FERTITEC

INNOVATIVE RECOVERY TECHNIQUES FOR ALTERNATIVE FERTILISERS

D1.3 – Market dynamics and regulatory analysis of alternative fertilisers

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CETENMA

21/11/2025

Funded by the European Union

Project Information

Project name	**FERTITEC**
Full project name	FERTIliser product recovery from secondary raw materials using best available TEChniques
Grant number	101157394
Project coordinator	RISE Research Institutes of Sweden
Project duration	1 January 2025 - 31 December 2027

Document Information

Deliverable name and number	D 1.3. Market dynamics and regulatory analysis of alternative fertilisers
Due date	30/11/2025
Actual submission date	24/11/2025
Contributing partners	Premyanov Nikolay (Q-Plan), Tampio Elina and Laakso Johanna (LUKE), Skowron Piotr (IUNG), Kubai Mwenda Robert (EAFF), Cordeiro Cheryl Marie and Sindhøj Erik (RISE)
Reviewer partners	Q-PLAN
	Deliverable type
R	Document, report
	Dissemination level
PU	Public

Version	Date	Author	Comments
1	8 Sept 2025	Cristiano Pisani & Martin Soriano	First version for review
2	21 Nov 2025	Cristiano Pisani & Martin Soriano	Definitive version sent to coordinator

FERTITEC Project Synopsis

The Horizon EU CSA project FERTITEC, funded under the *HORIZON-CL6-2024-ZEROPOLLUTION-01-02* call, promotes the circular economy by advancing **alternative fertilising products** derived from secondary raw materials. By reducing dependence on conventional mineral fertilisers, the project addresses challenges in **waste management and environmental pollution**, contributing to sustainable nutrient recovery. Conventional fertiliser production depletes natural resources and generates pollution, underscoring the need for more **resource-efficient solutions**.

FERTITEC builds on expertise from previous EU-funded initiatives—including Novafert, SUSFERT, FER-PLAY, SOILUTIONS, MainstreamBIO, SuMaNu, CINURGI, and NUTRIMAN—by integrating advanced **waste recycling technologies** into fertiliser production. The goal is to develop **competitive, bio-based alternatives** that enhance both agricultural productivity and environmental sustainability.

Aligned with the **EU's strategic priorities** in sustainable agriculture, waste reduction, and the bioeconomy, FERTITEC also works to harmonise **sustainability certification systems** and improve the marketability of bio-based fertilisers. Through its **Knowledge Exchange Platform (KEP)**, the project fosters collaboration with key agricultural stakeholders to drive innovation in the fertiliser industry.

By **bringing forward Best Available Fertilising Techniques (BATs) in several EU countries and extrapolating outcomes to the African Union**, FERTITEC supports the broader transition to sustainable fertilising solutions. With a commitment to both **environmental sustainability and economic viability**, the project integrates learnings from past initiatives, engages industry actors, and applies state-of-the-art fertiliser technologies—helping shape the future of sustainable agriculture in Europe and beyond.

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Executive Summary

Deliverable D1.3 “Market dynamics and regulatory analysis of alternative fertilisers” reports the results of Task 1.4 “Market dynamics & regulatory analysis of alternative fertilising products” within the EU-funded FERTITEC project. The FERTITEC project aims to propose a comprehensive solution for waste recycling and the sustainable fertiliser production from secondary raw materials.

This report provides an in-depth analysis of the market dynamics along with the regulatory framework for broader adoption of alternative fertilising (AF) products. Moreover, the analysis incorporates opinions and experiences from over one hundred relevant market and policy actors, gathered through a dedicated survey conducted by CETENMA.

The document assesses the current and projected market size for feedstocks and AF at both global and European scales, identifying potential market gaps and opportunities. It also details key elements of agricultural, waste management, and circular economy legislation at European and national levels, with contributions from project partners representing various countries. This includes a comprehensive analysis of legislation, certification schemes, and market standards impacting the AF market in each country.

The survey results, which capture the opinions and experiences of market and policy actors, are integrated into this report. The concluding section offers a general assessment of all findings, highlighting key messages and policy recommendations as the final objective of D1.3.

The outlooks indicate a positive and continuously growing market trend for AF at both European and global scale. However, a significant gap currently exists between conventional and AF; market estimations forecast a faster growth rate and adoption for AF in the near future. The availability of feedstocks appears to be a key driver of growth in the AF market, particularly in countries with abundant organic feedstock from several economic categories. This also supports the adoption of the best available technologies for organic-based products.

Barriers and drivers in AF adoption include technical and economic viability, scalability, concerns on plant response, limited technical knowledge of the growers on available products, lack of incentives, complex logistics, regulation and certification burdens and lack of social acceptance. Last but not least, the results highlight the significant need for continuous legislative review and updates. Specifically, ongoing technical updates to AF legislation are essential, encompassing a review of feedstocks and AF standards, end-of-waste status definitions, technological limitations, and mandatory fertiliser market certifications.

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Table of acronyms

Acronym	Definition
ABP(s)	Animal by-products
ACEFER	Spanish Fertilisers Commercial Association
AENOR	Spanish Association for Standardisation and Certification
AF(s)	Alternative fertiliser(s)
ANFFE	National Association of Fertiliser Manufacturers
AU	African Union
BAT(s)	Best available technique(s)
BBF	Bio-based fertiliser
BOE	Boletín Oficial del Estad
Ca	Calcium
CABM	Carbon Border Adjustment Mechanism
CAAE	Andalusian Committee for Organic Agriculture
CAP	Common Agricultural Policy
C&D	Communication and dissemination
CF	Conventional (synthetic/mineral) fertiliser
CAGR	Compound Annual Growth Rate
CMC	Component Material Category (under Regulation (EU) 2019/1009)
CO_2	Carbon dioxide
DoA	Description of Action
EAFF	Eastern Africa Farmers' Federation
EC	European Commission
EMCA	Environmental Management and Coordination Act
EP	Expert Panel
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	FAO Statistical Database
FE	Fertilizers Europe
FPR	Fertilising Products Regulation (EU) 2019/1009
GA	Grant Agreement
GDP	Gross Domestic Product
GHG	Greenhouse gas
JRC	Joint Research Centre
K	Potassium
KCL	Potassium chloride
KEBS	Kenya Bureau of Standards
KEPHIS	Kenya Plant Health Inspectorate Service
Kg/ha	Kilograms per hectare
KPCB	Kenya Pest Control Products Board
IFA	International Fertiliser Association
LCA	Life Cycle Assessment

Acronym	Definition
M	Million
MAPA	Ministry of Agriculture, Fisheries and Food
MITECO	Ministry for the Ecological Transition and the Demographic Challenge
MS	Member State(s) (of the EU)
Mt/y	Million tonnes per year
N	Nitrogen
N_2O	Nitrous oxide
ND	Nitrates Directive (Council Directive 91/676/EEC)
NEMA	National Environment Management Authority
NH3	Ammonia
NOx	Nitrogen oxides
OM	Organic matter
P	Phosphorus
PCPB	Pest Control Products Board
PEMAR	State Waste-Management Framework Plan
PFC	Product Function Category (under Regulation (EU) 2019/1009)
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
REC	Spanish Composting Network
RNF(s)	Recycled nutrient fertiliser(s)
R&D	Research and Development
SDGs	Sustainable Development Goals
SME	Small and Medium-sized Enterprise
SOHISCERT	Hispanic Certification Society
SRM(s)	Secondary raw material(s)
SWOT	Strengths, Weaknesses, Opportunities and Threats
TRL	Technology Readiness Level
UNE	Asociación Española de Normalización
UWWTD	Urban Waste Water Treatment Directive (Council Directive 91/271/EEC)
WFD	Waste Framework Directive
WP	Work Package

1. Introduction

The need for a real change in agricultural sustainability goes through a direct change in the fertilisers market, being one of the most impacting areas of the agriculture sector worldwide. The European Union (EU) is particularly active in promoting this shift through policy activity, regulation, and innovation projects focused on developing a true and sustainable alternative to conventional fertilisation. FERTITEC is one of the EU-funded projects focused on bringing a comprehensive solution for waste recycling and sustainable fertilisers production from secondary raw materials, in connection with other previously funded projects (FER-PLAY, MainstreamBIO, SOILUTIONS, SuMaNu, AgroTechnology ATLAS, B-FERST, NOVAFERT, CINURGI, Manure Standards, SUSFERT, NUTRI-KNOW, NUTRIMAN, etc). FERTITEC aims to impact at national and regional levels, by identifying and promoting the best available techniques (BATs) for the production of alternative fertilisers (AF) across several EU countries (Sweden, Greece, Finland, Spain and Poland) and extending the results to the African Union (AU) landscape through the participation of the Eastern Africa Farmers' Federation Society (EAFF). This federation society, based in Kenya, is a member-based farmers' organisation network from 10 countries in Sub-Saharan Africa.

In FERTITEC, AF are defined as organic or inorganic fertilisers and soil improvers recovered from main and secondary raw materials. However, AF in literature and legislation are categorised and defined in multiple ways based on their origins, mostly (such as organic fertilisers, biofertilisers, recycled nutrient fertilisers, etc.). The production and wider adoption of these fertilisers are hampered by several barriers. In agreement with Kurniawati *et al*. (2023), they can be summarised as follows: technical and economic viability, scalability, concerns on plant response, limited technical knowledge of the growers on available products and lack of social acceptance, scarce incentives, regulation and certification burdens, and complex logistics.

During the last decades, the agriculture sector has been facing an important and challenging transition from a traditional to a new sustainable production strategy. This transition, affected by economic, social and environmental factors, needs to be accelerated and supported. The environmental angle is related to the contamination of soil, air and water, which can even directly harm human health, such is the case of nitrate water contamination causing the blue baby syndrome (Knobeloch et al., 2000). One of the most important factors which explains this contamination is the inefficient and abusive use of synthetic/conventional fertilisers (referred as CF in many instances of this document). They have played a very important role in the development of the agri-food industry, contributing to productivity and food supply. However, they are responsible for emissions to the air and the hydrosphere, and excessive accumulation in soil and plants. In 2022, the EU reported[1] that the quantity of mineral fertilisers (N and P) used in agricultural production across the EU was 9.8 million tonnes, representing an important decline of 10.3% compared with the quantity used in 2021, and a cumulative decline of 15.9% from the relative peak in 2017. However, these figures can be partially associated with the

[1] Use of fertilisers in EU agriculture down 10% in 2022 - News articles - Eurostat

prices rising of fertilisers due to Russia's military aggression against Ukraine and the resulting consequences. This demonstrates how geopolitical effects drive multiple markets and how dangerous it might be to depend on restricted sources and the need for alternative sources when prices rise. Regarding this the global reserves for P for example, are highly concentrated in a few countries, China and Morocco, this last alone accounting for 77% of the global phosphate rock reserve (Cooper et al., 2011).

In terms of emissions to the atmosphere associated with fertiliser manufacturing from Europe, and according to the last available estimation from the Food Agriculture Organization (FAO) database (FAOSTAT), the total emission (direct, indirect) of carbon dioxide (CO_2) and nitrous oxide (N_2O) peaks to 829001702 kilotonnes (kt) and 894393 kt, respectively in 2022[2]. According to Menegat *et al* (2022), the synthetic N fertiliser supply chain is responsible for estimated emissions of 1.13 gigatons of CO_2 in 2018, representing 10.6% of agricultural emissions and 2.1% of global GHG emissions, precluding the achievement of the Paris Agreement's 1.5° and 2°C climate change targets (Clark et al., 2020).

Besides the GHG emission, the excessive use of fertilisers negatively contributes to water pollution, causing eutrophication. In the case of nitrate leaching, and due to the complex relationship between land use activities, fertiliser N management, rainfall, irrigation management, soil N dynamics and soil features, accurate quantification of the leaching process to surface and ground water bodies is still challenging. Along with nitrogen, the other macronutrient which plays a significant role in eutrophication is phosphorus. Phosporus leaching from agricultural fields is primarily driven by excessive P fertilisation. As an alternative, the use of AF such as biochar (in general, slow-release fertilisers) and sustainable nutrient management practices (e.g. distributing N inputs across locations to maximise production, precision agriculture, etc.) have shown promising results for reducing N leaching (Bijay-Singh & Craswell, 2021).

Fertiliser products commercialised since summer 2022 are regulated by the EU Fertilising Products Regulation (FPR)[3] which includes CE mark and labelling requirements. These requirements ensure that the products meet the environmental and safety standards of the new legislation. A promising solution toward a more sustainable agriculture sector able to reduce resource depletion, waste accumulation and GHG emissions has to do with the increase in the use of AFs.

Alternative fertiliser products are generated from many different feedstocks. During the last decade, new technologies and the refinement of more traditional ones are allowing to explore and expand the use of different raw materials and feedstock for AF production. Alternative fertiliser is a wide term encompassing a wide range of fertiliser products receiving different names (e.g. organic fertilisers, biofertilisers,fertilisers from recovered waste material products, bio-based fertilisers, recycled fertilisers etc). The EU divides fertilisers into three main categories based on their formulation: Mineral fertilisers, organic fertilisers and organo-mineral fertilisers. Organic fertilisers are defined as derived from organic origin such as animal products, plant residues or human origin, containing carbon (C) and nutrients of exclusively biological origin and exclude material which is fossilised or embedded in geological formations[4]. Therefore, all these three categories could be classified as AF providing that nutrients are obtained from secondary raw materials.

[2] https://www.fao.org/faostat/en/#data/Gt
[3] Fertilizing Products Regulation - Fertilizers Europe
[4] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Fertiliser

As it happens within the synthetic fertiliser industry, AF can be produced with diverse characteristics depending on formulations, forms, nutrient contents, nutrient speed release, etc., which are determined by production technologies, raw materials availability and customers' needs. This wide range of possibilities must align with end-user demands and preferences, being the factor that most influences market growth at different scales. Recent studies have highlighted the importance of understanding the reactions that occur within the fertosphere (soil area surrounding the fertiliser granule)[5] when developing AFs. These reactions are dictating the availability of the nutrients supplied by the fertiliser, thus the crop speed response (Lombi et al., 2025).

