited in organic farming. However, this last limitation does not apply to blood, bone, meat, fur or hair-based products. Even though manure-based products from factory farming origin are not authorised, there is no clear definition on what the criteria are to categorize a farm as such.

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1.3. PROCEDURE OF AUTHORISATION OF FERTILISERS IN ORGANIC AGRICULTURE SECTOR

Europe has been a pioneer in the development and regulation of organic farming practices, with many countries having robust organic certification systems and a strong consumer demand for organic products. In general terms, organic farmers adhere to strict standards and undergo certification processes by authorised certifying agencies to ensure compliance with organic regulations.

In this sense, the authorization of fertilizing products in organic agriculture at European level involves a structured and rigorous evaluation process overseen by competent authorities and guided by expert advice from the Expert Group on Technical Advice on Organic Production (EGTOP). In this regard, EGTOP is the responsible of providing technical advice to the European Commission regarding the implementation of regulations governing organic production in the European Union, including the authorisation of certain products, such as fertilising products. The procedure starts with the submission by the manufacturer of the specifically generated application form, from now on “dossier”, requesting the amendment of the Annex II of the Implementing Regulation 2021/1165. The dossier includes detailed information about the product's composition, manufacturing process, labelling, and intended use in organic agriculture and it is submitted to the competent authority of a Member State. The competent authority is responsible of evaluating the appropriateness and alignment of the proposed product with the requirements set in organic regulations and of addressing the completed dossier to the EGTOP for its technical evaluation. The EGTOP is in charge of conducting a thorough technical assessment of the fertilizing product based on scientific evidence, best practices, and organic principles. This assessment considers factors such as the product's composition, origin of raw materials, manufacturing procedure, mode of action, potential risks, and compatibility with organic farming practices. Then, based on the conclusions of the technical evaluation, the EGTOP provides recommendations to the competent authority regarding the authorization of the fertilizing product for use in organic agriculture. In case the evaluation is positive, recommendations regarding including certain conditions or restrictions might be requested. Finally, the competent authority is responsible of EGTOP's recommendations along with other relevant factors before making a decision on the authorization of the fertilizing product. If the product meets the requirements of organic regulations, the competent authority may grant authorization and issue a certificate or label indicating its suitability for use in organic farming.

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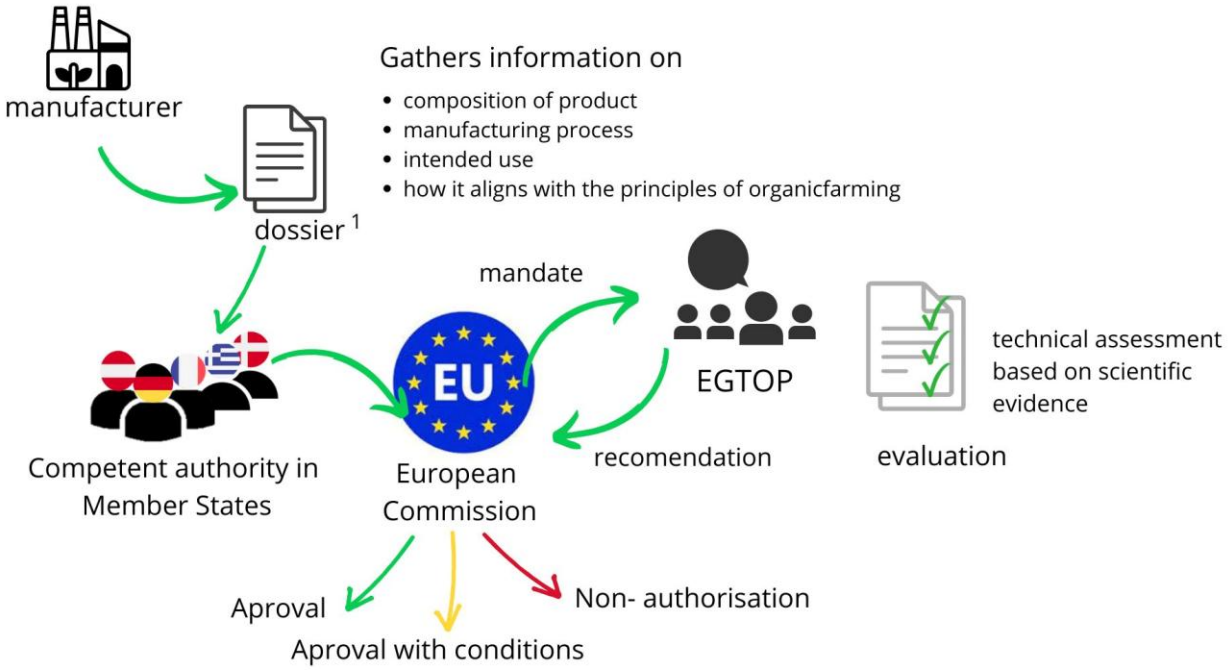

Figure 6 Visual description of the procedure of authorisation of fertilisers to be used in organic agriculture sector.

1.1 FERTIMANURE

To achieve the ambitious target of 25% of agricultural area under organic farming by 2030, it is necessary to provide the organic sector with options that will create the conditions that can trigger the change in EU agriculture towards the high-quality standards that EU consumers value.

FERTIMANURE project is proposing new circular economy strategies aiming to be aligned with current European initiatives (Circular Economy Action Plan, Farm-to-Fork Strategy, New Common Agricultural Policy, etc) producing high quality and safe fertilising products (bio-based fertilisers, BBFs) from animal manure, which is one of the most important secondary sources of nutrients that, we highly believe, can be crucial to ensure a sustainable agriculture and the future food security. In this regard, it is worth highlighting that the EU has the world's largest livestock sector. More specifically, the main European agricultural activity (48% of the total EU agricultural activity and yearly €130bn output value) are production of meat, milk and eggs, making up 40% of the EU's agricultural value. In this context, it is important to note that 72.2% of all EU livestock is produced by very large intensive livestock farms.

FERTIMANURE aims to provide relevant key information to change the paradigm about bio-based fertilising products recovered from animal manure in organic farming, demonstrating that FERTIMANURE BBFs can offer the quality and safety requirements as well as efficiently perform in agronomic and sustainability terms, bringing also benefits over the agronomic use of unprocessed manure. This approach clearly contributes to aligning both organic farming sector and circular bioeconomy. Also, FERTIMANURE wants to provide a synthetized technical guidance for an adequate fertiliser supply specifically designed for the organic farming sector as they might struggle finding adequate fertilising products for their crops.

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2. Methodologies and Organisation of the work

First, a working team with different expertise was established to work on the assessment of the FERTIMANURE BBFs in the framework of the organic farming sector.

The first meetings were devoted to thoroughly discuss on the alignment of FERTIMANURE perspective with the organic farming. The main critical barriers were identified and a first version of the policy brief with the title "FERTIMANURE POSITION PAPER ON INCREASING THE SCOPE OF BIO-BASED FERTILISERS FOR ORGANIC FARMING" was finalised in November 2022. This position paper included also the description of the most promising FERTIMANURE products to be authorised for their use in organic farming.

The policy brief was distributed among some representatives of DG AGRI, ministries of agriculture of Spain, The Netherlands and other relevant stakeholders such as the European Sustainable Phosphorus Platform (ESPP) and European Policy Bioeconomy Policy Initiative (ECBPI). Some positive reactions were received from the representatives of the ministries of agriculture although FERTIMANURE was recommended to follow the established procedure for the critical evaluation of the suitability and alignment of the products identified by the EGTOP. Therefore, dossiers were prepared for the most promising products identified in previous step: the soil improver from the Dutch pilot, the P-rich ashes and biostimulants from the Spanish pilot, and the biochars from the Frech and German pilots. After further discussion, finally the dossiers of P-rich ashes and biochars from French pilot were not further worked out.

3. How FERTIMANURE aligns with the organic farming sector

3.1 FERTIMANURE contributing to the general principles and objectives of the organic farming sector

As mentioned, organic farming is defined by a set of principles and goals. The FERTIMANURE project is aligned with many of them and can thus provide valuable contributions to boost organic farming. In that sense, the following list aims to present how the work done in this project could potentially help the organic farming sector in being more competitive, sustainable and aligned with EU initiatives.

FERTIMANURE aligned with the objectives of organic farming:

- **Contributing to protection of the environment and the climate:**
  FERTIMANURE BBFs are produced from manure, an important **secondary nutrient resource**. By obtaining and using BBFs derived from manure is expected to improve nutrient management over the use of raw manure in agricultural lands. Specifically, obtained BBFs were assessed in terms or **agronomic performance** in different scales and with different objective, including **mineralisation** tests and field tests over 2 years to assess the efficient use of nutrients and **potential nutrient losses**. In parallel, expected environmental performances are evaluated including the **whole life cycle** of products (in both production and application stages).
  Moreover, **Tailor Made Fertilisers** (TMFs) are **formulated** to be efficient nutrient sources for specific crops and soils, avoiding to the maximum extent nutrient losses.

- **Maintaining the long-term fertility of soils:**

  Within FERTIMANURE different BBFs are produced aiming for different agricultural purposes:

  (i) mineral fertilisation by recovered ammonium, phosphorus and potassium rich products,

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(ii) organic soil conditioners able to improve physical structure and microbial soil functions and
(iii) products specifically aimed to enhance microbial activity and soil health (biostimulants and TMF-enriched with microorganisms).

By combining different FERTIMANURE BBFs, **nutrient and carbon cycles can be closed** by returning them to agricultural soils and ultimately, **soils' health can be restored**, and their **fertility** improved at **long-term**.

- **Substantially contributing to a non-toxic environment:**
  Quality and safety parameters of FERTIMANURE BBFs have been thoroughly assessed following the analytical parameters considered in the European Fertilising Product Regulation 2019/1009 in each case. At this point, it is important to note that Regulation (EU) 2021/1165 authorising certain products and substances for use in organic production and establishing their lists establishes as reference the Fertilising Product Regulation as reference in terms of quality parameters for products and substances authorised to be used in organic farming.
  Additionally and to further assess the safety of FERTIMANURE BBFs in the framework of one-health, monitoring of potential antibiotic resistance genes are being carried out within FERTIMANURE BBF production and application steps.
- **Encouraging short distribution channels and local production in the various areas of the Union:**
  Within its circular economy scenarios, FERTIMANURE evaluated obtaining high quality BBFs by applying biorefinery processes **directly on farm** following a decentralised approach. In this scenario, nutrients can be efficiently used directly in the farm in which are produced or sold to a nearby farmer. Otherwise, the second scenario considers the purchase of those BBFs by the fertilising industry as ingredient for their formulations. In both cases, FERTIMANURE aims to contribute towards shortening of supply and distribution chains, aiming to reduce the dependency on external nutrient sources. Within its "FERTIMANURE" management package, the logistics tool developed allows to manage more adequately (with or without applying recovery technologies) the nutrients generated in manure surplus areas and efficiently use them in areas with nutrient deficit.

FERTIMANURE aligned with the general principles of organic farming:

- **The responsible use of energy and natural resources, such as water, soil, organic matter and air:**
  FERTIMANURE aims to implement innovative integrated treatment schemes on-farm by the implementation of 5 different and complementary biorefineries. Different technologies were assessed for 3 different manures and **use of material and energy resources were continuously monitored and optimised** during each biorefining process to meet this principle. **Environmental sustainability assessment** is carried out for each BBF obtained considering its **whole life cycle**, including its processing and application.

- **The production of a wide variety of high-quality food and other agricultural and aquaculture products that respond to consumers' demand for goods that are produced via processes that do not harm the environment, human health, plant health or animal health and welfare:**
  The agronomic performance of FERTIMANURE BBFs is assessed through agricultural trials performed at different scales. Fertilisation of experimental crops is done considering the characteristics of BBFs, soil characteristics and the nutrient requirements of crops avoiding nutrient loses. To achieve this tailored fertilisation plan, the FERTIMANURE **TMF nutrition tool** was developed which will be publicly available. FERTIMANURE Nutrition tool, thus, aims to supply the required amount and form of nutrients to agricultural crops.
  Among parameters evaluated within agricultural trials, volume, quality and health of the crop produced is assessed. Besides, as mentioned, environmental sustainability of the whole life cycle of FERTIMANURE BBFs is being assessed.

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- **The restricted use of external inputs; external inputs shall be limited to natural or naturally-derived substances among others:**
  Main feedstock used to produce FERTIMANURE BBFs is **manure**, in different forms and origins. Manure is a **natural and renewable resource,** rich in nutrients and carbon, and its potential as fertiliser is not being fully exploited. In this regard, the recycling of its carbon and nutrients contributes significantly to close carbon and nutrient cycles, reducing the dependency upon non-renewable nutrient sources.

- **The adaptation of the production process, where necessary and within the framework of this Regulation, to take account of the sanitary status, regional differences in the ecological balance, climatic and local conditions, stages of development and specific husbandry practices:**
  Within FERTIMANURE, estimation of nutrient imbalances among livestock intensive farming regions in Europe has been performed. Additionally, FERTIMANURE has developed a **logistics tool** aimed to appropriately manage the recycled nutrients from those regions with surplus to those with deficit. As stated, agricultural trials are performed following the fertilisation plan given in the nutrition tool considering the status and characteristics of soils which contribute to minimise nutrient loses.

3.2 FERTIMANURE BBFs in the framework of the organic farming

In general terms, the BBFs produced within FERTIMANURE can be categorised into 3 different groups:

(i) mineral fertilisation by recovered ammonium, phosphorus and potassium rich products,
(ii) organic soil conditioners able to improve physical structure and microbial soil functions and
(iii) products specifically aimed to enhance microbial activity and soil health (biostimulants and TMF-enriched with microorganisms).

To assess the potential of FERTIMANURE BBFs in the framework of organic farming, first we evaluated how each of the 18 BBFs align with the principles and objectives of organic farming. In this regard, some clear conclusions were done, leading to selecting the most promising group BBFs that are listed below.

Mineral nitrogen products

First, organic farming sector is aiming to minimize external nutrient sources and following the article 5 of general principles of the Regulation (EC) 2018/848, point g specifically restricts the use of such sources to low solubility mineral fertilisers. Moreover, mineral nitrogen fertilisers are strictly forbidden in Annex II, point 1.9.8 (EU Regulation 2018/848). Thus, considering the mentioned, all the ammonium-based mineral BBFs (ammonium sulphate, ammonium nitrate, ammonium water and monoammonium phosphate) would not be aligned with what the sector is demanding and should be discarded for their further evaluation.

Avoiding thermal processes

The organic farming sector is also aiming to avoid nutrient loses to the maximum extent, and therefore the sector is not in favour of any thermal processes applied to manure as they would lead to an avoidable loss of nitrogen, that includes the thermal oxidation processes (through the use of a biomass boiler in the Spanish pilot) and pyrolysis or pyrolysis-like processes of digestate (FR), poultry manure (FR) and cattle dung (GE). However, here, the pyrolysis-like Thermo-Catalytic Reforming (TCR) process implemented in German pilot should be highlighted as it includes a coupled monoammonium phosphate (MAP) reactor that allows the recovery of the nitrogenous emissions during pyrolysis process. Therefore, although it is included as the thermal processes that the sector is willing to avoid, this specific process is designed to minimise the nitrogen

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loses during processing and therefore would be completely aligned with the general principles of the sector. Although it was not tested as it in FERTIMANURE biorefineries, nitrogen recovery strategies such as stripping and scrubbing systems before thermal treatments could be effectively implemented to recover nitrogen and avoid to the maximum extent the nitrogen losses afterwards, and thus maximize resource recovery and better-align with the principles of the sector.

The term "factory farming"

Second, there is a clear limitation of FERTIMANURE BBFs related to their origin. All the manure-based fertilising products listed as authorised products in Annex II of EU Implementing Regulation 1165/2021 (including raw manure in solid or liquid form, digestate or composted manure-based fertilising products) limit their authorisation to non-factory farming sector, thus allowing at this moment only those manure-derived products coming from organic livestock production. It is important at this point to note that extensive farming does not have significant problems with manure management.

Considering the implication of manure-based products on the extension of organic farming system expected for the coming years and the need to align the sector to the circular bioeconomy strategy, the expert group EGTOP, in its report from May 2021 on the use of fertilisers from conventional animal husbandry in organic plant and algae production (EGTOP, 2021) concluded that the term factory farming should be let out. Instead, EGTOP recommended the need to define a required positive and/or a negative list of elements and techniques to fulfil for allowance of animal products and waste from conventional farming in organic plant production. This opens an important window for the recovered BBFs even though they dot come from organic farms. In early 2024, a new permanent group of EGTOP (permanent group on "factory farming") was designated to discuss on the list of positive and negative elements and make a recommendation to the commission. The completed report was discussed in the last EGTOP plenary session held on March 2024.

The implication of the conclusion of this discussion on the term of "factory farming" is critical for FERTIMANURE BBFs as they are mainly recovered from the manure generated in conventional farms, not per se being large scale intensive livestock farming. Therefore, considering what is currently stated in Annex II of Regulation 2018/848, nowadays it may seem complicated to integrate FERTIMANURE products in organic production systems.

In this regard, a thoroughgoing discussion involving different key actors (organic farmers, policy makers, regulation authorities, food industry, consumers, scientific advisory bodies, etc.) is needed to reach a shared approach on the authorised use of the recovered BBFs. Considering the possibility to use nutrients recovered from animal manure (even though from factory origin) for organic farming would help to integrate recycled nutrients into organic food production closing nutrient cycles, improve nutrient uptake at early growth stages and lowering the dependency upon non-renewable and less sustainable nutrient sources.

FERTIMANURE BBFs with potential to be authorised

In this regards, different organic soil conditioners, recovered phosphorus products and plant biostimulants can be of special interest for the organic farming sector. These products are completely aligned with the aims of organic farming for several reasons listed below:

- **Organic soil conditioners in FERTIMANURE** are: i) the soil conditioners obtained from solid fraction of digestate produced from cattle manure (NL), biochar obtained from digestate (FR), poultry (FR) and cattle dung (DE), and biodried organic amendment obtained from the solid fraction of pig slurry (SP). Overall, it can be said that these highly organic products improve physical structure and microbial soil functions being able to restoring soils' health and improving soils' fertility improved at long-term. They show potential to closing nutrient and carbon cycles by returning them to agricultural soils. Biochar can be even considered as a product with potential as carbon storage into agricultural soils.