Taking all this information into consideration, and under the context of this project, AF are those produced from secondary raw materials, can be of organic or inorganic nature and include soil improvers. As defined by The European Circular Economy Stakeholder Platform, secondary raw materials are those recovered from waste or end-of-life products through recycling, able to replace some or all virgin raw materials in manufacturing processes. Therefore, the use of secondary raw materials contributes to reducing the pressure on virgin raw materials and the total amount of waste. Limitations are related to their variable composition and production, complex logistics, and the lack of quality standards for some materials, increasing the difficulty for manufacturers to use them in their supply chain.

Secondary raw materials under the scope of this project are described as follows:

- Agricultural Biomasses: livestock manure and slurry, crop residues, waste feed, agricultural processing residues and digestate.
- Urban wastewater: sewage sludge, wastewater, dewatered sludge, digested sludge.
- Municipal Biowaste: household food waste, restaurant food waste, green landscape waste, supermarket food waste.
- Industrial side-streams: food industry by-products, wood/pulp and paper industry by-products, mining by-products, chemical industry by-products.
- Blue Biomasses: fish and shellfish by-products, seaweed and microalgae residues, aquaculture sludge, eutrophication biomass, hydrolysed waste.

The shift to use AFs might be one of the most promising avenues to reduce the negative environmental impacts of agriculture. Several studies have highlighted their environmentally friendly aspects, depending on their formulation and type of source raw materials (Hasler et al., 2015). Other studies have evaluated the innovative circular biowaste valorisation status by comparing several circular technologies for material valorisation (Suárez Valdés et al., 2024). Numerous circular economy approaches and technologies have already been developed for AF production and resumed in an open-access database[6,7,8], and for many of them Life Cycle Assessment (LCA) to nutrient circular economy pathways have been described (Miao & Zeller, 2025). The need for trustworthy technologies for producing safe and soil health-improving AF products instead of direct land application, with a special focus on improving soil health has also been reported (Kurniawati et al., 2023).

[5] EGUsphere - Mapping the fertosphere's phosphorus availability distribution in a field trial using a novel diffusive gradients in thin-films (fDGT) technique
[6] https://doi.org/10.5281/zenodo.15772874
[7] https://fer-play.eu/resources/
[8] https://www.novafert.eu/inventory/

In terms of their potential adoption, studies have shown that farmers from Germany, France, Italy, Spain, Poland, Hungary, and the Netherlands prefer AF as long as they can match the nutrient concentration and plant response of conventional fertilisers (Tur-Cardona et al., 2018). Other studies have contributed novel strategies facilitating the selection of the most promising AF value chains (Paredes et al., 2025). Despite the efforts, more awareness, research and investments are needed in order to boost the adoption. To this end recent studies reported challenges and opportunities in promoting AF based on surveys conducted with farmers across Europe (Albaladejo-Rodilla et al., 2025).

This report analyses the market dynamics and the regulatory framework at the European and national level (among the six participating countries) for producing and using AF products in order to boost their broader adoption. Moreover, the results of an online survey are considered to support the findings of this report.

In general, results from this document are expected to contribute to encouraging the transition to bio-based systems within the agricultural sector. Specifically for the FERTITEC project, results are expected for the evaluation and selection of Best Available Techniques (BATs). This report will contribute to identifying challenges and opportunities related to the market dynamics and regulatory frameworks, which, together with technical feasibility, environmental performance and circularity, socio-economic aspects, will be used for the BAT assessment. In terms of governance, the analysis of the regulatory framework will help shape policies that support the adoption of more sustainable fertilising methods, which can lead to stronger regulatory measures and incentives. Moreover, D1.3 will contribute to assessing the practicality and scalability of the technologies for AFs production, and shape communication/dissemination messages. Finally, by detailing current market dynamics and the regulatory framework, this document will directly impact the extrapolation of the project's findings to the AU landscape.

Against this background, the analysis in this report is guided by the following questions:

1. What are the current and emerging market conditions for AF products in the EU and in the selected partner countries, and how do these conditions affect their competitiveness and uptake?
2. How do EU and national regulatory frameworks, including certification and standards, enable or constrain the production and use of AF products derived from secondary raw materials?
3. Which market and regulatory drivers and barriers are most critical for the diffusion of AF-related technologies and value chains, and therefore need to be addressed in subsequent FERTITEC work packages on BAT assessment, business models and policy recommendations?

2. Overall approach and methodology

For the development of this report, a desk-research approach has been followed, including an analysis of the current and projected market size, supply and demand for various AF products and secondary feedstocks. FERTITEC project's market analysis focuses on key aspects such as currently available fertilisers and novel feedstocks with potential for near-future fertiliser production. Moreover, a mapping of key elements of agricultural, waste management and circular economy legislation, certification schemes and market standards (at the EU and national level of the countries participating in FERTITEC) was conducted in order to detect gaps or barriers negatively affecting the AFs market and BATs deployment. This mapping builds upon previous contributions from other EU-funded projects such as NOVAFERT, FER-PLAY, MainstreamBIO, SOILUTIONS, SuMaNu, AgroTechnology ATLAS, B-FERST, NOVAFERT, CINURGI, Manure Standards, SUSFERT, NUTRI-KNOW or NUTRIMAN. Web research was extended to the EU law - EUR-Lex website, using the following keywords: “fertilisers”, “circular economy” and “waste management”. All these findings are enriched through an online questionnaire directed to policy and market actors.

Market size assessment was developed at three levels: worldwide, European and national. In a global market, it is crucial to investigate international trends and patterns which have a decisive impact on the European market, which represented the next level. Last but not least, a third level was considered and related to the countries participating and involved in this FERTITEC project.

This analysis covers the key elements of agricultural, waste management, and circular economy legislation, and the main certification schemes and market standards which that directly or indirectly impact the AF market. The analysis is firstly done at EU level, before moving to each country-based partners, which include Spain, Sweden, Greece, Finland, Poland and Kenya (for the AU landscape).

At EU level, legislative acts are typically categorised in five types[9], including: regulations, directives, decisions, recommendations and opinions:

- Regulations do not involve any transposition at the national level; they are legal acts that are binding in their entirety.
- Directives set binding objectives and require a transposition at national level to achieve these objectives.
- Decisions are entirely binding so do not need transposition.

[9] Types of EU law - European Commission

- Recommendations, like opinions, are non-binding and do not impose any legal obligation.

At national level, as discussed, the focus has been placed on 5 EU countries and Kenya. Together with the assessment described above, a final Section on drivers and barriers is included, highlighting the main factors having an impact either positively or negatively on the AFs market and their adoption. For the specific case of Kenya, legislation is developed by the AU, which plays a significant role in setting continental policies and frameworks. This process involves passing through Regional Economic Communities (RECs) such as the East African Community (EAC), which develops regional policies and protocols and encourages their adoption by member states, including Kenya.

In order to reinforce and validate the findings from the desk research, external consultation was carried out. External opinion was sought following two different approaches: 1) A survey (targeting at least 100 respondents); 2) Individual expert consultation.

The first approach consisted of an online survey targeting at least 100 respondents with the results used to help in identifying challenges and opportunities for broader AF adoption associated with market and regulatory conditions. The questionnaire, prepared in Microsoft Forms and provided in the Annex Section, was conducted to gather opinions and experiences of market, policy actors and other relevant stakeholders. Multiple-choice and direct questions were combined to gather information on: AF knowledge status, main drivers and barriers, use or production at local scale, policy impact, market gap and opportunities. The questionnaire was prepared in English, and translated into Spanish to facilitate the collection of responses in events organised in this latter country.

In order to validate survey results, get additional answers and more robust conclusions, the survey was simplified and circulated in the 2nd FERTITEC Expert Panel meeting held online on 30/10/2025 using the Mentimeter platform. Such opinions were gathered following the presentation of the preliminary key results of this report by the authors (Martín Soriano and Cristiano Pisani).

Both full surveys, along with detailed information on answers, responses, rankings, and associated data, are publicly available on the following link on the Zenodo platform https://doi.org/10.5281/zenodo.17590621

The second approach featured interviews and informal conversations with fertiliser experts on a number of key questions, with opinions presented in an aggregated manner.

3. Global and EU market

Before attempting to evaluate the market size of AF, it is important to assess this market for the feedstocks that are used for their production. In global terms, demand of secondary feedstock for AF production has substantially increased in recent years, mostly driven by the expansion of the organic farming sector, environmental concerns associated to the use of fossil-based fertilisers, and

increasing global food demands from growing countries such as China and India. Among the different farming systems, organic agriculture is one of the most demandingfor AFs. Data from EUROSTAT[10] (2022) highlight that among the EU countries in FERTITEC, Sweden results to be the one with the highest shares of organic farming areas (Figure 1). In terms of farmland under organic management, Spain is, after France, the country with the highest surface devoted to this management (2.7 million ha).

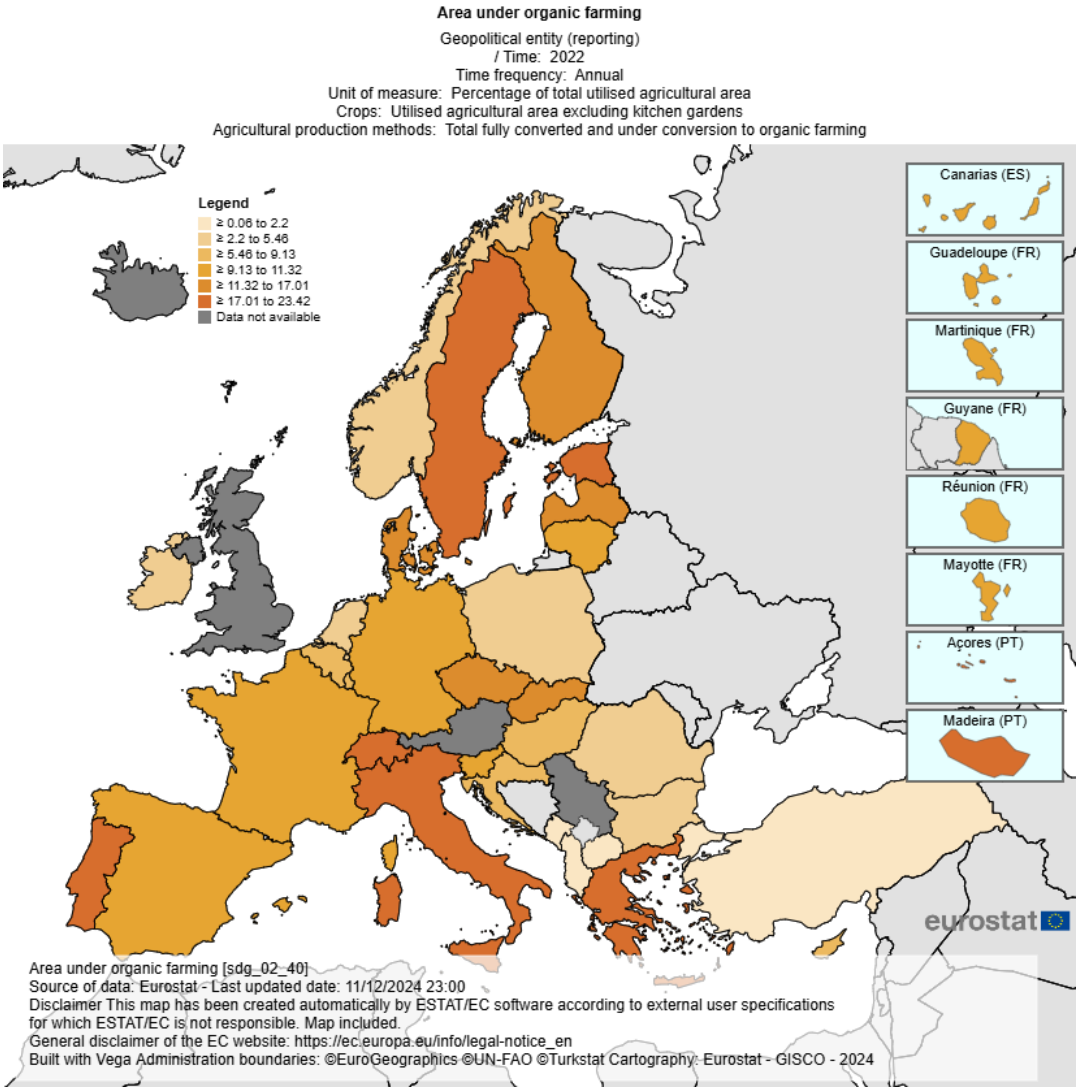


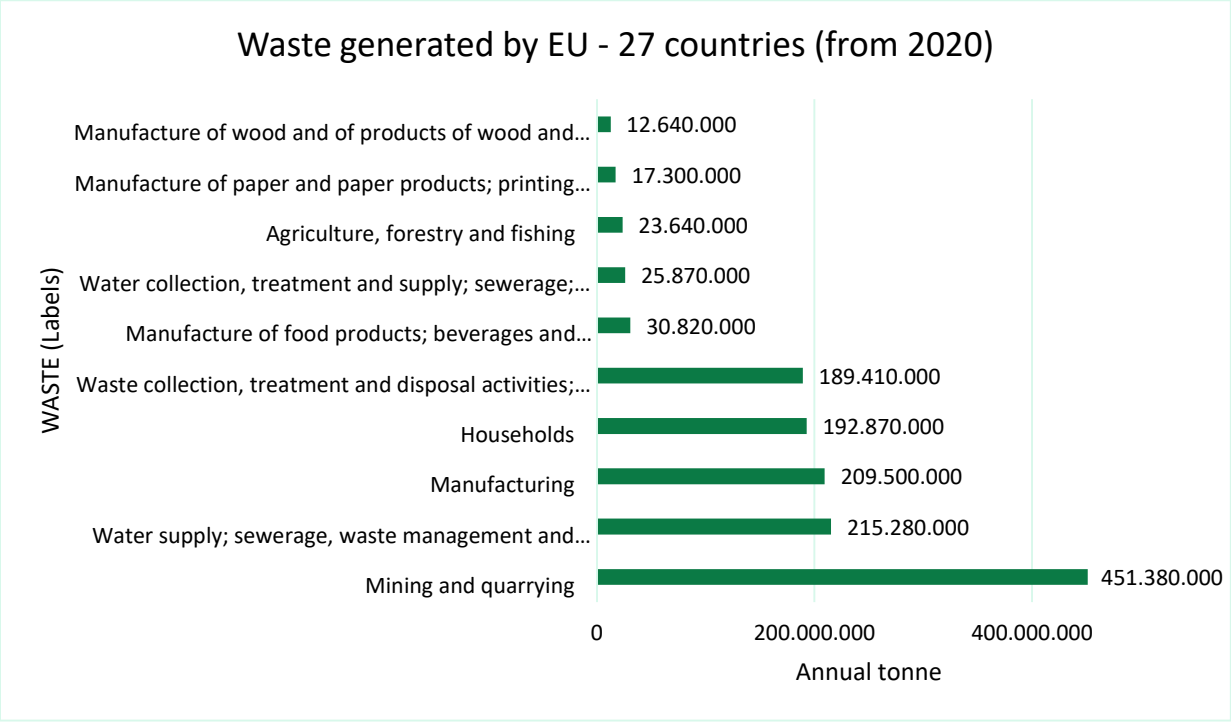
Figure 1. Data[11] from EUROSTAT showing the percentage of organic farming area with respect to the total agricultural area in several EU countries (2022).