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Moreover, they can all be used as highly organic ingredient used as the basis of solid organic or organo-mineral products for Tailor Made Fertilisers (TMFs) formulated to be efficient nutrient sources for specific crops, avoiding nutrient losses.
Out of the organic soil conditioners produced in FERTIMANURE, two are the most promising products: the soil conditioner produced in the Netherlands from the anaerobic digestion of cattle slurry and biochar from cattle dung obtained in Germany. Specific dossiers to authorise their inclusion in the Annex II of the Regulation 1165/2021 have been prepared to be sent for their evaluation by EGTOP.

- **Recovered phosphorus products in FERTIMANURE** are: i) P rich ashes from the combustion of biodried organic amendment from pig slurry (SP), ii) phosphoric acid obtained from the acidic treatment of P rich ashes (SP), iii) wet of dried P rich sludge product (NL), iv) biochar (DE and FR).
  As a natural and renewable resource manure has potential as a substitute of mineral phosphorus and potassium fertilisers leading to reducing the dependency upon non-renewable nutrient sources, in which phosphorus is recognised to be critical for the European supply chains. Phosphorus rich ashes and biochar stand out as an efficient source of phosphorus after the agronomic testing performed in the framework of the project. However, such products are obtained in most of the cases after thermal processes which lead to nitrogen loses in exhaust gases and therefore only the German biochar from cattle dung (which includes nitrogen recovery strategy from exhaust gas) is considered for its authorisation.

- **Plant biostimulants obtained in FERTIMANURE**: one plant biostimulant is obtained from microalgae cultivated over reclaimed water obtained from pig slurry. This product was demonstrated to act as plant biostimulant and protect crops (tests demonstrated to improve the nutrient availability, nutrient efficiency and crop tolerance to abiotic stress, namely, hydric and saline stress). Biostimulants show the ability to increase plant resistance to hydric stress, suggesting their potential use in locations with high risk of drought periods, and and/or in crops with high water demand. All in all, aminoacid-based biostimulants could help to optimize the use of water in crops. Specific dossier to authorise the inclusion of this product in the Annex II of the Regulation 1165/2021 have been prepared to be sent for their evaluation by EGTOP.

4. Conclusions and recommendations

Within the assessment of FERTIMANURE BBFs in the framework of organic farming sector the work has been focused on evaluating to how FERTIMANURE products align with the general principles and objectives of organic farming. In general terms, FERTIMANURE, through its thorough assessment of the manure management strategies proposed, including the BBFs obtained, has demonstrated that contributes to:

- The environmental protection and climate by contributing to a better use of resources in two dimensions: i) through the effective valorisation of manure, a natural and renewable resource, reducing dependency on non-renewable nutrient sources; ii) through improving the nutrient management over raw manure demonstrated by agronomic tests and environmental impact monitoring of BBFs and TMFs.
- The maintenance of long-term soil fertility by contributing to the soil health through tailored fertilization plans, considering BBF characteristics and soil conditions by the development and distribution of the TMF tool.
- Promoting healthy and safe food production system by obtaining high-quality, environmentally friendly products meeting the EU Fertilising Product Regulation standards.
- Encouragement of short distribution channels and local production is promoted in the decentralized biorefinery approach proposed, allowing on-farm nutrient production or local sales. In addition, FERTIMANURE proposes strategies to better manage nutrient surplus and deficit areas efficiently though a complete logistics.

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Some critical points to be considered when evaluating the appropriateness of BBFs in the framework of organic farming sector were identified being summarised as follows.

- **Mineral Nitrogen Products in Organic Farming**: Organic farming prohibits the use of mineral nitrogen fertilizers due to their high solubility. Therefore, ammonium-based mineral fertilizers, including ammonium sulphate, ammonium nitrate, and others, are prohibited under these regulations.

- **Avoidance of Thermal Processes:** Organic farming aims to minimize nutrient losses, leading to a preference against thermal processes applied to manure. Processes like thermal oxidation and pyrolysis are generally avoided due to nitrogen loss concerns. However, the Thermo-Catalytic Reforming (TCR) process, which includes a MAP reactor, minimizes nitrogen losses during pyrolysis and therefore would be aligned with organic farming principles.

- **Limitations Related to "Factory Farming":** Manure-based fertilizing products are currently limited to those derived from organic farms specifically prohibiting those manure-based materials coming from “factory farming”. However, under these regulations there is no clear definition on the criteria to set a farm as a “factory farm”. A discussion is currently ongoing within the expert group designated by the Commission (EGTOP) regarding the term "factory farming" and its implications for integrating recovered fertilizers into organic farming. The conclusion of this discussion is critical for integrating products like FERTIMANURE BBFs from conventional livestock farming (not factory farming) into organic production systems.

- **Discussion and Integration into Organic Farming:** A thorough discussion involving various key stakeholders is necessary to establish a shared approach to the authorized use of recovered BBFs in organic farming. Considering the use of nutrients recovered from animal manure, even from factory farms, can help integrate recycled nutrients into organic food production, closing nutrient cycles and promoting sustainability.

Having into consideration the key points discussed and although currently can be considered under the term “factory farming origin”, we identified three promising products to be accepted under the organic farming regulation:

- the soil improver being the solid fraction of digestate produced from anaerobically digested cattle manure in the Dutch pilot;
- the biochar from cattle dung obtained in German pilot which includes a unit for the nitrogen recovery from off-gases of TCR unit;
- the amino acid-based plant biostimulants obtained from the enzymatic hydrolysis of the microalgae cultivated over the permeate recovered from pig slurry in the Spanish pilot;

As tangible outputs of the work developed within this assessment, 3 dossiers of the products identified were developed following the procedure established requesting the amendment of the Annex II of the Implementing Regulation 2021/1165 (see annex I.A, I.B. and I.C). Besides, a position paper was developed “*on increasing the scope of bio-based fertilisers for organic farming*”.

Considering the key points identified, the project makes the following specific recommendations for future work in research and innovation projects and even for the policy makers:

- It is crucial to establish practical and verifiable criteria for manure-derived BBFs coming from conventional farms to be accepted in the organic farming sector

- In general terms and related to the previous point, it is necessary to start discussions on adapting regulations to recognize BBFs as authorized fertilizing products for organic farming, promoting sustainability and future food security. These discussions must include all the key stakeholders

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involved in the value chain of organic sector, including agricultural and farming sectors, food transformation sector and consumers.

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Annexes

ANNEX I Specific dossiers prepared for the authorisation of organic soil conditioner (NL) (ANNEX I.A), Biochar from cattle dung (GE) (ANNEX I.B) and Plant biostimulant (SP) (ANNEX I.C).

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ANNEX I.A

DOSSIER CONCERNING THE REQUEST TO AMEND ANNEX II TO COMMISSION IMPLEMENTING REGULATION 1165/2021[1]

Fertilisers, soil conditioners and nutrients referred to in Article 24 (1)(b) of Regulation (EU) No 848/2018[2] to be evaluated for use in EU organic production

Article 24 (7) of Regulation (EU) No 848/2018:

"Where a Member State considers that a product or substance should be added to or withdrawn from the lists of authorised products and substances referred to in paragraphs 1 and 2, or that the specifications of use referred to in the production rules should be amended, it shall ensure that a dossier giving the reasons for the inclusion, withdrawal or other amendments is officially sent to the Commission and to the other Member States and is made publicly available, subject to Union and national legislation on data protection. The Commission shall publish any requests referred to in this paragraph."

1. General information on the request

Nature of the request	☒ Inclusion ☐ Deletion ☐ Change of disposition
Request introduced by	[Member State] Contact e-mail:
Date	

Please indicate if the material provided is confidential

2. Requested inclusion/deletion/amendment

Name of additive / substance	Primary use/conditions
SOIL CONDITIONER FROM DIGESTATE – CATTLE MANURE	Stable odourless solid product with high fibre and carbon content (~12% organic matter) and also nutrients, suitable for consumers as potting/gardening soil and for farmers as a soil conditioner on agricultural land.

[1] EUR-Lex - 32021R1165 - EN - EUR-Lex (europa.eu)
[2] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0848&from=EN

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3. Status

Authorization in general agriculture or food processing

Historic use: digestate or processed digestate has been generally used in agriculture by spreading it on agricultural land as source of organic matter and nutrients and to improve the general characteristics of agricultural soil.
Regulatory status (EU, national, others) (including expiry dates of authorisation if applicable): Category of fertilising product under EU reg. 2019/1009: FPC 3.A – organic soil conditioner composed of CMC 5 – Digestate other than fresh crop digestate.

4. Identification[3]

Identification of substance, terminology, synonyms

Chemical name(s): organic amendment / soil improver
Other names: stable organic matter, solid fraction of digestate, biogas digestate, Acidogenic digestate; Methanogenic digestate, Anaerobically digested manure;
Trade name: Organic soil improver from dairy slurry
CAS code (Chemical Abstracts Systematic Names): Not identified
Other code(s)

5. Aspects related to the relevance and priority of the request

Geographical relevance (Member States, regions, …): Carbon content with potential to increase carbon stocks in soils, feed their microbiota and ultimately improve soils' quality and health. Contains other valuable nutrients (macro, meso and micro-nutrients) in lower concentration, relatively high in phosphorus, normally slowly released, which could be additionally removed by an additional process of acidification and precipitation if needed.
Socio-economic relevance (acreage, turnover, number of stakeholders affected, …): diversification of potential revenues for livestock farmers and new and recycled nutrient sources for agricultural and fertilising companies to be used in their formulations. Additionally, digestate is produced from the anaerobic digestion of cattle slurry, diversifying potential energy source in a farm and making it self-sustainable energetically, making the farm, therefore, less dependent on external energy sources.
Sectors affected: livestock sector, agricultural sector and industrial sector (fertilizing industry)
Stakeholder engagement/consultation in dossier preparation Farmers in the dairy farming region Achterhoek in the Netherlands and farmer organisations such as ZLTO/LTO are involved and positive.

[3] To be filled in only when applicable

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Market presence: availability (quantity / quality) and origin (local / imported) For an actual average farm it could represent 10% of the volume of (digested) manure, for example for dairy livestock farms. The product originates from relatively simple solid-liquid separation technologies like a screw press, drum filter, belt press or centrifuge press, with generally low cost and energy of treatment. In countries like Netherlands, Germany, Belgium and Denmark these installations are becoming common practise, so are the products derived.
Aspects of international harmonization / market distortion In United States, digestate obtained from manure is the second greatest source, after digestate obtained from sewage sludge. Concentrated animal feeding operations (CAFOs) are regulated as point sources of pollution by the EPA [40 CFR 412]. In most of the States anaerobic digesters on CAFOs are required to meet all federal, state and local regulations, including Best Management Practices for the application of manure [40 CFR 412.4]. Anaerobic digestate made of manure feedstocks does not appear on the National List of Non-synthetic substances prohibited for use in organic crop production published by the National Organic Standards Board of United States. Therefore, Manure-based digestate could be authorised if processing requirements are met (§205.203(c)(2)). In the case of Japan, the Japanese Agricultural Standard for Organic Products of Plant Origin lists a number of authorised fertilising products in its Appended Table 1 "Fertilizers and soil improvement substances". In the list of authorised substances, substances derived from fermented, dried or calcined manure (derived from manure of livestock and poultry) as well as methane fermentation digestive juices in which manure is specifically mentioned as an authorised feedstock are mentioned.
A (possible) authorization leads to amendment(s) in the respective Annex[4] Origin of the digested manure should be amended, currently factory farming not authorised, but lacks clarification on the definition of the term.
Other aspects justifying high priority, such as: It is primarily used to cycle organic matter, and also provides macro, meso, and micronutrients. In this regard, organic matter and particularly highly stable carbon can be integrated into agricultural soils which is expected to significantly increase the soils' health and ultimately increase carbon stocks significantly contributing to the climate action. In countries like Netherlands, Germany, Belgium and Denmark solid-liquid separation installations are becoming common practise, and so the products. Therefore, availability of these kind of processed organic amendments is expected to increase. • other

[4] It should be carefully analysed whether the specific use of a substance is already (implicitly) authorized or not. This is to avoid the following conclusion: "The Group considers that the use of … is in line with the objectives, criteria and principles of the organic regulation. There is no need for amendment of the specific conditions of Annex …"

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6. Characterisation

Raw materials, methods of manufacture

Composition/ingredients: Digested cattle slurry: • Organic carbon: 126 g/kg fresh matter • Total nitrogen: 6.5 g/kg fresh matter • Total phosphorous: 2.4 g/kg fresh matter • Total potassium: 5.0 g/kg fresh matter • Dry matter: 260 g/kg fresh matter.
Relevant nutrients and trace elements content: • S: 1.4 g/kg fresh matter • Ca: 4.4 g/kg fresh matter • Mg: 2.1 g/kg fresh matter • Na: 0.8 g/kg fresh matter • Mn: 521 mg/kg dry matter • Zn: 277 mg/ kg dry matter • Cu: 154 mg/kg dry matter
Other trace elements and pathogens: • Ni: 5.2 mg/kg dry matter • Pb: 5 mg/kg dry matter • Cr: 6.6 mg/kg dry matter • Cr VI: not available • Hg: <0.05 mg/kg dry matter • As: <1 mg/kg dry matter • Cd: <0.4 mg/kg dry matter • Fe: 2.4 g/kg dry matter • Salmonella spp.: Not detected in 25 g of sample • E.Coli:9,500 CFU/g. (Colony Forming Units)
Basic physical properties: Solid fibrous material with basic pH 8.4 and 0.5 g/cm3 density
Solubility

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According to the agronomic tests performed (soil incubations, pot tests and field tests) release of available nutrients is relatively slow in soil
Origin of raw materials, production methods: Anaerobic digestor working at reactor temperatures between 35 and 37ºC. The effective capacity of digester is 650m3 and the residence time 90 days on average. The digestor treats all the cattle slurry produced in the dairy farm plus other co-substrates (feed residues, solid stable manure, etc.). Digestate is separated in a solid and liquid fraction with a conventional separation system, in this case a screw press using electricity

7. Specification of use

Agronomic use

Fertiliser or soil conditioner: organic soil conditioner with low concentration of nutrients mainly in organic form
Application method: integration into agricultural soil, mainly arable crops, fodder maize or natural grass land, can be in a two-step process, first application above ground and then plowing under within some hours
Dosage: Ideally the dosage would dependent on the current soil carbon content, cultivation system type, other fertilizers and residual effect of previous fertilisation, etc. Following the recommendation done by one of the national agricultural laboratories Eurofins, dosage would range from roughly 0 to 3,000 kg in terms of effective organic matter (=EOM), so the effective part of the organic matter. However, in practice, the dosing would depend on maximum applicable nitrogen and in the case of some countries such as the Netherlands, additional national phosphorus application limits linked to soil status/type and crop type would determine the application dose
Stage of plant development: Soil preparation before sowing
Physiological effect, mode of action: Nutrient provision for crops and soils, but mainly structural effect for soil quality and fertility

8. Reasons for the inclusion, withdrawal or amendments

Explain the need for the proposed fertilizer or soil conditioner or nutrient Soil organic carbon levels are under treat, since more and more organic residues and wastes are digested for biogas production or incinerated. Carbon is not stable in soils and have to be replenished. This organic soil conditioner can be a potential product with high value. High in carbon, low in nutrients which are recovered separately in useful products
What alternative solutions are currently authorised or possible? • Biogas digestate containing animal by-products (categorised as category 3 or 2 according to Regulation (EC) No 1069/2009) co-digested with material of plant or animal origin as listed in Annex II of Regulation 2021/1165 are accepted. However, factory farming origin

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is forbidden. It is not clear what is the criteria to consider a family company and small sized cattle farm of about 60-80 dairy cows as factory farming but most probably and considering the characteristics of the farm Arjan Prinsen Farm (producer) can be categorised out of that definition. Cows are largest part of the year outside in the field, that is also a requirement set by the milk cooperative for which milk is produced. In the Netherlands the organisation responsible of authorising manure derived fertilisers (SKAL, see https://www.skal.nl/ in Dutch) in organic farming authorised 30% from non-organic agriculture source, specifically from cattle, goats, sheep and horse. In this case, the requirement is that the animals have pasture or an outdoor area, or a partially littered floor. Manure from veal calves and solid manure from free-range pigs are also only permitted under these conditions. Arjan Prinsen Farm meets those conditions
Is there any traditional use or precedents in organic production? Only digestate from manure from farms under organic farming

9. Consistency with objectives and principles of organic production

Please use the checklist in Annex A to this dossier to indicate consistency with objectives and principles of organic production, as well as criteria and general rules, laid down in Council Regulation (EC) 834/2007 Title II and Title III as applicable.