Most of the feedstocks for AF production are organic, or biobased, in nature. At a global scale, the market size of organic wastes was valued at € 35.17x10^3 million in 2024 and is expected to reach

[10] Statistics | Eurostat
[11] Area under organic farming

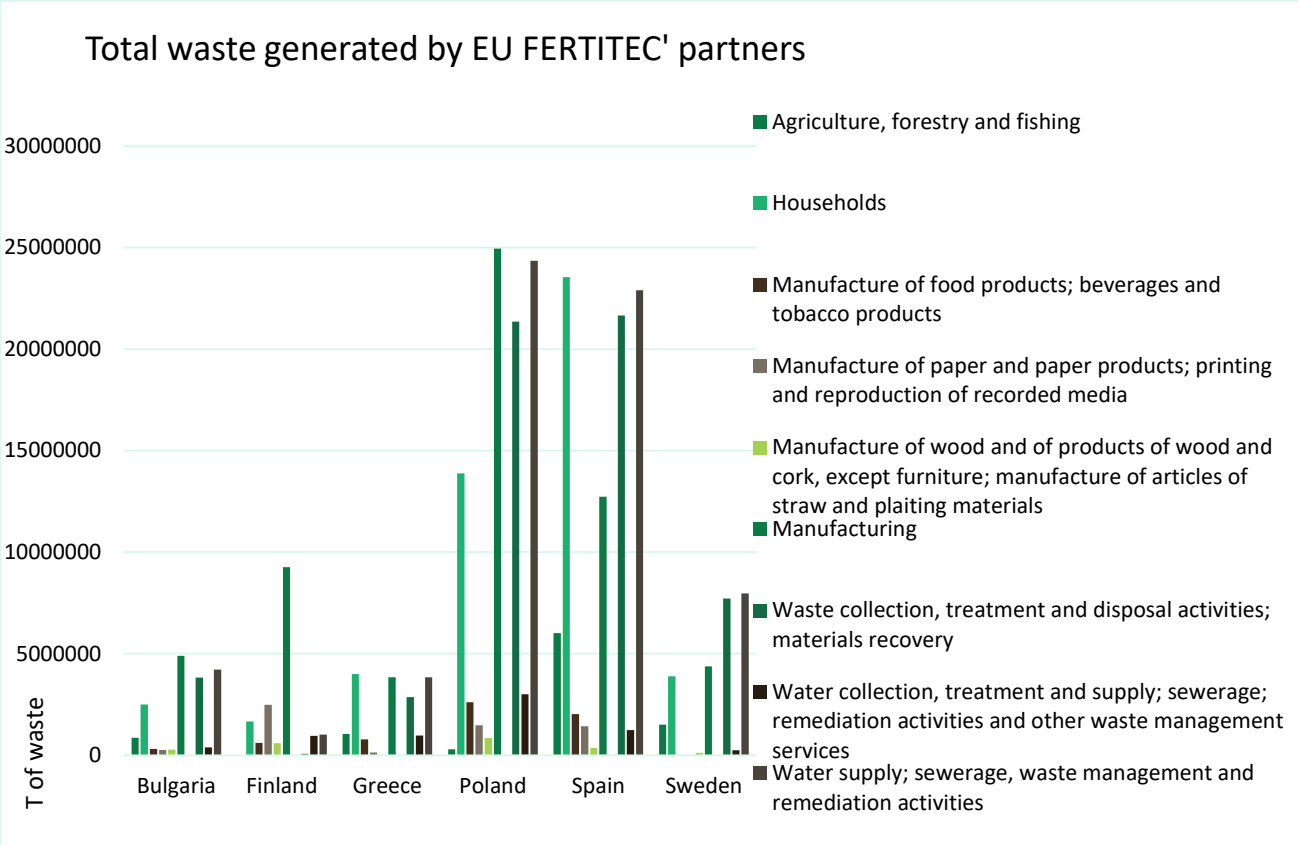
58.49x10^3 million[12], with a forecasted growth of 4.6% of the Compound Annual Growth Rate (CAGR[13]) from 2025 to 2032.

In terms of sectors and activities generating waste which include most of the sources of feedstocks for the production of AF across the EU-27, EUROSTAT[14] provides detailed figures. Apart from the construction sector (generating 38.4% of the total waste in Europe), the mining and quarrying sector proved to be the most contributing sector, followed by water supply, manufacturing, households and waste collection, treatment and disposal (see next Figure 2). Despite the high amount of mineral waste, at the moment, the most common feedstocks used for AFs production come from biobased materials (i.e., agriculture biomass, urban wastewater and municipal biowaste, etc.).



Doing the analysis at national level based on total waste generated, countries like Spain and Poland show high volumes of waste from agriculture and manufacturing, indicating strong potential for AF feedstock sourcing (Figure 3).

[12] Organic Waste Market: Global Industry Analysis and Forecast
[13] CAGR of an established period refers to the average annual change in the value of an investment over a period longer than one year.
[14] Statistics | Eurostat



For the specific raw materials under scope of the FERTITEC project, an estimation of the amount and corresponding market sizes are provided as follows:

- **Agricultural biomass.** In Europe, the total average biomass production from the agricultural sector is estimated at 956 Mt/y of dry matter (Garcia *et al*., 2018), with 46% (442 Mt/y), corresponding to above-ground (leaves, stems, straw)[16] residues (Janiszewska and Ossowska, 2022). In agricultural processes, the different waste types generated are categorised as function of their characteristics and potential applications. Categories include: crop residues, such as stalks, husks, and stems; animal manure and bedding materials; food processing waste; and agricultural byproducts.
  Another important feedstock of this category is manure. It is estimated that 1400 Mt of manure from farmed animals were produced annually in the period 2016–2019 in the EU28[17]. The global agricultural biowaste market size was valued in the report from 6Wresearch at € 34.47 x10^3 million in 2024 and is expected to reach € 49.98x10^3 million by 2031, at a CAGR of 5.50%

[15] EUROSTAT Generation of waste by waste category
[16] agricultural_biomass_final_web (8).pdf
[17] Manure management and soil biodiversity: Towards more sustainable food systems in the EU - ScienceDirect

from the forecast period 2025 to 2031[18]. It can be highlighted that Asia holds a significant share due to its large agricultural sector and high production of waste, especially in countries like India and China.

In 2021, 6Wresearch published an additional report that esteemed Europe's agricultural waste market size is projected to reach €16.98 x10^3 million by 2031, growing at a CAGR of 5.8% during the forecast period from 2025 to 2031[19].

- **Urban Wastewater.** Estimation available on total annual production of wastewater at EU level based on recent studies reports 47,313 million m^3 (Procházková et al., 2023). Urban wastewater in 2022 accounted for 234Mt (10.5%) of 2233 Mt of total waste generated[20]. Also, important here is the fact that about 90% is collected and treated in accordance with the EU Wastewater Treatment Directive. In terms of market size, and according to SPER Market Research[21], the European wastewater treatment market which refers to the process for removing pollutants from the water (originating from domestic, industrial or agricultural activities), is estimated to reach €14.58x10^3 million by 2033 with a CAGR of 4.59%. About the expected benefits by wastewater treatment[22]**.**, The EU publication[23] estimated a generation of €6.6x10^3 million per year by 2045.
- **Municipal biowaste.** At EU level, and according to data from EUROSTAT, about 75 million tonnes of municipal biowaste are generated. Biowaste constitutes 30-40% of municipal solid waste, with variations between Member States from 18% up to 60%. The European Compost Network (ECN)[24] published a report on 2022 highlighting that less than 40 Mt of municipal biowaste are separately collected and processed into high-quality compost and digestate in Europe (ECN, 2022).
- **Industrial side streams.** Which in FERTITEC project includes food industry by-products, wood/pulp and paper industry by-products, mining by-products, chemical industry by-products and biochar, ash and gypsum. At the EU level, the total amount of food waste was about 59 Mt/y of fresh mass. The food industry by-products defined as processing and manufacturing sector is esteemed at EU level generating 11 Mt/y of fresh mass[25]. Other different raw materials in this category in FERTITEC project include pulp and paper industry. Recent studies estimated that 11 Mt of waste are produced yearly by the European pulp and paper industry (Monte Lara et al., 2009) and more data regarding this sector are reported by JRC, but in a different unit system (m^3)[26] and forest biomass flow diagram in Mt of solid wood equivalent for the 28 EU member states in 2015[27].

  It is estimated that the management of industrial side-streams supposes €143x10^3 million to the industry, supposing a high cost and a considerable loss of potentially valuable source of bioactive ingredients[28].

[18] Global Agricultural Waste Market (2025 - 2031) | Trends, Outlook & Forecast
[19] Europe Agricultural Waste Market | Size, Trends & Forecast 2031
[20] Waste statistics - Statistics Explained - Eurostat
[21] https://www.sperresearch.com/report-store/europe-wastewater-treatment-market.aspx
[22] Urban wastewater - European Commission
[23] Urban wastewater - Environment - European Commission
[24] Bio-Waste in Europe - European Compost Network
[25] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Food_waste_and_food_waste_prevention_-_estimates
[26] JRC Publications Repository - Wood Resource Balances of European Union and Member States - Release 2021
[27] Forest
[28] Using industrial side streams in Food, Feed, Cosmetics and Packaging – INGREEN

As it has been seen earlier, further important raw material in the industrial side streams category in terms of quantity of waste comes from mining activity. Worldwide, the estimation of the generation of solid waste from this sector is about $100x10^3$ Mt/y, in addition to the sizeable amount already existing in active, inactive and closed tailings[29]. At EU level, they represent 22.7% of the total amount of waste.

- **Blue biomass.** This feedstock category comprises fish and shellfish by-products, seaweed and microalgae residues, and aquaculture sludge. Seafood loss and waste are defined as waste that includes all potentially useful material removed from fish, shellfish, crustaceans, and other species (Venugopal, 2022). A global-scale fishery production has been estimated to reach 179 Mt, producing between 50–125 Mt of fishery waste in 2018. Europe represented 10% (5-12.5 Mt) with mere changes in 2019-2020[30]. However, the exact amounts of this feedstock category have not yet been precisely estimated.

Out of the information provided, several conclusions can be extracted:

- At the moment, the most important category for the production of AF is agricultural biomass but it is needed to distinguish between the available materials and the registered amount of waste (which is lower). This is because a high percentage of these subproducts are reused as feed, animal bedding or returned to soil. However, they typically attract low value and the whole aim and purpose of this deliverable and the FERTITEC project is to promote successful and profitable business cases based on AF.
- Urban wastewater and municipal biowaste, in this order, also represent very interesting sources for the production of AF. The issue in many instances associated with these resources are related to high nutrient extracting costs and insufficient quality due to the presence of impurities and pollutants.
- Industrial side streams are also interesting sources for AF production, being in some cases more attracting than municipal waste due to the fact that the production is localised and, in most of cases, the raw material is not that much mixed. However, and as previously discussed. However, and specifically for the largest contributor which is the mining and quarrying sector, at the moment, only small amounts are used and/or available for the production of AF.
- Last but not least, blue biomass entails a large potential, however, at the moment, production estimation is uncertain and only relatively small amounts are available.

Additional valuable data on the estimated amounts of nutrient-rich side streams (i.e. organic biodegradable biomasses) for the EU member states was provided by the LEX4BIO project report[31] "*Dataset of regional NRSS available for producing BBFs in the EU*". Also, their N and P contents are quantified and their spatial distribution presented.

[29] Executive summary – Recycling of Critical Minerals – Analysis - IEA
[30] Nutrient recovery and recycling from fishery waste and by-products - ScienceDirect
[31] Microsoft Word - LEX4BIO_D1.1_WP1.docx

Once the secondary feedstocks have been analysed, the actual market analysis of AF is provided. Starting with the global market, it is dominated by CF, controlled by few companies, with reserves (in the case of elements such as P and K) concentrated in few countries.

According to data from FAO (FAO, 2024; FAO, 2025), in 2023, the total amount of fertiliser consumed worldwide was 190 million tonnes (evolution until 2022 in Figure 4)[32], with the largest share belonging to nitrogen (approximately 58% followed by 22 and 21% in the case of P and K, respectively; Figure 5). As can be seen, this amount has been steadily increasing year after year. The use is generally matched by the production, although the latter remains slightly higher (207 Mt in 2023 vs. the 190 Mt previously reported). Demand is led by Asia, followed by America, Europe, Africa and Oceania, in this order.

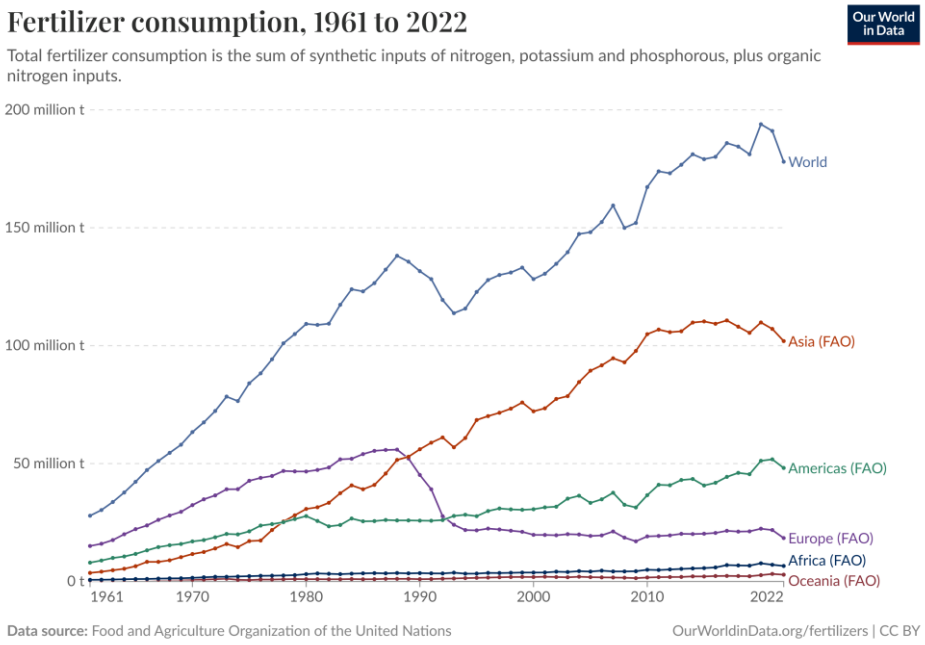


Figure 4. World fertiliser consumption

[32] Fertilizers - Our World in Data

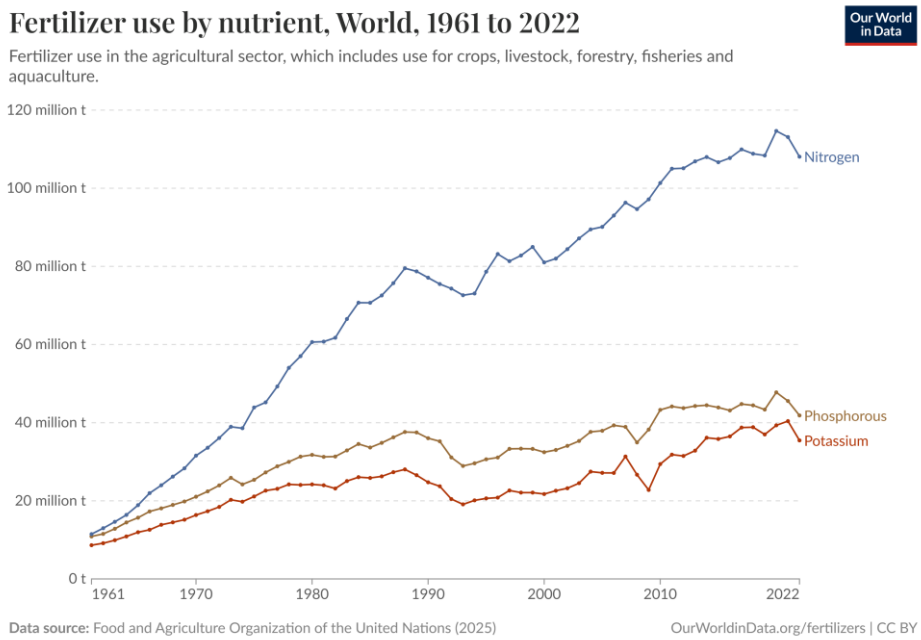


Figure 5. World fertiliser consumption by nutrient

In terms of application of fertiliser products (including nitrogenous, potash, and phosphate fertilisers), measured in kilograms of total nutrients per hectare of cropland, average values are 116 kg/ha in 2023 which is 29% more than in 2002 (90 kg/ha), reflecting a gradual intensification of fertiliser application. In contrast, fertiliser use per capita remained relatively stable, moving from 22.4 in 2002 to 23.5 kg/capita in 2023. Comparing among world regions, the application per Ha ranged from 22 kg/ha in Africa to 177 kg/ha in Asia. According to FAO (2018), Africa's low fertiliser use per hectare indicates challenges in terms of access to inorganic products which, important to this report, may be complemented in some countries by larger amounts of organic manure. Conversely, the high values in Asia and the Americas suggest a predominance of intensive agriculture and high-yielding agricultural cropping systems. With 65 kg/ha and 75 kg/ha, respectively, Oceania and Europe had intermediate values among regions. In the next Figure, the evolution of fertiliser application rates over the long-run for selected countries is depicted.

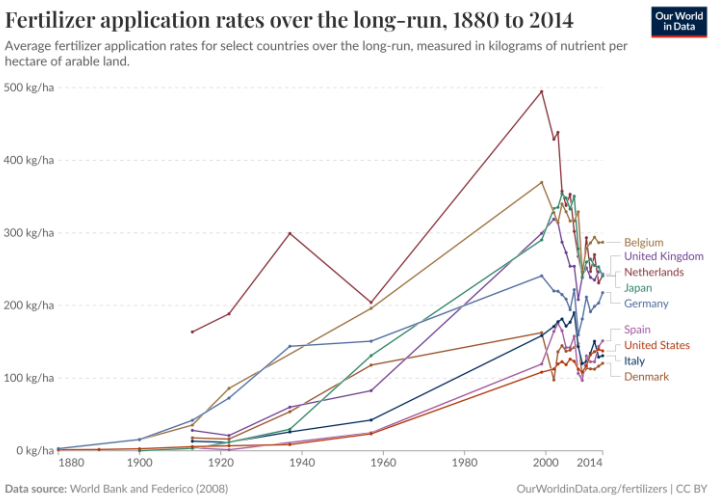


Figure 6. Evolution of world fertiliser application rates

With all this information taken into account, and as discussed by FAO (2025) for the specific case of Europe, the application of fertilisers declined between 2002 and 2023 by 8 percent from 22 Mt to 20 Mt. The region accounts for 11% of the global fertiliser use and following declines in the 90's, agricultural use of inorganic fertilisers has largely stabilised in the last decade. Nitrogen fertilisers are the main contributors (66 percent) of the total applications, with phosphate and potash fertilisers contributing 16–20 percent each. This decrease, largely due to P and K use, can be attributed to several factors, including conflicts and sanctions imposed on major exporters such as the Russian Federation and Belarus, coupled with increased natural gas prices in Europe. Additionally, severe droughts in Western Europe further exacerbated the situation by reducing agricultural productivity and thereby decreasing the demand for fertilisers.

Further data from EUROSTAT[33] on 2023 (for EU27 only data from 2019 is available) shows that among the EU participating countries in FERTITEC, Poland results to be the country that has the highest consumption of fertilisers (mineral) followed by Spain, Sweden, Greece and Finland for N, and Poland followed by Spain, Greece, Sweden and Finland for P. This suggests that, compared with the other countries, Poland, together with Spain might have a faster increase in the AF market in the near future due to the higher demand for nutrient supply. Source graphs are provided as follows illustrating that the demand remained relatively stable for N, and was reduced for P, comparing 2019 with 2023. A similar country distribution for total fertiliser consumption in 2022, when considered on a per capita basis, is shown based on FAO data[34]. Poland results in being the country that has the highest consumption (43.38 kg) per capita, followed by Spain (27.19 kg), Sweden (26.6 kg), Finland (26.4 kg), Greece (25.5 kg) and Kenya (4.08 kg).

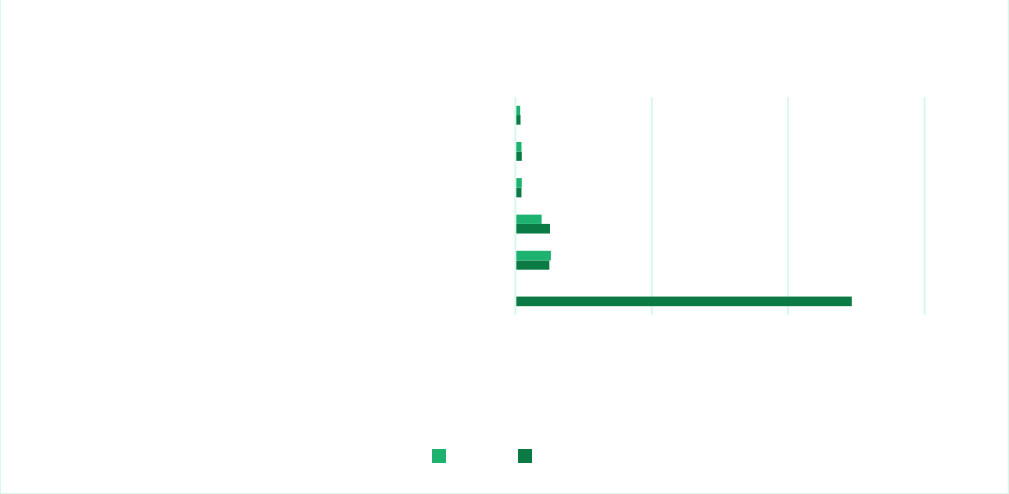


Figure 7. Consumption of inorganic N fertilisers in the EU countries participating in FERTITEC project and at the EU level

[33] Statistics | Eurostat
[34] Fertilizer use per capita, 1961 to 2022

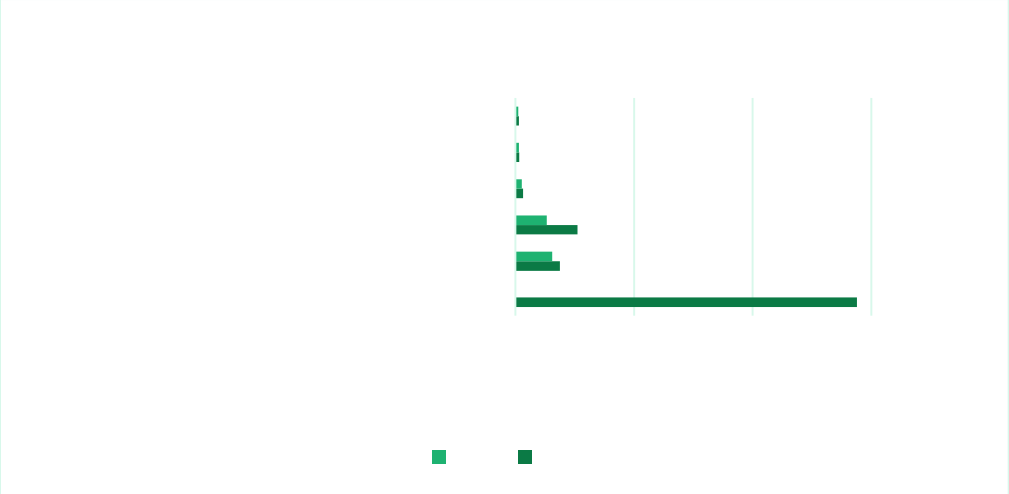


Figure 8. Consumption of inorganic phosphate fertilisers of the EU countries participating in FERTITEC project and at EU level.

In the case of Africa (the other world area under scope in FERTITEC), according to FAO (2025), the use of mineral fertilisers increased by 65 percent between 2002 and 2023, from 4.3 Mt to 7.0 Mt. The region accounted for 4 percent of global use in 2023, with nitrogen use remaining the dominant component. The growth in nitrogen application, which more than doubled, largely drove the increase. Egypt, Nigeria and South Africa continued to be the largest users in the region.

Once the world consumption and use has been evaluated, the actual production is assessed. According to data from Fertilizers Europe[35], the global and EU-27 (mineral) fertiliser production in 2021 was 259.1 Mt and 17.3 Mt, respectively. In the N fertiliser market, only few countries (the Russian Federation, China, Qatar, Saudi Arabia and the United States of America), account for 46 percent of global nitrogen exports in 2022, with Russia with 16% being the largest contributor. In the last years, Russia and China have decreased the exports (in the latter case due to internal demand). Conversely, Qatar, Saudi Arabia and the United States of America all recorded significant increases. In the case of phosphate, the exports are even more concentrated, with five countries (Morocco, China, the Russian Federation, Saudi Arabia and the United States of America) representing 76 percent of global exports in 2022. Morocco holds the largest share of all phosphate exports (21 percent). The leading exporters of potash fertilisers in 2022 were Canada (37 percent of global exports), the Russian Federation (23 percent), Belarus, Israel and Germany (7–8 percent each). Regarding EU, the only significant source of phosphate rock is the Sokli mine[36], located in Finland. In the specific case of EU, in 2022, the European trade by nutrient was 7.5 Mt imported and 3.6 Mt exported. Seen as fertiliser products, and according to data from Eurostat from 2024[37], a total of 24.3 Mt of fertiliser products were imported and 11.2 Mt exported.

Crucial to this report is how this consumption of fertilisers is translated into global[38] market value. The estimated size according to the latest reports from surveillance companies such as Mordor Intelligence is 346.83 × 10^3 million € in 2025, expected to reach 466.18 × 10^3 million € by 2030,

[35] https://www.fertilizerseurope.com/wp-content/uploads/2023/07/Industry-Facts-and-figures-2023.pdf
[36] Sokli - Sokli Oy
[37] https://agridata.ec.europa.eu/extensions/DashboardFertiliser/FertiliserTrade.html
[38] https://www.mordorintelligence.com/industry-reports/fertilizers-market

growing at a CAGR of 6.1% during the forecast period (2025-2030). Other market research consultancies estimate the value of the global fertiliser market at approximately 149.50 × 10^3 million in 2024, and it is expected to reach 208.1 × 10^3 million € by 2033, growing at a compound annual growth rate (CAGR) of approximately 3.3% from 2025 to 2033[39]. Additional sources (such as Global Market Insight, GMI, reports[40]) estimate the market at € 178.54 × 10^3 in 2024 and is estimated to reach € 231.11 × 10^3 million in 2034 at 2.6% CAGR from 2025 to 2034, according to Global Market Insights Inc.

Considering the range of estimates and data provided by these consulting firms, the global fertilisers market appears to be valued between € 172.34 × 10^3 and € 344.68 × 10^3 in the period between 2014 and 2025, with a CAGR within the 2.6% and 6.1% over the next decade. In Europe[41], the estimation is 47.63 × 10^3 million € by 2025 and 62.28× 10^3 million € by 2030, growing at a CAGR of 5.51%. In terms of actual trade, and according to data from Eurostat (2024), the value is 8836178×10^3€ for imports and 5092536×10^3€ for exports. According to data from 2022, the main trade (imports) was with: Russia (2564 M€), Egypt (1779 M€) and Algeria (1002 M€). In the case of exports, the main countries were: USA (486 M€), Norway (439 M€) and Turkey (207 M€).