Annex A

CHECKLIST FOR CONSISTENCY
with objectives and principles of organic production with reference to specific articles in the organic regulation

Criteria	**Specific articles in Regulation (EU) 848/2018**	**Fulfilled? Yes / no / not applicable**	**Brief qualification**
Exclude the use of GMOs and products produced from or by GMOs	Art. 3(58)(59)(60); Art. 5(f)(3); Art. 11; Art. 30(4)	Not applicable	
Enhances the health of soil, water, plants and animals	Art. 4(b)	Y	Tested and demonstrated in pot and field trials
High level of biodiversity	Art. 4(c) and (i); Art 6(a)	Not applicable	Not assessed, but expected to promote soil biodiversity by the addition of organic carbon

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Criteria	Specific articles in Regulation (EU) 848/2018	Fulfilled? Yes / no / not applicable	Brief qualification
Makes responsible use of energy and the natural resources, such as water, soil, organic matter and air	Art. 3(a)(iii)	Y	Soil conditioner obtained after anaerobic digestion permitting the generation of heat and electricity from the co-generation engine implemented at the farm. The farm is potentially energetically self-sufficient.
Aim at producing products of high quality	Art. 5(d)	Y	Agricultural performance equivalent to other conventional organic fertilizing products (supporting material D2.5 Final - Report on agronomic performance of the obtained BBFs and TMFs in laboratory setting and D2.6 Final - Report on agronomic and Environmental performance in field trial Experiences will be available online in the webpage of FERTIMANURE)
Aim at producing a wide variety of foods and other agricultural products……goods produced by the uses of processes that do not harm the environment, human health, plant health or animal health and welfare	Art. 5 (d)	Y	Crops tested: grass, maize, potatoes and root crops in general
Use living organisms and mechanical production methods	Art. 5(f)(i)	N	Produced after the biological transformation of cattle manure with agricultural residues through anaerobic digestion and subsequent solid liquid separation

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Criteria	Specific articles in Regulation (EU) 848/2018	Fulfilled? Yes / no / not applicable	Brief qualification
Limited to natural or naturally-derived substances	Art. 5(g)(ii)	Y	Produced from digested cattle manure using feed residues as co-substrate
For chemically synthesized inputs: appropriate management practices do not exist	Art. 4(c)(i)	Not applicable	
For chemically synthesized inputs: organic, natural or naturally-derived alternative substances are not available on the market	Art. 24(5)	Not applicable	
For chemically synthesized inputs: use of organic, natural or naturally-derived alternative substances contributes to unacceptable environmental impacts	Art. 24(5)	Not applicable	
Maintenance of plant health primarily by preventative measures, such as resistant species/varieties, appropriate crop rotations, cultivation techniques, mechanical and physical methods, thermal processes and the protection of natural enemies of pests	Art. 3(4)	Not applicable	
All plant production techniques used shall prevent or minimise any contribution to the contamination of the environment	Art. 3(5)	Y	Potential contamination to groundwater and atmosphere assessed. Better performing in terms of emissions than the conventional fertilisation strategies used (mineral fertiliser fertilization)

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Criteria	Specific articles in Regulation (EU) 848/2018	Fulfilled? Yes / no / not applicable	Brief qualification
The corresponding use is authorised in general agriculture […]	Art. 9 (3)	Y	Full accepted in the Netherlands and other countries. With application requirements for best agronomic and environmental performance
Their use is necessary for sustained production and essential for its intended use	Art. 24(3)(a)	Y	Cycling organic matter is important in arable farming and dairy farming
All products and substances shall be of plant, animal, microbial or mineral origin …	Art. 24(3)(b)	Y	Animal manure based and not addition of chemicals
… except where products or substances from such sources are not available in sufficient quantities or qualities or if alternatives are not available	Art. 24(3)(b)	Not applicable	
Their use is essential for the control of a harmful organism or a particular disease for which other biological, physical or breeding alternatives or cultivation practices or other effective management practices are not available	Art. 24(3)(c)(i)	Not applicable	
If products are not of plant, animal, microbial or mineral origin and are not identical to their natural form, they may be authorised only if their conditions for use preclude any direct contact with the edible parts of the crop	Art. 24(3)(c)(ii)	Not applicable	
Products and substances to be withdrawn or their use amended/ limited	Art. 24(7)	No	
Others: please specify			

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ANNEX I.B

DOSSIER CONCERNING THE REQUEST TO AMEND ANNEX II TO COMMISSION IMPLEMENTING REGULATION 1165/2021[5]

Fertilisers, soil conditioners and nutrients referred to in Article 24 (1)(b) of Regulation (EU) No 848/2018[6] to be evaluated for use in EU organic production

Article 24 (7) of Regulation (EU) No 848/2018:

"Where a Member State considers that a product or substance should be added to or withdrawn from the lists of authorised products and substances referred to in paragraphs 1 and 2, or that the specifications of use referred to in the production rules should be amended, it shall ensure that a dossier giving the reasons for the inclusion, withdrawal or other amendments is officially sent to the Commission and to the other Member States and is made publicly available, subject to Union and national legislation on data protection. The Commission shall publish any requests referred to in this paragraph."

1. General information on the request

Nature of the request	☒ Inclusion ☐ Deletion ☐ Change of disposition
Request introduced by	[Member State] Contact e-mail:
Date	

Please indicate if the material provided is confidential

2. Requested inclusion/deletion/amendment

Name of additive / substance	Primary use/conditions
BIOCHAR FROM MANURE – CATTLE DUNG	Carbon and phosphorus rich stable product used as soil amendment

3. Status

Authorization in general agriculture or food processing

Historic use

[5] EUR-Lex - 32021R1165 - EN - EUR-Lex (europa.eu)

[6] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0848&from=EN

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Regulatory status (EU, national, others) (including expiry dates of authorisation if applicable) Category of fertilising product under EU reg. 2019/1009: FPC 3.A – organic soil conditioner composed of CMC 14 – Pyrolysis and gasification materials.

4. Identification[7]

Identification of substance, terminology, synonyms

Chemical name(s): biochar
Other names: charcoal, carbon, organic amendment, stable organic matter
Trade name: biochar
CAS code (Chemical Abstracts Systematic Names) CAS 16291-96-6
Other code(s): potential product registration as REACH regulation: EC# 240-383-3 Charcoal

5. Aspects related to the relevance and priority of the request

Geographical relevance (Member States, regions, …): high stability with a controlled release of present or added nutrients. Carbon content with potential to increase carbon stock in soils and ultimately soils' health
Socio-economic relevance (acreage, turnover, number of stakeholders affected, …): diversification of potential revenues for livestock farmers and new and recycled nutrient sources for agricultural and fertilising industry sector. Potential of creating a carbon sink and decarbonize sectors of agriculture
Sectors affected: livestock sector, agricultural sector and industrial sector (fertilizing industry)
Stakeholder engagement/consultation in dossier preparation: stakeholder consultation on specific workshops within FERTIMANURE project to the broader farming sector
Market presence: availability (quantity / quality) and origin (local / imported). currently biochar from vegetal origin is available in the market. The Europe Biochar Market was worth USD 0.59 billion in 2021 and is estimated to be growing at a CAGR of 13.6%, to reach USD 0.72 billion by 2026 (market data forecast, 2023)
Aspects of international harmonization / market distortion The Crops Subcommittee of the National Organic Standards Board of United States evaluated in 2021the inclusion of cow manure derived biochar on the national list of authorised products. In this case the product would be categorised as Organic Food Production Act (OFPA) category for Crop and Livestock Materials and is characterized as a fertilizer and carbon storage soil amendment/soil conditioner to aid in organic crop production. Biochar is defined in NOP

[7] To be filled in only when applicable

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guidance document 5034 “Materials for Organic Crop Production” as: "[…] biomass that has been carbonized or charred. Sources must be untreated plant or animal material. Pyrolysis process must not use prohibited additives." And refers to the practice standard 205.203 on Soil fertility and crop nutrient management. The biochar in evaluation falls under this description. In the case of Japan, the Japanese Agricultural Standard for Organic Products of Plant Origin lists a number of authorised fertilising products in its Appended Table 1 “Fertilizers and soil improvement substances”. In the list of authorised substances, Charcoal Natural substances or substances derived from natural sources which have not undergone any chemical treatment are mentioned. This mention, does not mention manure as an unauthorised feedstock
A (possible) authorization leads to amendment(s) in the respective Annex[8] Yes. Inclusion of manure-derived biochar in the already existing category of the biochar authorised from organic materials of plant origin. Specification of coupling a N recovery from off gas could be required
Other aspects justifying high priority, such as • highly stable carbon can be integrated into agricultural soils which is expected to significantly increase the soils’ health and ultimately increase carbon stocks significantly contributing to the climate action • biochar from cattle manure contains available and slow-release phosphorus (demonstrated by mineralisation tests) which can achieve significantly replacing other non-renewable phosphorus sources • biochar can help to inhibit the leaching of nutrients such as N, P and K, thus reducing the amount of additional fertilizer required

6. Characterisation

Raw materials, methods of manufacture

Composition/ingredients cattle dung (3-8 samples from different batches): • Organic carbon: 393g/kg fresh matter • Total nitrogen: 10.2g/kg fresh matter • Total phosphorous: 30.4g/kg fresh matter • Total potassium: 95g/kg fresh matter • Dry matter: 980 g/kg fresh matter
Relevant nutrients and trace elements content: • S: 2.5 g/kg fresh matter • Ca: 22.9 g/kg fresh matter

[8] It should be carefully analysed whether the specific use of a substance is already (implicitly) authorized or not. This is to avoid the following conclusion: "The Group considers that the use of … is in line with the objectives, criteria and principles of the organic regulation. There is no need for amendment of the specific conditions of Annex …"