Once the global CF market has been analysed, needed to make comparisons and analyse opportunities and trends, the AF is now assessed. Worldwide estimations of AF market are scarce and imprecise. What several reports agree is that the inorganic segment commands the major market share, primarily due to its cost-effectiveness, wider availability, and longer shelf life compared to AF. As discussed in the GMI report, this AF segment, while growing, remains a smaller contributor to the market due to its higher production costs, shorter shelf-life, and limited scalability. Its adoption is mostly driven by consumer preference for natural, eco-friendly, and clean-label products, especially in niche markets. However, until cost and stability challenges are addressed, CF products are likely to maintain their market leadership.

Fertilizers Europe[42], where the majority of mineral fertiliser manufacturers across the EU are involved, has developed a database on the availability of livestock-derived nutrients in Europe, which represents the vast majority of organic nutrient sources[43]. Differences across countries are mainly driven by the number of animals present in the national territories. Higher availability is registered in Western European Countries, with France, Germany, Spain and the United Kingdom showing a higher level of AFs consumption. The report estimates that in 2023, European crops received from AF (organic sources): 8.3 million tons of N, 4.5 million tons of phosphate and 9.9 million tons of potash. In comparison, the same nutrients from mineral fertilisers amounted to 9 million tons of N, 2.2 million tons of phosphate, and 2.4 million tons of potash. Therefore, if the fertilisation from both sources is summed, a total of 36.4 million tons of fertilisers are applied to EU soils, 63% coming from AF and 37% from CF.

[39] Fertilizer Dimensioni del mercato, quota, Rapporto di previsione 2033
[40] Fertilizer Market Size, Share, Growth & Forecast Report, 2034
[41] https://www.mordorintelligence.com/industry-reports/europe-fertilizers-market
[42] Publications - Fertilizers Europe
[43] Forecast-2024-34-web.pdf

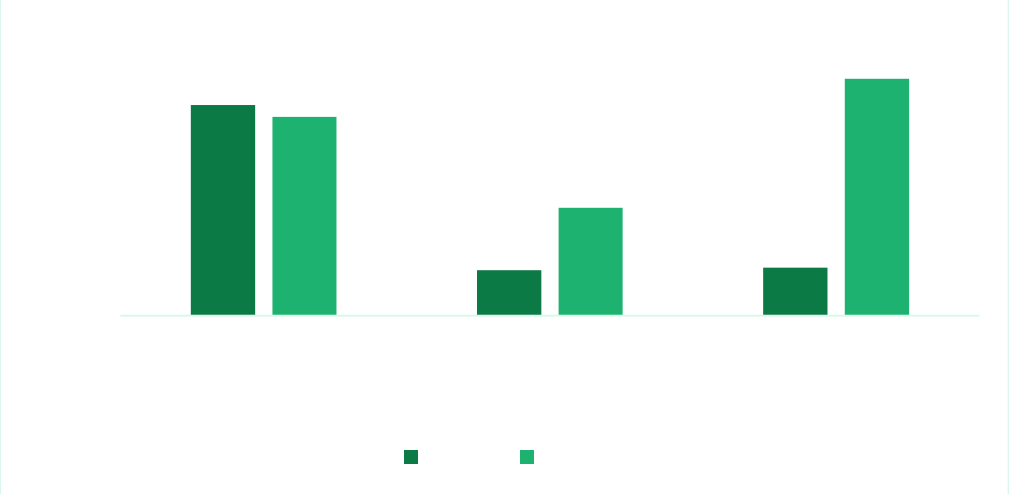


Figure 9. Consumption of mineral nutrients (nitrogen, phosphate, potash) and major nutrient addition of non-mineral fertiliser sources of the EU 27 countries in 2023.

Regarding demand, Europe and Latin America are the uppermost consumers of AFs driven by the rigorous regulations imposed on agrochemicals (Kumawat et al., 2021).

In Europe, the size estimation of the organic fertiliser[44] market (originated from: manure, meat and bone meal-based fertilisers and oilcakes) is 3.89 million × 10^3 € in 2025, and expected to reach 5.70× 10^3 million € by 2030, growing at a CAGR of 7.95%. In the case of the biofertilisers market (which are organic fertilisers that contain beneficial microorganisms), the size in Europe is estimated at 0.98 × 10^3 million € in 2025, expected to reach 1.54× 10^3 million € by 2030, growing at a CAGR of 9.49%[45]. The relatively high CAGRs indicate a strong trend towards AFs, driven by the industry's focus on enhanced nutrient efficiency and reduced environmental impact but also related to the organic farming adoption by farmers. If these estimations are compared with those for the EU global fertiliser market provided above, AF represent approximately 10% of the market share. Using data from Eurostat in 2024, it is possible to compare the above-mentioned total amount of fertiliser products imported in 2024 (24.3 Mt; average value of 8836178 × 10^3 €; average unit value of 36 € per 100 kg) with that of manure/other agricultural biomass-based fertilisers cited as “animal/vegetable” fertilisers (111895 t; × 77668 × 10^3 €; average unit value of 69 € per 100 kg) that only entails 0.46% in volume and 0.88% in market. What is probably more interesting in terms of market value are the exports. In this case, the total amount of fertiliser products exported in 2024 was 11.2 Mt (attracting 5092536 × 10^3 €; average unit value of 45 € per 100 kg), comparing with 563804 t of manure/other agricultural biomass-based fertilisers, attracting 308363 × 10^3 € (average unit value of 55 € per 100 kg). Therefore, animal/vegetable fertilisers supposed 5% of the exports and 6% of the value. Considering both the imports and the exports, animal/vegetable fertilisers supposed 1.9% of the volume and 2.8% of the market.

According to the data provided, and in terms of the global fertiliser market, the AF one is comparatively small. But, it has been seen that according to data from Europe, organic fertilisation is more important than the mineral one. Therefore, it seems that the CF dominate the market and the AF the nutrient input. This is explained by the fact that one thing is the actual nutrient consumption (where AF have

[44] https://www.mordorintelligence.com/industry-reports/europe-organic-fertilizer-market
[45] https://www.mordorintelligence.com/industry-reports/europe-biofertilizer-market

a very strong presence) and another is the market size. Contrary to CF, AF attract in many cases low commercial value (i.e. AF such as manure, digestate or compost are given for free or sold at low value), and are affected by weak traceability.

The previous analysis, supported by predicted trends by for example the Directorate-General for Agriculture and Rural Development, which clusters the data by category using data from Eurostat, outlines AFs as a sector which will tendentially increase over the upcoming years. The question is the potential to partially replace CF and coexist with them in many situations, providing that, in general, the demand of nutrients is expected to increase in the coming years. In the case of Europe, and for the period 2024 – 2034, most European member states (EU-27) as well as Norway and the UK expect an increase in nutrient consumption (2.6% for N, 20.1% for P and about 18% for K fertilisers). Therefore, the actual prospects and the approximate percentage of replacement are still unknown. And this is because, in general, the fertiliser market is very complex and influenced by myriad of factors including: geopolitical (e.g. Russian invasion of Ukraine in February 2022, which has been reported by Höhler *et al*. (n.d.) to have a pronounced impact in Europe), technology and legislation development, final configuration of the final products and production costs (Siciliano et al., 2020), evolution of cultivated land and crop typology, social perceptions, logistics, climate change. The influence of most of these factors to the AF products can go both ways. For example, technology development can result in BAT for the production of AF with higher TRL and more robust, and final products having a more defined and targeted composition. At the same time, such development can result in the access to new mineral deposits (or improve the access to existing ones) thus favouring CF. Saying so, this factor as a whole together with legal imperatives and consumer preference, seems to play in favour of the adoption of AF, at least in Europe. The most promising opportunities are linked to the expansion of the organic agriculture sector and arise where organic residues are produced close to agricultural land. Geopolitics (at least for Europe) also seem to favour AF where they are locally produced and consumed. Climate change and continuous soil degradation also imply the use of AF, especially those that can contribute not only to plant nutrition but also to soil health. However, AF will have to compete with the prevalent lack of trust from the growers, limited nutrient concentration, variability in composition, presence of potential contamination, and logistical constraints related to collection, transport, and application.

Market trends show increasing demand for several AF products but yet in small percentage if compared to the whole fertilisers sector. In fact, and according to the market size estimation figures provided for EU, by 2030 AF are likely to represent 12% of the market share, compared with the current 10% calculated. Mordor intelligence reports that the fertiliser industry is experiencing a gradual shift toward sustainable and specialised fertiliser solutions, driven by technological advancements and environmental regulations. For example, the ornamental sector has shown particular promise in adopting innovative fertilisation techniques, with production increasing by 9.3% in recent years. This trend is accompanied by growing interest in precision farming technologies, controlled-release

fertilisers, and bio-based alternatives, reflecting the industry's movement toward more sustainable agricultural practices[46]. For the next decade, and according

Indeed, Europe accounted for 41.7% of the global AFs market in 2022[47], highlighting its leadership in sustainable agricultural practices where the production of AFs is mainly represented by the meal-based fertiliser products (61.9% of the total market value in 2024) due to their rich nutrient content, such as N, P, K, and Ca. Meal-based fertiliser products are preferred and consumed mostly by row crop farmers.

The microorganism-based AF sector also looks promising. Microorganisms with known plant-nutrient derived activity, such as N-fixing, P-mobilising, K solubilising, P solubilising, micronutrient and plant growth-promoting (Daniel et al., 2022), are selected. These microorganism-based fertilisers are typically organised depending on the selected organism (*Rhizobium, Azotobacter, Azospirillum*, blue-green algae, phosphate-solubilising bacteria, mycorrhiza, etc.), technology used (e.g. carrier-enriched), type of application (e.g. seed vs. soil treatment), targeted crop type... Among these microorganisms, the most used is *Mycorrhiza,* dominating the global market and holding approximately 36% market share in 2024, followed by bacteria nitrogen fixing of the genus *Rhizobium,* with an expected growth rate of 11% between 2024 and 2029[48].

Market gaps are identified when there is a demand which is not satisfied by the existing market. Authors believe that this is the case for AF. Such demand for AF exists but it is not adequately attended by current limitations discussed above related to logistics, infrastructure, technologies and efficient collection, sorting, and processing. Another limitation is related to the absence of an exhaustive mapping of the available feedstocks and technologies already in use in all countries, which could be replicated and adapted to other regions.

This existing gap represents opportunities which rely on technology and legislation development and availability of feedstocks in sufficient quantity and quality.

4. EU Regulatory Framework, certification schemes and market standards

Favourable conditions with appropriate policy measures and incentives are key for the widespread distribution and adoption of AF. In Europe, several legislative pieces on agriculture, waste management, and circular economy impact AFs uptake directly or indirectly. The analysis of the

[46] Europe Fertilizers Market Size & Share Analysis - Industry Research Report - Growth Trends
[47] Europe Organic Fertilizer Market Size & Share Analysis - Industry Research Report - Growth Trends
[48] Biofertilizer Market Size & Share Analysis - Industry Research Report - Growth Trends

regulatory framework is also important from the point of view of shaping future policies that support the adoption of more environmentally friendly and sustainable fertilisation practices.

A comprehensive overview of EU legislation which are relevant to AF is provided below:

1. **Fertilising Products Regulation (FPR), (EU) 2019/1009,** whose main objective is to establish common standards for fertiliser commercialisation products, highlighting the importance of AFs in line with circular economy strategies (Huygens et al., 2019). The different products are categorised by: product function categories (PFCs) with specific requirements and component material categories (CMCs). For the products that accomplish with the requirements to be commercialised, a product-specific labelling with the CE mark and declaration of conformity is obtained[49].
2. **Circular Economy Action Plan (CEAP)**[50] was adopted in 2020 to reduce pressure on natural resources and create sustainable growth and jobs across several sectors. One of the targets is the fertiliser industry[51] that recycles millions of tonnes of materials from other industries.
3. **Regulation (EU) 2025/973**[52] of 23 May 2025 and **2023/121**[53] of 17 January 2023 amending and correcting Implementing **(EU) 2021/1165**[54], authorising certain products and substances for use in organic production and forbidding, for example, products obtained from feedstock by "factory farming origin". Among the products and substances listed are: fertilisers, soil conditioners and nutrients that can be used.
4. **Waste Framework Directive (WFD) 2008/98/EC**[55]**,** which establishes measures to preserve the environment and human health by preventing and reducing waste generation and its negative impacts, promoting resource efficiency and the transition to circular economy systems.
5. **Nitrates Directive (91/676/EEC)**[56], aiming to reduce water pollution caused by nitrates from agricultural sources and prevent further pollution by promoting good agricultural practices and more conscious fertilisers use. According to the mandate of this Directive, all member states have to establish action programs to reduce and monitor nitrate pollution.
6. **Carbon Border Adjustment Mechanism (CABM)**[57]**, (EU) 2025/2083,** is the EU's tool to put a fair price on carbon emitted during the production of carbon-intensive goods that are entering the EU, and to encourage cleaner industrial production in non-EU countries. This includes fertilisers in the CBAM' scope, meaning importers must report the carbon emissions embedded in imported fertilisers.
7. **Sewage Sludge Directive (86/278/EEC)**[58]**,** regulating the safe and sustainable use of sewage sludge in agriculture to prevent harmful effects on soil, vegetation, animals, and humans. This directive directly impacts the fertilisers sector by setting standards and monitoring requirements.