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• Mg: 6.7 g/kg fresh matter • Na: 8.2 g/kg fresh matter • Mn: 0.4 g/kg fresh matter • Zn: 358.5 mg/ kg dry matter • Cu: 51.1 mg/kg dry matter
Other trace elements and pathogens: • Ni: 6.9 mg/kg dry matter • Pb: 1.9 mg/kg dry matter • Cr: 11.0 mg/kg dry matter • Cr VI: 0.05 mg/kg dry matter • Hg: 0.02 mg/kg dry matter • As: 0.47 mg/kg dry matter • Cd: 0.06 mg/kg dry matter • Fe: 3402 mg/kg dry matter • PAH: 3.0 mg/kg dry matter • Cl: 17 g/kg fresh matter • Salmonella spp.: Not detected in 25 g of sample • E.Coli:<10 CFU/g (colony forming units)
Basic physical properties: Solid porous material with basic pH 12.3 and 0.5 g/cm3 density
Solubility: Low solubility of carbon (opportunity to increase carbon stock in soils), average solubility for nutrients in matrix
Origin of raw materials, production methods: Dried Cattle dung, where the exhaust gas is scrubbed with sulfuric acid to produce ammonium sulphate solution) is treated by thermo-catalytic Reforming (TCR). Process reactor temperatures between 450°C and 500°C and post-reforming temperatures between 600°C and 650°C. The process gas from the TCR process contains up to 5 % ammonia. This ammonia is recovered in the MAP reactor. There a scrubbing process with phosphoric acid, followed by crystallization produces solid mono ammonium phosphate (MAP) which can be used as a fertilizer without further purification

7. Specification of use

Agronomic use

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Fertiliser or soil conditioner: Soil conditioner
Application method: Integration into soil using a plow
Dosage: 90-500 kg/ha (extrapolated from pot trials)
Stage of plant development: Soil preparation before sowing
Physiological effect, mode of action: Nutrient provision for crops and soils, but mainly structural effect for soil quality and fertility

8. Reasons for the inclusion, withdrawal or amendments

Explain the need for the proposed fertilizer or soil conditioner or nutrient The main function of this product is the improvement of the physical structure and microbial soil functions together with its potential as carbon storage into agricultural soils. However, it can also be a relevant source of phosphorus and potassium. As a natural and renewable resource, it contributes significantly to close carbon and nutrient cycles, reducing the dependency upon non-renewable phosphorus and potassium sources
What alternative solutions are currently authorised or possible? • Biochar from plant origin is authorised to be used in organic farming, and biochars from other origins (EGTOP, 2018) or specifically from bone meal (EGTOP, 2022) were positively evaluated for their authorisation • Soft ground rock phosphate or basic slag (Thomas phosphates or Thomas slag) as source of phosphorus are authorised. As non-renewable source of phosphorus, finding new and renewable phosphorus sources such as the biochar obtained from the TCR cattle dung is critical • In pressure regions there is an excess of cattle manure which cannot be brought to fields directly. Transportation out of the regions is expensive and ineffective. By producing N-fertilizers within the process the nitrogen can be distributed specifically with regards to crop needs
Is there any traditional use or precedents in organic production? No

9. Consistency with objectives and principles of organic production

Please use the checklist in Annex A to this dossier to indicate consistency with objectives and principles of organic production, as well as criteria and general rules, laid down in Council Regulation (EC) 834/2007 Title II and Title III as applicable.

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Annex A

CHECKLIST FOR CONSISTENCY
with objectives and principles of organic production with reference to specific articles in the organic regulation

Criteria	Specific articles in Regulation (EU) 848/2018	Fulfilled? Yes / no / not applicable	Brief qualification
Exclude the use of GMOs and products produced from or by GMOs	Art. 3(58)(59)(60); Art. 5(f)(3); Art. 11; Art. 30(4)		Not applicable
Enhances the health of soil, water, plants and animals	Art. 4(b)	Y	Presumably from the agronomic tests performed. Improves soil health especially for loamy or sandy soils by providing better ventilation and, due to the large surface area of the material, good conditions for the colonization of soil-typical microbial communities (Blanco-Canqui, 2017; Razzaghi et al., 2020)
High level of biodiversity	Art. 4(c) and (i); Art 6(a)		Not tested
Makes responsible use of energy and the natural resources, such as water, soil, organic matter and air	Art. 3(a)(iii)	Y	Able to partially substitute non-renewable P sources

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Criteria	Specific articles in Regulation (EU) 848/2018	Fulfilled? Yes / no / not applicable	Brief qualification
Aim at producing products of high quality	Art. 5(d)	Y	Agricultural performance equivalent to other conventional fertilizing products. Improvement of soil structure. (Supporting material D2.5 Final - Report on agronomic performance of the obtained BBFs and TMFs in laboratory setting and D2.6 Final - Report on agronomic and Environmental performance in field trial Experiences will be available online in the webpage of FERTIMANURE)
Aim at producing a wide variety of foods and other agricultural products……goods produced by the uses of processes that do not harm the environment, human health, plant health or animal health and welfare	Art. 5 (d)	Y	Non-hazardous product, process ensures the breakdown of substances present in cattle manure, such as antibiotics, In addition, no germs or bacteria can be detected due to the high process temperature. PAH were measured and were always below the threshold values established in the Fertilising product Regulation (Reg. (UE). 2019/1009) Crops tested: ryegrass, potatoes, maize
Use living organisms and mechanical production methods	Art. 5(f)(i)	No	Use of thermo-chemical processes
Limited to natural or naturally-derived substances	Art. 5(g)(ii)	Y	Cattle dung is a recycled raw material

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Criteria	Specific articles in Regulation (EU) 848/2018	Fulfilled? Yes / no / not applicable	Brief qualification
For chemically synthesized inputs: appropriate management practices do not exist	Art. 4(c)(i)	Not applicable	
For chemically synthesized inputs: organic, natural or naturally-derived alternative substances are not available on the market	Art. 24(5)	Not applicable	
For chemically synthesized inputs: use of organic, natural or naturally-derived alternative substances contributes to unacceptable environmental impacts	Art. 24(5)	Not applicable	
Maintenance of plant health primarily by preventative measures, such as resistant species/varieties, appropriate crop rotations, cultivation techniques, mechanical and physical methods, thermal processes and the protection of natural enemies of pests	Art. 3(4)	Not applicable	Not tested
All plant production techniques used shall prevent or minimise any contribution to the contamination of the environment	Art. 3(5)	Not applicable	
The corresponding use is authorised in general agriculture […]	Art. 9 (3)	Y	Under CMC14 and as FPC 3.A – organic soil conditioner
Their use is necessary for sustained production and essential for its intended use	Art. 24(3)(a)		Not tested
All products and substances shall be of plant, animal, microbial or mineral origin …	Art. 24(3)(b)	Y	Animal manure origin

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Criteria	Specific articles in Regulation (EU) 848/2018	Fulfilled? Yes / no / not applicable	Brief qualification
… except where products or substances from such sources are not available in sufficient quantities or qualities or if alternatives are not available	Art. 24(3)(b)	Not applicable	
Their use is essential for the control of a harmful organism or a particular disease for which other biological, physical or breeding alternatives or cultivation practices or other effective management practices are not available	Art. 24(3)(c)(i)	Not applicable	
If products are not of plant, animal, microbial or mineral origin and are not identical to their natural form, they may be authorised only if their conditions for use preclude any direct contact with the edible parts of the crop	Art. 24(3)(c)(ii)	Y	Product used in soil preparation. It will not be in contact with any edible part of the crop
Products and substances to be withdrawn or their use amended/ limited	Art. 24(7)	Y	Use of non-renewable P-sources such as Soft ground rock phosphate can be partially substituted
Others: please specify			

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ANNEX I.C

DOSSIER CONCERNING THE REQUEST TO AMEND ANNEX II TO COMMISSION IMPLEMENTING REGULATION 1165/2021[9]

Fertilisers, soil conditioners and nutrients referred to in Article 24 (1)(b) of Regulation (EU) No 848/2018[10] to be evaluated for use in EU organic production

Article 24 (7) of Regulation (EU) No 848/2018:

"Where a Member State considers that a product or substance should be added to or withdrawn from the lists of authorised products and substances referred to in paragraphs 1 and 2, or that the specifications of use referred to in the production rules should be amended, it shall ensure that a dossier giving the reasons for the inclusion, withdrawal or other amendments is officially sent to the Commission and to the other Member States and is made publicly available, subject to Union and national legislation on data protection. The Commission shall publish any requests referred to in this paragraph."