[49] L_2019170EN.01000101.xml
[50] https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en
[51] Circular Economy Action Plan - Fertilizers Europe
[52] Implementing regulation - 2025/973 - EN - EUR-Lex
[53] http://data.europa.eu/eli/reg_impl/2023/121/oj
[54] http://data.europa.eu/eli/reg_impl/2021/1165/2025-06-15
[55] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008L0098-20240218
[56] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A01991L0676-20081211
[57] http://data.europa.eu/eli/reg/2025/2083/oj
[58] Directive - 86/278 - EN - EUR-Lex

8. **Common Agricultural Policy (CAP, 2023-27)**[59], driving the transition to a circular economy by promoting sustainable farming practices including the re-use and optimisation of agricultural waste and the promotion of the use of organic fertilisers and reduction of the dependency on chemical fertilisers by supporting the development and use of AF.
9. **Industrial Emissions Directive (2010/75/EU)**[60], whose main objective is to reduce pollution from industrial activities. This Directive targets emissions from the production and use of fertilisers such as nitrogen oxides (NOx) and ammonia (NH_3). It also boosts the use of the BAT to minimise emissions, and includes specific emission limit values for pollutants associated with fertiliser production and monitoring emissions from industrial installations.
10. **Regulation (EC) No 1907/2006** concerning **Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)**[61]**.** It affects the fertilisers sector by imposing to register chemical compounds under REACH used in fertiliser formulations if produced/imported in amounts >1 tonne/year. This restricts or limits the use of raw materials used for AFs production, unless officially reached the status of "end-of-waste".
11. **Regulation (EC) No 1107/2009**[62] concerning the **placing of plant protection products on the market,** including plant biostimulants.
12. **Animal by-products (ABPs) Regulation (EC) No 1069/2009**[63]**,** which aims to ensure the safety of the food and feed value chains by minimising risks to human and animal health arising from those products. The regulation impacts the fertilisers sector and market by dividing ABP-derived material in risk categories which condition their potential use as fertilisers and the obtention of the CE mark.
13. **Regulation (EU) 2018/848**[64] **on organic production and labelling of organic products from agriculture**. This piece of legislation regulates and promotes the use of AF in organic farming.
14. **Ecodesign for Sustainable Products Regulation (ESPR) (EU) 2024/1781**[65]**.** This regulation establishes a framework for setting ecodesign requirements for sustainable products, including fertilisers. Fertilisers must meet new sustainability standards, including resource efficiency and the inclusion of recycled materials.
15. **EU Emissions Trading System (EU ETS) Directive (2003/87/EC)**[66] promoting reductions of greenhouse gas emissions in a cost-effective and economically efficient manner. This affects the fertilisers sector, mainly the production of N fertilisers to meet CO_2 emissions limits.
16. **Farm to Fork Strategy**[67]. This strategy is a key component of the European Green Deal, aiming to create a fair, healthy, and environmentally friendly food system. This regulation impacts the fertilisers sector by targeting nutrient losses reduction and promoting practices to prevent overuse and runoff (especially N and P).
17. **EU Taxonomy Regulation (EU) 2020/852**[68]**,** establishing the criteria for determining whether an economic activity qualifies as environmentally sustainable.

[59] https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance_en
[60] https://eur-lex.europa.eu/eli/dir/2010/75/oj/eng
[61] https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32006R1907
[62] EUR-Lex - 02009R1107-20221121 - EN - EUR-Lex
[63] Regulation - 1069/2009 - EN - EUR-Lex
[64] http://data.europa.eu/eli/reg/2018/848/2025-03-25
[65] http://data.europa.eu/eli/reg/2024/1781/oj
[66] http://data.europa.eu/eli/dir/2003/87/oj
[67] Farm to Fork Strategy - European Commission
[68] http://data.europa.eu/eli/reg/2020/852/oj

18. **Directive 94/62/EC[69],** which aims to reduce the environmental impact of packaging (including the fertilisers sector), by promoting recycling and reuse, and guaranteeing compliance with both national and EU regulations.
19. **Directive (EU) 2024/3019[70]** laying down rules on management of urban wastewater, to protect the environment and progressively reduce greenhouse gas emissions to sustainable levels, improving the energy balance of urban wastewater collection and treatment activities and contributing to the transition towards a circular economy.

Other valuable documents related to circular economy legislation and waste management have been released by the Joint Research Centre (JRC). This is the case of the "Best Available Techniques Reference Document for Waste Treatment", which details the multiple possibilities of treatment of different types of waste (Pinasseau et al., 2010). Moreover, the European Commission recently released[71] an Action Plan for the Chemicals Industry to strengthen the competitiveness and modernisation of the EU chemical sector by removing extended registration requirements and applying standard REACH rules, easing market access. It also plans to introduce clearer criteria and methods for assessing microorganisms in plant biostimulants, simplifying processes.

Another source of highly valuable information for the assessment of the impact of EU legislation on AF is EU funded projects. This is for example the case of FER-PLAY, which conducted a detailed and comprehensive analysis on the regulatory conditions influencing the production and deployment of AF, focusing on the 7 AF value-chains selected in the project.

In summary, the EU legislation is promoting the agriculture sector to become more sustainable, especially by fostering the use of AF, and trying to reduce the use of fossil-based fertilisers. It is thus expected that political actions will have a positive impact on the AF market.

European certification schemes are systems of verification to assess that a given product, process, or service meets specific criteria or standards, which are mostly derived from legislation. They can be mandatory (set directly by legislation), voluntary (e.g., developed by industry bodies) or mixed.

The EU fertiliser certification scheme is the official pathway that a fertiliser product must undergo to be commercialised in EU Countries. To sell a fertiliser product in Europe, the CE mark is mandatory. To obtain the CE mark, a fertiliser must comply with EU FPR 2019/1009. The FPR regulates both the end characteristics (contaminants, nutrient levels – though less stringent than today) as well as the input materials contained in every fertilising product. A product can be manufactured with the CE mark only if, in accordance with the FPR:

- Meets the requirements for the relevant PFC (Annex I), the main being: fertilisers, liming material, soil improver, growing medium, inhibitor, plant biostimulant, fertilising product blend. EU fertilising products are subject to different safety and quality requirements depending on the function(s) claimed by the manufacturer.

[69] http://data.europa.eu/eli/dir/1994/62/2018-07-04
[70] http://data.europa.eu/eli/dir/2024/3019/oj
[71] Commission strengthens Europe's chemical industry

- Meets the requirements for the relevant CMC or categories (Annex II). EU fertilising products may consist solely of materials complying with the requirements for one or more of the 15 component material categories listed in the FPR. The FPR lays down different rules for each component material category regarding, for instance, the input materials or the processing methods.
- Is labelled in accordance with the labelling requirements (Annex III).
- Has successfully passed the relevant conformity assessment procedure (Annex IV).

In addition to official government certification, there are voluntary standards to increase market trust or meet buyers' demands. These voluntary standards (e.g. fertilisers for organic agriculture) might become mandatory depending on the final specific destination use. Some examples of EU standards which contribute to the AF market come as follows:

- Organic agriculture: a robust standard list for organic agriculture is provided by the (EU) 2018/848 and the respective updates (EU) 2021/1165 and the very last (EU) 2025/973. These norms restrict fertilisers types allowed in organic agriculture. The legislation describes types of fertilisers allowed, detailing feedstocks permitted, nutrient content, contaminants, and excluding synthetic fertilisers.
- The European Committee for Standardisation (CEN) published three deliverables[72] (CEN/ TC 223 'Soil improvers and growing media', CEN/TC 260 'Fertilisers and liming material' and CEN/TC 455 'Plant biostimulants') providing analytical methods to be used by producers to verify the compliance of their products with the Regulation.
- EU Ecolabel[73], which promotes goods and services with a guaranteed reduced environmental impact throughout their entire life cycle.
- Product Environmental Footprint (PEF)[74], which provides rules to quantify and communicate environmental impacts of products, goods and services using life cycle assessment (LCA) methodologies.
- OK Biobased (TÜV Austria)[75], which determines in percentage of renewable raw materials (% biobased). Depending on this, the product can be certified as one, two, three or four-star bio-based.
- ISCC PLUS[76] offers a voluntary certification scheme designed to validate the sustainability characteristics of alternative feedstocks.

[72] CEN published 82 new Technical Specifications on fertilizing products in support of the EU Circular Economy objectives - CEN-CENELEC
[73] EU Ecolabel - Home
[74] PEF METHOD - European Commission
[75] OK biobased - OK Certification
[76] ISCC PLUS - ISCC System

5. National legislation, certification schemes and market standard analysis

Once covered relevant legislation, certification and market standards at EU level, this Section features these topics at national/regional level for the countries involved in FERTITEC (Spain, Sweden, Greece, Finland, Poland and Kenya). It is important to know those national framework conditions in order to clear out conditions and boost the adoption of AF. Favourable conditions with appropriate policy measures and incentives are key for the widespread use of AF.

Each subsection is organised in the same way and presents the following information for each case country:

- A compilation of the key elements of legislation related to AF.
- The description of the government-mandated certification scheme for AF as per Regulation (EU) 2019/1009 and coexistence with existing national legislation.
- Identification of voluntary market standards which are relevant for AF. Their identification and adoption at national level is important because they facilitate market adoption, access and trade, enhance efficiency and interoperability, and build consumer confidence by establishing a shared framework and codifying best practices.
- A general assessment of the situation of AF at national level using all the above-mentioned information.

5.1.1 Spanish agricultural, waste management, and circular economy key elements of legislation

EU directives and their transposition at national level in Spain, which directly or indirectly impact AFs and circular economy, are published and available at the *State Agency Official State Gazette* (Boletín Oficial del Estado, BOE)[77]. Table 2 displays such regulations, highlighting the policy area, competent body, implementation date and the relevant challenges vs. opportunities.

Table 1 Key legislation affecting alternative fertilisers in Spain. NA (not available).

Legislation	Policy area (Agriculture, Circular Economy, Waste Management)	Competent body (level of government, department, etc.)	Effective since	Potential challenges for alternative fertilisers	Potential opportunities for alternative fertilisers
State Waste-Management Framework Plan 2024-2035	Circular economy & waste management	Ministry for the Ecological Transition and the	22/1/25	Objectives for nutrient (N/P) recovery, especially from organic	Development of new product formulations

[77] BOE.es - State Agency for the Official State Gazette

		Demographic Challenge (MITECO)		waste sewage sludge	
Royal Decree 529/2023 on fertiliser products	Agriculture	Government, Ministry of the Presidency	18/7/23	Fertiliser's characteristics (i.e., digestate, soil amendments, compost, etc.)	Characterisation of alternative fertilisers increases trust
Regulation (EU) 2023/121	Agriculture	European Parliament and the Council of the EU	7/2/23	Exclude animal manure as a source material for factory farming origin	Improve adoption of new products, including struvite
Royal Decree 1051/2022	Agriculture	Government, Ministry of the Presidency	1/1/23	Mew normative for nutrient input to agricultural soils	Sustainable nutrition input reduction
Royal Decree 1050/2022	Agriculture	Government, Ministry of the Presidency	1/1/23	New phytosanitary application normative	Detailed and controlled application of products
Royal Decree 1055/2022 on Packaging and Packaging Waste	Circular economy & Waste management	Government	29/12/22	Responsibility of fertiliser packaging	Waste optimization
Fertiliser products regulation (Reg. (UE) 2019/1009)	Agriculture	European Parliament and the Council of the EU	1/7/22	Labelling and traceability requirements	New product categories (including biostimulants)
Law 7/2022 on Waste and Contaminated Soils for a Circular Economy	Circular economy, Agricultural & Waste management	MITECO	10/4/22	Reducing quantity of raw material available, or additional treatment required	Incentives for compost/digestate as fertilisers. Mandatory organic waste collection.
Royal Decree 47/2022 on Nitrate Pollution from Agriculture	Agriculture	Government, Ministry of the Presidency	21/1/22	Definition of N vulnerable areas, limitation on manure and N-based fertilisers. Obligation to register and monitor fertilisers use	Reducing water pollution, ecosystem recovery

Organic production regulation (Reg. (UE) 2018/848)	Agriculture	European Parliament and the Council of the EU	1/1/22	Strict requirements to accomplish in organic farming	Market growing, environmental benefits
Law 7/2021, on Climate Change and Energy Transition	Circular Economy & Agriculture	MITECO	22/5/21	Measures and standard achievement	Foster circular economy
EU taxonomy	Circular Economy & Agriculture	European Commission	12/7/20	Complexity of the normative, and the cost for adaptation	New investment in sustainable opportunities
Royal Decree 553/2020 Waste movement	Waste management	Government, Ministry of the Presidency	1/7/20	Requirements and standards regarding waste movement	Facilitating waste management
Spain Circular 2030 Strategy	Circular economy, agriculture & waste management	MITECO	6/20	Foster nutrient and waste (organic) recovery	Market increasing, products diversification and availability
Royal Decree 506/2013 on fertiliser products	Agriculture	Government, Ministry of the Presidency	11/7/2013	Complexity of application	Provision of a legal framework
Royal Decree 11/1995 urban wastewater	Circular economy, agriculture & Waste management	MITECO	28/12/95	Treatment achievement normative	Possibility and safe reuse of urban wastewater
Royal Decree 1310/1990 on sewage sludge	Circular economy, agriculture & waste management	MITECO	2/11/90	Specific limits on heavy metal concentrations and monitoring requirements	Exact procedures, documentation, and compliance measures for sustainable use of use of sewage sludge in agriculture
Directive 86/278/CEE sewage sludge	Waste management & agriculture	Council of the European Communities	4/7/86	Content limits of heavy metals	Guarantee safe use of sewage sludge in agriculture

Following this summary Table, these pieces of legislation are further described as follows:

1. **State Waste-Management Framework Plan (PEMAR) 2024-2035**. This plan[78] has been elaborated to comply with the Directive 2008/98/EC, concerning multiple waste flows, and

[78] BOE-A-2025-1118 Plan Estatal Marco de Gestión de Residuos 2024-2035

setting targets for waste reduction, recycling, and recovery. It presents several measures to increase the selective collection of biowaste.