1. General information on the request

Nature of the request	☒ Inclusion ☐ Deletion ☐ Change of disposition
Request introduced by	[Member State] Contact e-mail:
Date	

Please indicate if the material provided is confidential

2. Requested inclusion/deletion/amendment

Name of additive / substance	Primary use/conditions
ALGAE-BASED BIOSTIMULANTS	Enzymatically hydrolysed *Scenedesmus spp.* microalgae biomass cultured in reclaimed water from pig slurry. Product sold as fertiliser and plant protection products

[9] EUR-Lex - 32021R1165 - EN - EUR-Lex (europa.eu)
[10] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0848&from=EN

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3. Status

Authorization in general agriculture or food processing

Historic use:
Regulatory status (EU, national, others) (including expiry dates of authorisation if applicable): Category of fertilising product under EU reg. 2019/1009: PFC6B. – non microbial biostimulant composed of CMC 1 – Virgin material substances and mixtures

4. Identification[11]

Identification of substance, terminology, synonyms

Chemical name(s): Aminoacid-based biostimulants
Other names: protein hydrolysate
Trade name
CAS code (Chemical Abstracts Systematic Names): CAS 100209-45-8
Other code(s): Potential product registration as REACH regulation: 309-353-8 (protein hydrolysate, vegetable)

5. Aspects related to the relevance and priority of the request

Geographical relevance (Member States, regions, …): Biostimulants can help to stimulate plant growth through different mechanisms. Our aminoacid-based biostimulants were demonstrated (in pot tests) to help several crops to face hydric and salinity stress (demonstrated in tomato, spinach and lettuce), which can be particularly relevant in Mediterranean region in which water scarcity is an increasing concern
Socio-economic relevance (acreage, turnover, number of stakeholders affected, …): Demonstrated plant protection effect towards hydric and saline stress conditions in pot test. Diversification of plant protection products that might open a new revenue source for livestock farmers. Field tests did not produce conclusive results and additional tests would be needed to validate the results from mesocosms
Sectors affected: livestock sector, agricultural sector and industrial sector (organic fertilizing product industry)
Stakeholder engagement/consultation in dossier preparation: public administration involved in the preparation of the dossier (DACC Department of Climate Action, Food and Rural Agenda of the Catalan Government)
Market presence: availability (quantity / quality) and origin (local / imported): Most market analysts report that the European biostimulants market accounts for roughly half of the global

[11] To be filled in only when applicable

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market. Estimates of the value of the European market range around USD 1.5-2 billion in 2022. (Market Date Forecast, Market and Markets and Dunham Trimmer). The compound annual growth rate (CAGR) reported is 10-12% (European Biostimulants Industry Council, 2023)

Aspects of international harmonization / market distortion

The National Organic Program of the United States published the guidance document "Materials for Organic Crop Production" and referred as NOP 5034-1. This guide is aimed to be a guidance for organic producers when deciding about the authorised materials to be used in the organic sector, including organic agricultural production. The guide includes a list of materials which are considered non synthetic (natural) and are not required to be included on the National List. There is an specific section regarding aquatic plant products, including algae and algae products that can be extracted with non-synthetic or synthetic materials. Enzymes (endo and exopeptidases) used in the hydrolytic process of algae to extract free aminoacids in biostimulant could be categorized as non-systhetic materials and moreover animal-derived enzymes are authorised as ingredients in or on processed products labelled as "organic" or "made with organic (§ 205.605). Therefore, we do not identify any aspect against authorising the biostimulant in evaluation as fertilising product for crops according to the US rules of organic farming.

Aminoacid-based biostimulants, as such, are not mentioned in the table authorising certain "Fertilizers and soil improvement substances" of the Japanese Agricultural Standard for Organic Products of Plant Origin (Appended Table 1). However, since biostimulants are algae-derived product they could be categorised as "Substances derived from plants and their residues" in which the only requirement for its authorisation is that the product must not have undergone any chemical treatment. Enzymatic treatment is a fermentative process, and therefore the biostimulant in evaluation could be authorised in the Japanese organic production

A (possible) authorization leads to amendment(s) in the respective Annex[12]

According to the agronomic results obtained, Aminoacid rich biostimulants obtained from microalgae hydrolysis could be included as "*Other low risk substances from plant or animal origin* *" in the Annex I Active substances contained in plant protection products authorised for use in organic production. Otherwise, this product could fit in the following categories listed in the Annex II: Hydrolysed proteins of plant origin, Algae and algae products

Other aspects justifying high priority, such as

- Using these biostimulants can help diverse crops to face different stressors (effectivity demonstrated under hydric and saline stress). They could increase plant resistance to stress conditions, limiting the need of other protection products. Also, since biostimulants were also related to better soil nutrient availability, their use could be associated to a less fertilising product need
- Other

[12] It should be carefully analysed whether the specific use of a substance is already (implicitly) authorized or not. This is to avoid the following conclusion: "The Group considers that the use of … is in line with the objectives, criteria and principles of the organic regulation. There is no need for amendment of the specific conditions of Annex …"

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6. Characterisation

Raw materials, methods of manufacture

Composition/ingredients: Biostimulants obtained after enzymatic hydrolysis of *Scenedesmus spp*. using 2% endopetidase + 1% exopeptidase. Microalgae were cultivated over reverse osmosis permeate obtained from the liquid fraction of pig slurry (a farm in Catalonia region with a rearing license for 1618 fattening pigs per year).

Biostimulants are composed of 1.5% of total free aminoacids

Relevant nutrients and trace elements content: Macro, meso and micronutrient contents as well as heavy metals contents of the aminoacid based biostimulant are reported in the following table

Parameter	Value	Parameter	Value
Organic Matter (g/kg fresh matter)	60.4 ± 1.2 (n=2)	**Cu (mg/kg DM)**	<0.1 (n=2)
Organic C (g/kg fresh matter)	25.2 ± 0.2 (n=2)	**Zn (mg/kg DM)**	<0.1 (n=2)
Total N (NTK) (g/kg fresh matter)	4.5 ±0.3 (n=2)	**Fe (mg/kg dry matter)**	<0.1 (n=2)
Total P (g/kg fresh matter)	40.9 ±0.1 (n=2)	**Mn (mg/kg dry matter)**	<0.1 (n=2)
Total K (g/kg fresh matter)	1.2 ±0.1 (n=2)	**Cd (mg/kg dry matter)**	<0.1-(n=2)
S (g/kg fresh matter)	0.37 ±0.03 (n=2)	**Ni (mg/kg dry matter)**	<0.1 (n=2)
Ca (g/kg fresh matter)	<0.1 (n=2)	**Pb (mg/kg dry matter)**	<0.1 (n=2)
Mg (g/kg fresh matter)	< 1	**Cr (mg/kg dry matter)**	<0.1-(n=2)
Na (g/kg fresh matter)	0.33 ±0.03 (n=2)	**Hg (mg/kg dry matter)**	<0.1 (n=2)
Protein content (g/kg fresh matter)	28.3 ±1.8 (n=2)	**As (mg/kg dry matter)**	<0.1 (n=2)
Total free amino acids (g/kg fresh matter)	13.6 ±1.2 (n=2)		

Basic physical properties: liquid biostimulant (0.99 kg/L) with near to neutral pH (pH 7.7)

Solubility

Origin of raw materials, production methods:

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1. First microfiltration (400 nm pore size tubular ceramic membrane) and reverse osmosis (a low rejection polymeric RO membrane working at ~40bar and 50ºC) of the liquid fraction of pig slurry to obtain a clean and safe permeate (Rodriguez-Alegre et al., 2023)
2. Reclaimed permeate is then used as culturing media for *Scenedesmus spp*. microalgae in photobioreactor. A commercial inoculum of *Scenedesmus spp*. microalgae (2.2L of inoculum per each L of permeate) is used to inoculate the culturing media. Microalgae cultivation lasts for approximately 1 month, after that period, the remaining nutrients in the permeate are exhausted and microalgae are dewatered through a centrifuge, obtaining 0.63% of the inlet permeate recovered as microalgae paste (in fresh mass) rich in algal protein. The exhausted cultivation media could be used as reclaimed water
3. Enzymatic hydrolysis of dewatered algae biomass. The optimised hydrolysis for the maximum protein solubilisation consisted of the use of 2% DM. exopeptidase and 1% DM. endopeptidase at 50ºC for 6h, and then 1% endopeptidase in the aqueous phase at 50ºC for 1h. Besides, hydrolysis was maximised when pH was controlled to pH8

7. Specification of use

Agronomic use

Fertiliser or soil conditioner: biostimulant
Application method: Foliar application
Dosage: Depending on amino acids concentration but slightly higher than commercial references (6-10% free aminoacids)
Stage of plant development: 3-5 applications following phenological stages of the plant: seedling, vegetating, budding, flowering and ripening, i.e.
Physiological effect, mode of action: From the results obtained, it can be concluded that they improved the nutrient availability, nutrient efficiency and crop tolerance to abiotic stress, although the mode of action should be clarified by specific research Since they can increase plant resistance to hydric stress, we could suggest using them in locations with high risk of drought periods, and and/or in crops with high water demand. All in all, aminoacid-based biostimulants could help to optimize the use of water in crops

8. Reasons for the inclusion, withdrawal or amendments

Explain the need for the proposed fertilizer or soil conditioner or nutrient

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What alternative solutions are currently authorised or possible? Algae and algae products are authorised in organic farming provided that they are treated by (i) physical processes including dehydration, freezing and grinding; (ii) extraction with water or aqueous acid and/or alkaline solution or (iii) fermentation. Enzymatic hydrolysis could fit under these definitions. However, in this case organic origin of the feedstock is compulsory which algae cultured over reclaimed water recovered from the membrane treatment of the liquid fraction of pig slurry does not meet
Is there any traditional use or precedents in organic production? Algae and algae products are authorized, including hydrolysed products. Origin of the cultivation media and enzymatic hydrolysis are the specific points to be evaluated for their authorisation

9. Consistency with objectives and principles of organic production

Please use the checklist in Annex A to this dossier to indicate consistency with objectives and principles of organic production, as well as criteria and general rules, laid down in Council Regulation (EC) 834/2007 Title II and Title III as applicable.

Annex A

CHECKLIST FOR CONSISTENCY
with objectives and principles of organic production with reference to specific articles in the organic regulation

Criteria	**Specific articles in Regulation (EU) 848/2018**	**Fulfilled? Yes / no / not applicable**	**Brief qualification**
Exclude the use of GMOs and products produced from or by GMOs	Art. 3(58)(59)(60); Art. 5(f)(3); Art. 11; Art. 30(4)	Not applicable	
Enhances the health of soil, water, plants and animals	Art. 4(b)	Yes	
High level of biodiversity	Art. 4(c) and (i); Art 6(a)		Not tested
Makes responsible use of energy and the natural resources, such as water, soil, organic matter and air	Art. 3(a)(iii)	Yes	Biostimulants have been demonstrated to enhance the protection towards hydric stress. They can help using more efficiently the resources such as water, nutrients etc.

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Criteria	Specific articles in Regulation (EU) 848/2018	Fulfilled? Yes / no / not applicable	Brief qualification
Aim at producing products of high quality	Art. 5(d)	Yes	Improved agronomic performance under stress conditions (supporting material D2.5 Final - Report on agronomic performance of the obtained BBFs and TMFs in laboratory setting and D2.6 Final - Report on agronomic and Environmental performance in field trial Experiences will be available online in the webpage of FERTIMANURE)
Aim at producing a wide variety of foods and other agricultural products……goods produced by the uses of processes that do not harm the environment, human health, plant health or animal health and welfare	Art. 5 (d)	Yes	
Use living organisms and mechanical production methods	Art. 5(f)(i)	Yes	Microalgae *Scenedesmus spp*. Is cultivated and then enzymatically hydrolysed to obtain biostimulants. Permeate to cultivate algae is obtained by mechanical separation (separation and purification via membrane systems). Algae paste is dewatered via centrifugation before its enzymatic treatment.

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Criteria	Specific articles in Regulation (EU) 848/2018	Fulfilled? Yes / no / not applicable	Brief qualification
Limited to natural or naturally-derived substances	Art. 5(g)(ii)	Yes	Endo and exo-proteases are used for the enzymatic hydrolysis, which are normally obtained by fermentative processes
For chemically synthesized inputs: appropriate management practices do not exist	Art. 4(c)(i)	Not applicable	
For chemically synthesized inputs: organic, natural or naturally-derived alternative substances are not available on the market	Art. 24(5)	Not applicable	
For chemically synthesized inputs: use of organic, natural or naturally-derived alternative substances contributes to unacceptable environmental impacts	Art. 24(5)	Not applicable	
Maintenance of plant health primarily by preventative measures, such as resistant species/varieties, appropriate crop rotations, cultivation techniques, mechanical and physical methods, thermal processes and the protection of natural enemies of pests	Art. 3(4)	Yes	Plant health is enhanced by promoting the resistance of plant to hydric and saline stress, which are preventative measures
All plant production techniques used shall prevent or minimise any contribution to the contamination of the environment	Art. 3(5)	Yes	
The corresponding use is authorised in general agriculture […]	Art. 9 (3)	Yes	In principle, under CMC1 virgin materials as PFC6B: non microbial biostimulant (Reg UE 2019/1009)

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Criteria	Specific articles in Regulation (EU) 848/2018	Fulfilled? Yes / no / not applicable	Brief qualification
Their use is necessary for sustained production and essential for its intended use	Art. 24(3)(a)	No	It is not essential but it could reduce the use of other input materials such as plant protection products or fertilising products
All products and substances shall be of plant, animal, microbial or mineral origin …	Art. 24(3)(b)	Yes	
… except where products or substances from such sources are not available in sufficient quantities or qualities or if alternatives are not available	Art. 24(3)(b)	No	
Their use is essential for the control of a harmful organism or a particular disease for which other biological, physical or breeding alternatives or cultivation practices or other effective management practices are not available	Art. 24(3)(c)(i)	Yes	It provides protection towards hydric and saline stress. Relevant stressors in areas with water scarcity such as Mediterranean area
If products are not of plant, animal, microbial or mineral origin and are not identical to their natural form, they may be authorised only if their conditions for use preclude any direct contact with the edible parts of the crop	Art. 24(3)(c)(ii)	Non applicable	
Products and substances to be withdrawn or their use amended/ limited	Art. 24(7)	Non applicable	
Others: please specify			

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FERTIMANURE

INNOVATIVE NUTRIENT RECOVERY FROM SECONDARY SOURCES-PRODUCTION OF HIGH-ADDED VALUE FERTILISERS FROM ANIMAL MANURE

PROJECT COORDINATOR

Fundació Universitària Balmes (Spain)

CONSORTIUM

Ghent University (Belgium)
Wageningen Environmental Research (The Netherlands)
University of Milan (Italy)
Leitat (Spain)
GreenWin (Belgium)
European Landowners Organisation (Belgium)
IPS Konzalting (Croatia)
Fraunhofer (Germany)
Dorset Green Machines (The Netherlands)
Prinsen Dairy Company (The Netherlands)
French Chamber of Agriculture (France)
Cooperativa Plana de Vic (Spain)
AlgaEnergy S.A. (Spain)
Fertinagro Biotech (Spain)
RITTMO Agroenvironnement (France)
Agrifutur (Italy)
Departament d'Agricultura, Ramaderia, Pesca I Alimentació (Spain)
Fertilizers Europe (Belgium)
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PROJECT WEBSITE:

https://www.fertimanure.eu

Brief summary FERTIMANURE project

The mission of the FERTIMANURE project is to provide innovative solutions (technology, end-products, and business models) that solve real issues, ie the manure challenge, and help farmers with the challenges that they are currently facing. FERTIMANURE will develop, integrate, test and validate innovative nutrient management strategies so as to efficiently recover and reuse nutrients and other products with agronomic value from manure, to ultimately obtain reliable and safe fertilisers that can compete in the EU fertiliser market.

The FERTIMANURE project will cover both technological and nutrient management approaches. The technological side will be addressed with the implementation of 5 innovative & integrated on-farm experimental pilots for nutrient recovery in the most relevant European countries in terms of livestock production (Spain, France, Germany, Belgium, The Netherlands), whereas nutrient management will be addressed through 3 different strategies adapted to mixed and specialised farming systems:

Strategy #1 with on-farm production and use of bio-based fertilisers (BBF)(1) , **Strategy #2** with on-farm BBF production and centralised tailor-made fertilisers (TMF)(2) production, and **Strategy #3** with on-farm TMF production and use.

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Definition of Bio-based fertilisers (BBFs): *Bio-based fertilisers (BBFs) are fertilising products or a component to be used in the production of (Tailor-Made) Fertilisers that are derived* ***from biomass-related resources.***

The BBFs of FERTIMANURE are "obtained through a ***physical, thermal/thermo-chemical, chemical, and/or biological processes for the treatment*** *of manure or digestate that result into a change in composition due to a change in concentration of nutrients and their ratios compared to the input material(s) in order to get better marketable products providing farmers with nutrients of sufficient quality".*

However, just separation of manure in a solid and liquid fraction (as first processing step) is excluded. These products are not conceived as a BBF, although they are valuable sources to supply nutrients on agricultural land.

LIST OF BBFs Produced in FERTIMANURE

Number	BBF-code	BBF product description
1	NL-AS	Ammonium sulphate solution
2	NL-LK	Liquid potassium rich fertiliser
3	NL-SC	Organic soil conditioner
4	NL-WP	Wet organic phosphorus rich fertiliser
5	NL-DP	*90% dried organic P rich fertiliser (calc)*
6	ES-NC	Nutrient-rich concentrate
7	ES-DSC	Bio-dried solid fraction
8	ES-PA	Phosphorous (ashes)
9	ES-AM	Ammonium salts
10	ES-AA	AA-based biostimulants
11	DE-AS	Ammonium sulphate solution (liquid)
12	DE-BC	Biochar (solid)
13	DE-AP	Ammonium phosphate on perlite (solid)
14	BE-AN	Ammonium nitrate
15	BE-AS	Ammonium sulphate
16	BE-AW	Ammonium water
17	FR-BC	Biochar
18	FR-AS	Ammonium sulphate
19	FR-LK	Liquid K-fertiliser

Definition of Tailor-Made Fertilisers (TMFs): *A tailor-made fertiliser (TMF) is a customized fertiliser that meets with the nutrient requirements of a specific crop by taking into account the soil type, soil fertility status, and growing conditions and fertilisation practises.*

The TMFs obtained in FERTIMANURE are produced from BBFs (produced from manure or digestate and/or other recovered fertilising products that are available) and/or mineral fertilisers (MF) (and/or biostimulants).

Fully crop specific TMFs can be defined and centrally produced assuming e.g. a sufficient nutrient status of a soil type and no additional fertilisation practice.

However, on farm level the soil-crop requirements will be different due to another nutrient status of the soil and the fact that often manure/digestate will be applied on the fields which has to be taken into account as nutrient supplier. Consequently, the composition of the TMF (combination of BBF and MF) that will be used by the farmer can differ from the one produced in a centralised way.

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