2. **Royal Decree 529/2023,**[79] modifying **Royal Decree 506/2013**, on fertiliser products. It aims to align national regulations with the EU Regulation 2019/1009, and to increase fertiliser availability and safety. This regulation covers important aspects which affect AF, such as: ammonium nitrate fertilisers, micronutrient mixes, criteria definition for subproducts used in fertilisers, and requirements for fertilisers high purity and safety standards.
3. **Royal Decree 1055/2022 on Packaging and Packaging Waste,**[80] focusing on prevention and recycling aligned with the EU Directive 94/62/EC. The packaging sector includes fertiliser products, encouraging the use of recyclable and sustainable materials, and clear labelling on packaging informing consumers about recycling and disposal.
4. **Royal Decree 1051/2022**[81] laying down normative for a sustainable nutrient input to agricultural soils. Moreover, it introduces a section requesting growers to provide specific information on fertilisers in their exploitation plans.
5. **Royal Decree 1050/2022**[82]**,** modifying **Royal Decree 1311/2012**[83]**,** which establishes the framework for the sustainable use of phytosanitary products, their registration and detailed use of the agriculture exploitation digital book.
6. **Fertiliser Products Regulation (Reg. (UE) 2019/1009)**[84]**.** It covers the direct transposition of the EU Regulation to the Spanish legal framework.
7. **Law 7/2022 on Waste and Contaminated Soils for a Circular Economy,**[85] addressing Spain's waste management framework and aligning with EU directives to promote a circular economy. This law involves the obligation for municipalities with over 5,000 inhabitants to selectively collect biowaste, introduces taxes for non-reusable plastic use, boosts the use of compost and digestate, and, in general, promotes the development of fertilisers from recycled materials.
8. **Royal Decree 47/2022**[86] on nitrate pollution from agriculture, aligned with the EU Directive 91/676/EEC, aims to protect water bodies from diffuse pollution caused by nitrates linked to agriculture sector. Specifically, this royal decree intends to: identify water areas affected by nitrate pollution, design vulnerable zone and the elaborate on a specific action plan, establish a good agriculture practices code, monitor potential changes, and establish a reporting system every four years.
9. **Taxonomy Regulation**[87] establishes the basis for the EU taxonomy by setting out the four overarching conditions that an economic activity has to meet to qualify as environmentally sustainable.
10. **Organic production regulation (Reg. (UE) 2018/848)**[88] this is the report directly translated from the Reg. (UE) 2018/848, including measures and specifications on organic production in the agricultural sector and organic products labelling.
11. **Law 7/2021**[89] **on climate change and energy transition,** setting the measures and standards to be achieved in line with Paris Agreement requirements. This law fosters circular

[79] https://www.boe.es/eli/es/rd/2023/06/20/529
[80] https://www.boe.es/buscar/act.php?id=BOE-A-2022-22690
[81] https://www.boe.es/eli/es/rd/2022/12/27/1051
[82] https://www.boe.es/eli/es/rd/2022/12/27/1050
[83] https://www.boe.es/eli/es/rd/2012/09/14/1311/con
[84] https://www.boe.es/buscar/doc.php?id=DOUE-L-2019-81081
[85] https://www.boe.es/eli/es/l/2022/04/08/7/con
[86] https://www.boe.es/eli/es/rd/2022/01/18/47
[87] EU taxonomy for sustainable activities - European Commission
[88] BOE.es - DOUE-L-2018-80995 Reglamento (UE) 2018/848 del Parlamento Europeo y del Consejo, de 30 de mayo de 2018, sobre producción ecológica y etiquetado de los productos ecológicos y por el que se deroga el Reglamento (CE) nº 834/2007 del Consejo.
[89] https://www.boe.es/eli/es/l/2021/05/20/7/con

economy and gas emission reduction, through normative and incentives having an impact on AFs production and market.

12. **Royal Decree 553/2020[90] on waste movement** regulation, providing requirements, standards and the necessary legal framework for waste movement within the national territory.
13. **Spain Circular 2030 Strategy**[91]**,** aiming to foster Spain towards a circular economy by 2030, based on reducing waste generation, decreasing national resource consumption and promoting reuse and recycling of material, including the agriculture sector. The strategy sets several objectives to achieve by 2030, such as:
    - Reduce national material consumption by 30% in relation to GDP, using 2010 as the reference year.
    - Reduce waste generation by 15% compared to 2010 levels.
    - Reduce food waste across the entire food chain: 50% per capita reduction at the household and retail levels, and 20% in production and supply chains from 2020 onwards, contributing to the Sustainable Development Goals (SDGs)[92].
    - Increase reuse and foster circularity.
    - Reduce greenhouse gas emissions to below 10 million tons of CO_2 equivalent.
    - Improve water use efficiency by 10%.
14. **Royal Decree 506/2013 on fertiliser products,** intending to establish the basic regulation on fertilising products and the necessary rules for coordination with the regional authorities.
15. **Royal Decree 11/1995 on urban wastewater** treatment, aiming to protect water quality from negative effects derived from urban wastewater discharges.
16. **Royal Decree 1310/1990 on sewage sludge** regulating the use of sewage sludge in agriculture in Spain.
17. **Directive 86/278/CEE[93] sewage sludge** directive aims to regulate the use of sewage sludge in agriculture to prevent harmful effects on soil, vegetation, animals and people.

5.1.2 Spanish certification scheme for bio-based products and fertilisers

In Spain, the legislative framework for the certification of fertiliser products is Royal Decree 529/2023, setting the standards for fertiliser products to comply with the minimum legal requirements as defined by Regulation (UE) 2019/1009 and become CE mark compliance. The competent body managing the application is the Ministry of Agriculture, Fisheries and Food (MAPA)[94] manages this application.

The registration process is done through an online application[95]. If the application is successful, the product becomes available in the national fertilisers register[96]. A specific search can be done by code, producer, province, commercial name or type of product. As the EU regulation allows for coexistence with national regulations, in Spain, fertiliser producers can apply to get the CE or the national fertiliser certification as set out by Royal Decree 529/2023. In addition, and as already stipulated in Royal

[90] https://www.boe.es/eli/es/rd/2020/06/02/553/con
[91] espanacircular2030_def1_tcm30-509532_mod_tcm30-509532.pdf
[92] THE 17 GOALS | Sustainable Development
[93] BOE.es - DOUE-L-1986-81012 Directiva del Consejo, de 12 de junio de 1986, relativa a la protección del medio ambiente y, en particular, de los suelos, en la utilización de los lodos de depuradora en agricultura.
[94] Ministerio de Agricultura, Pesca y Alimentación
[95] Ficha Procedimiento - Sede Electrónica MAPA
[96] [Consulta de productos fertilizantes] - Agricultura - mapa.gob.es

Decree 506/2013, the MAPA also allows fertiliser manufacturers to certify their processing and/or storage facilities[97].

Therefore, the MAPA, together with the Spanish Fertilisers Commercial Association (ACEFER),[98] is committed to promoting AFs, aligned with the circular economy objectives at the EU and national level.

5.1.3 Spanish market standards for bio-based products and fertilisers

In the previous Section, the government-mandated certification scheme as per Regulation (EU) 2019/1009 has been reviewed. This Section covers voluntary standards which are available at national level and support the market adoption of AF

- Asociación Española de Normalización (UNE) standards. UNE standards for inputs in organic agriculture aim to clarify the market and provide guarantees to farmers, while also serving as a reference for farmers, manufacturers, and certification bodies. Standards 142500[99] and 315500[100] cover production, packaging, labelling, and marketing requirements for fertilisers and plant protection products, directed at manufacturers. Standard 66500[101] sets minimum requirements for certification schemes and personnel involved in evaluating inputs against previous standards, aimed at certification bodies. The standards compliance (establishing limits on heavy metals, pathogens, contaminants, etc.) is also safeguarded by authorised laboratories. The list of private and public laboratories can be found on MAPA's official website[102].
- The previous standards are focused on inputs used in agriculture. There are other schemes that certify agricultural practices which use AF, then boosting their market. This is for example the case of the certification of organic (certified at regional level by competent organism or by private certifying entities), regenerative (e.g. Asociación Española de Normalización y Certificación, AENOR, certification[103]) or biodynamic agriculture (e.g. Demeter certification[104]).
- In terms of alternative fertilisation, organic amendments such as compost, digestate and sewage sludge are very important in Spain. From that perspective, the Spanish composting network (Red Española de Compostaje, REC)[105], even if it does not provide any official certification, it provides technical knowledge, training and promotes good practices on composting. Moreover, it promotes research through offering prizes for scientific works.
- The activity of industry associations is also important in terms of boosting market uptake of AF. This is for example the case of Asociación Nacional de Fabricantes de Fertilizantes (ANFFE)[106], the national association of fertiliser producers, which as for the REC, does not provide official certification but promotes fertiliser production based on efficiency criteria. ANFFE is a member of the International Fertiliser Association (IFA) and the Fertilizers Europe

97 Certificación de fabricantes
98 Homepage - Acefer
99 UNE 142500:2017 Insumos utilizables en la producción vegetal e...
100 UNE 315500:2017 Insumos utilizables en la producción vegetal e...
101 UNE 66500:2017 Requisitos mínimos para la certificación de ins...
102 Laboratorios
103 https://www.aenor.com/certificacion/empresas/alimentacion/agricultura-regenerativa
104 https://www.demeter.es/
105 Red Española de Compostaje – I+D+i en gestión de residuos
106 ANFFE

(FE), participating actively. Additionally, it holds the Secretariat of the AENOR Technical Committee CTN-142 on Fertilisers, soil amendments, and growing media.

In terms of standards, certification bodies are crucial. Some of the most representative and active in Spain are:

- AENOR. A global entity that offers conformity assessment (certification, inspection and testing), training and information services.
- Comité Andaluz de Agricultura Ecológica (CAAE)[107]. The first Spanish entity designated as a Notified Body (NB 2982) to certify the conformity assessment process to obtain the CE mark on fertiliser products.
- Sociedad Hispana de Certificación (SOHISCERT)[108]. Certification entity that has available its own certification system with relatives' market standards based on (UNE 142500 y UNE 315500), which allows for distinguishing those products within the market. High level of transparency and support from growers and competent authorities, are the key points of this association.
- ECOCERT[109]. Certification organism that assists stakeholders in the implementation and promotion of sustainable practices through certification, consulting and training services for different sectors. It promotes the use of AF fostering certification of organic farming since its creation.

5.1.4 Global assessment for Spain

Agriculture is a fundamental pillar for the Spanish economy, not just for its contribution to the Gross Domestic Product (GDP), it represents about 2.5% of the GDP, but also for its role in generating employment and in the sustainability of rural areas. This sector highly relies on the use of agricultural inputs such as fertilisers. Therefore, both public and private sectors are aware of the risks associated with being heavily dependent on mineral fertilisers, and agree on the need for a more sustainable fertilisation.

Besides the direct transposition of EU directives, the fertiliser related legislation has its own development at national level, mainly through the activity of the MITECO, showing a clear compromise and support to the recovery and reuse of nutrients from secondary raw materials.

According to data from Eurostat[110] (2024), the import and export market of the fertiliser sector, as in other places, is dominated by imports. In the case of Spain, 67% imports and 33% exports. The market share of AF considering both imports and exports is anecdotic, representing only a 0.3% in volume and 1% in market value. In terms of prices, there are considerable differences. The average unit value of fertiliser products (in general) was 39 and 61 €/100 kg for imports and exports, respectively; however, in the case of animal and vegetable fertilisers was 360 and 122 €/100 kg, respectively. It is thus clear that, according to these data, there is ample room for the local market of AF to satisfy the importing demands, and for this market to export fertilisers at attractive prices.

[107] Insumos
[108] Insumos para Agricultura Ecológica
[109] Las certificaciones de Ecocert | Ecocert
[110] https://agridata.ec.europa.eu/extensions/DashboardFertiliser/FertiliserTrade.html

In terms of entries to the system, the situation is very different. According to data from the Spanish Ministry of Agriculture[111] (2021), for the case of N, a total of 2296923 t of N entered the system, distributed among the following sources: mineral (1029913 t, 45%), manure (461532 t, 20%), sewage sludge and compost from municipal organic waste (53237 t, 2%), excrements from grazing (326137 t, 14%) and other sources including seeds, biological fixation and atmospheric deposition (426104 t, 19%). For the case of phosphate (362777.2 t in total), the distribution comes as follows: mineral (172949 t, 48%), manure (100337 t, 28%), sewage sludge and compost from municipal organic waste (33261 t, 9%), excrements from grazing (46149 t, 13%) and seeds (10079 t, 3%). It can then be deduced that organic fertilisation is as important as the mineral one for P, and almost as important for N.

Results show the global tendency, previously discussed, that distinguishes between actual nutrient consumption and market size. In other words, AF are very important in terms of their contribution to the nutrient inputs but attract low market value. This represents an enormous opportunity of AF, not just in terms of increasing their value, but also in replacing some of the mineral fertilisers. The AF market in Spain is continuously increasing through the development of legislation, technology, high demand for nutrients (N/P), relatively easy logistics and transport, the requirement of a more sustainable agriculture and the need to modernise the sector, along with a high availability of suitable feedstocks. Taking into account all these factors, the Spanish AFs market has the potential to quickly scale up and be positioned at national and the EU level. Saying so, and as in other places, existing challenges are related to the lack of sufficient field trials to demonstrate the efficacy of AF, concerns about their composition, quality and availability, and existing market, social, administrative and legislation barriers preventing widespread adoption.

5.2.1 Swedish agricultural, waste management, and circular economy key elements of legislation.

The authority responsible for fertiliser registration and certification in Sweden is the Swedish Board of Agriculture (Jordbruksverket)[112]. It is responsible for regulating and supervising fertilisers, including their registration, product classification, and compliance with Swedish and EU laws.

This section compiles the key elements of EU-derived legislation as implemented at the national level in Sweden. The next Table presents the AFs relevant national regulations, covering aspects from raw materials to certification and market standards. It highlights the competent body, outlines the main impacts on alternative fertilisers (both challenges and opportunities), and classifies the relevant policy area along with the effective dates.

[112] https://jordbruksverket.se

Table 2. Key legislation affecting alternative fertilisers in Sweden.

Legislation	Policy area (Agriculture, Circular Economy, Waste Management)	Competent body (level of government, department, etc.)	Effective since	Potential challenges for alternative fertilisers	Potential opportunities for alternative fertilisers
CAP Strategic Plan for Sweden (2023–2027)	Agriculture	Swedish Board of Agriculture (Jordbruksverket), under EU CAP Regulation	2023	Alternative fertilisers not yet mainstreamed in eco-schemes	Includes funding and support for organic and circular practices, can incentivise uptake
Regulation (EU) 2019/1009 on fertilising products (national implementation)	Agriculture, Circular Economy	Swedish Board of Agriculture (Jordbruksverket)	2022	CE-marking requirements can be complex for SMEs	Enables sale and recognition of CE-marked alternative fertilisers (e.g., compost, digestate, biochar)
Waste Ordinance (Avfallsförordning 2020:614)	Waste Management	National Government – Ministry of Climate and Enterprise; Naturvårdsverket	2020	Lack of tailored provisions for fertiliser-grade secondary materials	Provides framework for classification, sorting, and reuse of nutrient-rich waste
National Food Strategy (Livsmedelsstrategin 2017)	Agriculture, Circular Economy	Ministry of Rural Affairs and Infrastructure	2017	Does not explicitly promote alternative fertilisers	Encourages innovation and sustainability in domestic food production, enabling circular inputs
Environmental Code (Miljöbalken 1998:808)	Waste Management, Circular Economy	National Government – Ministry of Climate and Enterprise; Swedish Environmental Protection Agency (Naturvårdsverket)	1999	Unclear end-of-waste criteria and varying regional enforcement	Provides an overarching legal basis for circular material use and nutrient recovery

5.2.2 Swedish certification scheme for bio-based products and fertilisers

In Sweden, the certification schemes to get a fertiliser approved for sale are comprises two routes (A, B), which are provided below with their respective steps:

A. CE-marked Fertilising Products (EU 2019/1009)[113], steps to follow:
1. Classify product under a Product Function Category (PFC)
2. Prepare a technical dossier including: composition, nutrient content, safety & environmental data, quality assurance processes (optional for some categories)
3. Use a conformity assessment procedure (with or without a notified body)
4. Affix the CE-mark
5. Product is valid for sale in Sweden and the entire EU

B. National Authorisation (non-CE products), steps to follow:
1. Submit an application to Jordbruksverket (for "nationally recognised fertilisers").
2. Providing: product composition, technical data on nutrient content and potential contaminants, intended use (e.g., as a fertiliser or soil amendment), evidence of efficacy (e.g., lab tests, field trials).
3. Await classification decision (e.g., gödselmedel, jordförbättringsmedel, kalkmedel).
4. Upon approval, the product is legal for sale in Sweden only (not EU-wide).

There is no comprehensive public registry currently existing for nationally authorised fertilisers in Sweden. Besides for CE-marked products, the EU is developing a public database, but as of mid-2025, it is not fully operational. Information about authorised fertilisers in Sweden may be requested from Jordbruksverket, but is not published openly online in list form.

5.2.3 Swedish market standard for bio-based products and fertilisers

Alternative fertilisers in Sweden fall under two main regulatory regimes:

- EU Regulation (EU) 2019/1009 on fertilising products, fully applicable in Sweden since July 2022. It introduces harmonised rules for CE-marked products like compost, digestate, struvite, and biochar. Products meeting requirements can be sold across the EU, including in Sweden.
- National Fertiliser Regulation – SJVFS 2004:62 that regulates fertilisers not CE-marked (e.g., niche or local products). The national Fertilisers regulation is administered by the Swedish Board of Agriculture (Jordbruksverket).

The market trends show a growing interest in carbon-negative fertilisers like biochar driven by climate policy and carbon removal markets. Digestate use is expanding, especially in biogas-rich regions (e.g., Mälardalen, Skåne). Organic farming sector is an early adopter of compost and alternative amendments. Public procurement increasingly favours circular and organic products in municipal land use (e.g., landscaping, green infrastructure). Innovation projects (e.g., via Horizon Europe, Vinnova) are developing tailored bio-based formulations using Swedish feedstocks (e.g., forest residues, food waste). However, there are several significant challenges due to:

- Fragmented market access: CE-marking is costly and complex for SMEs; national certification lacks visibility
- Low nutrient density: many bio-based products require high volumes and careful logistics
- Regulatory uncertainty: some secondary materials lack clear classification, such as hydrochar, precipitated minerals

[113] EU 2019/1009 regulation

- Farmer scepticism: need for more field-based proof of performance

Besides the challenges also substantial opportunities have to be taken into account:

- Carbon markets and sequestration certification (e.g., biochar) offer new revenue streams.
- EU and national CAP support encourages reduced mineral fertiliser dependence.
- Strong research ecosystem (e.g., SLU, RISE, Lantmännen) supports development and validation.
- Swedish Circular Economy Strategy aligns with nutrient recycling and biowaste valorisation.

5.2.4 Global assessment for Sweden

Sweden presents a strong enabling environment for the uptake and development of AF, driven by its advanced environmental legislation, commitment to circular economy principles, and active innovation ecosystem[114]. The country aligns closely with EU climate, bioeconomy, and sustainable agriculture strategies, although certain regulatory and market bottlenecks still constrain wider adoption[115].

The regulatory framework is dual-tiered: Sweden applies the EU Fertilising Products Regulation (EU) 2019/1009[116], allowing CE-marked products to circulate freely across the EU, while maintaining a national authorisation pathway under SJVFS 2004:62[117] for fertilisers not covered by EU regulation. The Swedish Board of Agriculture (Jordbruksverket) is the competent national authority. Additional legislation, such as the Environmental Code and Waste Ordinance, supports the recovery and reuse of nutrients from organic waste streams.

Market trends show increasing demand for biochar, processed digestate, and compost-based products, particularly within organic farming, public land management, and biogas sectors. Projects like FERTITEC and initiatives by research actors (e.g., SLU[118], AvfallSverige[119]) are accelerating the development and demonstration of bio-based fertilisers. Sweden's CAP Strategic Plan 2023–2027 offers partial financial support for sustainable fertilisation through eco-schemes and investment measures, though dedicated subsidies for alternative fertilisers remain limited.

Challenges include high production and logistics costs, uncertainty around nutrient concentrations, and limited awareness or acceptance among conventional farmers[120]. The authorisation and CE-marking process is costly and technically demanding, particularly for SMEs and producers using heterogeneous secondary raw materials.

[114] Sweden's Circular Economy Strategy (2020), moz-extension://bdec00de-391b-4dcb-b876-f91b1c08a03d/pdfjs/web/pdf_viewer.html?file=https%3A%2F%2Ffaolex.fao.org%2Fdocs%2Fpdf%2Fswe208661.pdf
[115] Sweden - European Commission
[116] https://eur-lex.europa.eu/eli/reg/2019/1009/oj/eng
[117] https://lagen.nu/sjvfs/2004:62
[118] moz-extension://bdec00de-391b-4dcb-b876-f91b1c08a03d/pdfjs/web/pdf_viewer.html?file=https%3A%2F%2Fstud.epsilon.slu.se%2F19223%2F1%2Fjansen-d-20230702.pdf
[119] moz-extension://bdec00de-391b-4dcb-b876-f91b1c08a03d/pdfjs/web/pdf_viewer.html?file=https%3A%2F%2Fwww.avfallsverige.se%2Fmedia%2Fcwibhsx2%2Fsvensk_avfallshantering_2023_en.pdf
[120] https://www.sciencedirect.com/science/article/pii/S2772826923000226

Nonetheless, Sweden holds significant opportunities in advancing carbon-sequestering[121] fertiliser systems (e.g., biochar), nutrient recovery from wastewater (e.g., struvite), and leveraging its strong institutional base to support the transition toward climate-smart agriculture[122].

The overall assessment suggests that with continued regulatory clarity, economic incentives, and end-user engagement, Sweden could emerge as a leader in the European AF landscape, both in terms of production and sustainability performance.

5.3.1 Greek agricultural, waste management, and circular economy key elements of legislation.

In Greece, the ministries of Environment, Agriculture, and Development co-issued the national rules but the authority responsible for fertiliser registration/certification and day-to-day implementation is decentralised at regional level. According to the legislation, and for the specific case of the use of treated sludge on land, it must be authorised via a permit issued by the Regional Governor, following a recommendation from the local Directorate of Agricultural Economy and Veterinary Medicine of the respective Regional Unit. This means that the regional agricultural departments oversee the approval and monitoring of sludge-as-fertiliser use in the field. Environmental inspectorates also have oversight roles for compliance.

Key elements of EU-derived legislation as implemented at the national level in Greece are summarised in the following Table. The main national legislation regulating AF derived from waste (like sewage sludge) is the Joint Ministerial Decision YPEN/ΔΔΑ/41828/630/2023 (FEK B' 2692/2023)[123]. This regulation specifically governs the use of treated wastewater sludge in agriculture and land reclamation, ensuring compliance with EU Directive 86/278/EEC on environmental protection during sludge use. It replaced the older 1991 joint ministerial decision on sludge, updating national rules in line with current EU environmental and circular economy directives. On the other hand, conventional mineral fertilisers are governed by other regulations not detailed in this act.

Table 3. Key legislation affecting alternative fertilisers in Greece.

Legislation	Policy area (Agriculture, Circular Economy, Waste Management)	Competent body (level of government, department, etc.)	Effective since	Potential challenges for alternative fertilisers	Potential opportunities for alternative fertilisers

[121] https://www.norden.org/en/nominee/swedish-carbon-sequestration-sweden#:~:text=Switching%20to%20regenerative%20farming%20practices%20through%20knowledge,for%20the%20Nordic%20Council%20Environment%20Prize%202021

[122] moz-extension://bdec00de-391b-4dcb-b876-f91b1c08a03d/pdfjs/web/pdf_viewer.html?file=https%3A%2F%2Fwww.sei.org%2Fwp-content%2Fuploads%2F2020%2F01%2Fsei-2020-pb-sludge-crossroads.pdf#:~:text=Available%20nutrients%20in%20Swedish%20wastewater%20could%20potentially,mainly%20significant%20as%20a%20source%20of%20phosphorus.

[123] https://www.elinyae.gr/ethniki-nomothesia/ya-ypendda418286302023-fek-2692b-2142023

ΥΠΕΝ/ΔΔΑ/41828/630/2023 Gov. Gazette B' 2692/21.04.2023: "Measures, terms and procedures for the use of treated sludge in agriculture and land restoration"	Circular economy, agriculture & waste management	Ministries of Environment & Energy, Rural Development & Food, and Development & Investments	4/2023	Use of treated sludge is strictly regulated Use requires a formal permit for each case, creating an administrative burden. Increases compliance costs. Treated sludge cannot be sold as a fertiliser product, only directly delivered to an end-user, limiting market commercialisation Oversight and enforcement mechanisms (e.g. inspections, risk of fines) could discourage some farmers from adopting alternative fertilisers	Legal, transparent safe route to reuse treated sewage sludge as a fertiliser or soil improver. Encourages the circular economy, reducing landfill disposal of organic waste. Supports soil restoration and land reclamation projects (e.g. quarries, degraded land). Contributes to nutrient recycling, potentially reducing dependence on mineral fertilisers. Offers a predictable and EU-aligned framework that can build confidence in using waste-derived fertilisers under controlled conditions.
Regulation (EU) 2019/1009 on fertilising products	Agriculture, Circular Economy	Ministry of Rural Development & Food	2022	Complex conformity assessment for waste-derived products; need for harmonisation with national rules	EU-wide market access for certified fertilising products
Directive 2008/98/EC on waste (Waste Framework Directive) – transposed by Law 4819/2021	Waste Management, Circular Economy	Ministry of Environment & Energy	2021	Separate end-of-waste procedure increases administrative burden	Provides legal certainty for recovering organic waste as fertilisers

Regulation (EC) No 1907/2006 (REACH)	Chemicals, Agriculture	European Chemicals Agency (ECHA) / Ministry of Development & Investments	2007	Potential registration obligations for recovered substances; compliance costs	Ensures safety and traceability of substances in fertilisers; builds user confidence
Directive 86/278/EEC on sewage sludge (transposed by JMD YPEN/ΔΔΑ/41828/630/2023)	Agriculture, Waste Management	Ministries of Environment & Energy, Rural Development & Food	Original 1986, transposed 2023 (updated)	Strict quality limits; additional monitoring requirements	Safe reuse of sewage sludge supports nutrient recycling

5.3.2 Greek certification scheme for bio-based products and fertilisers

The authorisation process for a waste-based fertiliser in Greece typically begins with classifying the organic waste stream under Law 4819/2021[124], ensuring that it meets all treatment, hygiene, and environmental safety conditions to become a recoverable resource. Once these criteria are satisfied, the producer must apply for "end-of-waste" status, demonstrating that the material is clean, safe, and suitable for agricultural use. Technical documentation must include data on nutrient composition, heavy metals, pathogens, and potential contaminants, supported by laboratory analyses. After achieving end-of-waste status, the product must then be registered as a fertiliser with the Ministry of Rural Development and Food. This step involves submitting a dossier with technical specifications, results of laboratory testing, safety data sheets, and evidence of compliance with the applicable fertiliser regulations (such as Law 2538/1997 or EU Regulation 2019/1009). The authorities evaluate these documents, and if the product meets the relevant fertiliser standards, they authorise its sale and use in the market.

Greece maintains a public registry of authorised fertilisers through the Ministry of Rural Development and Food, which lists conventional mineral and organic fertilisers approved for commercial sale. However, for organic-waste-based products such as compost, their approval is usually handled on a case-by-case basis after achieving end-of-waste status, and these products may not always be systematically included in the same registry as conventional fertilisers. Nevertheless, the Ministry or regional agricultural authorities retain full oversight of these materials to ensure their traceability and compliance with applicable laws.

For the specific case of using sludge as fertiliser, the Greek legislation outlines a clear permitting procedure. Before application on land, a permit must be obtained: the interested farmer or sludge producer (on the farmer's behalf) applies to the competent local authority (the regional Agricultural Directorate). The application must include detailed information (as specified in Annexe V of the law) about the sludge and the proposed use site. The authorities review the request, ensuring it aligns with water basin management plans and any vulnerable zone requirements (e.g., nitrate-pollution vulnerable areas). They can demand additional data for environmental protection and may conduct on-site inspections before approval. Once the dossier is complete, the Regional Governor issues the

[124] https://www.elinyae.gr/ethniki-nomothesia/n-48192021-fek-129a-2372021

permit within 60 days. The permit document will specify crucial conditions: admissible heavy metal concentrations in the sludge, the maximum annual application rate (tons/ha/year) for the plot, any extra protective measures, monitoring obligations (such as soil testing frequency), and the validity period of the permit. Permits can be granted for up to 10 years (after which renewal is needed through the same process). In certain land reclamation cases, an environmental approval under other legislation can substitute for a separate sludge permit, but still must meet all conditions of this law.

The reviewed legislation does not establish a public registry of authorised fertiliser products or approved sludge-use cases. Instead, it relies on record-keeping and oversight by authorities. Producers must keep detailed records of all sludge produced and delivered (quantities, composition, recipients, dates, fields, etc.) for at least 10 years, and users of sludge must similarly keep logs of sludge application (soil analysis results, amounts used, other inputs on the same land). These records must be provided to regulatory authorities upon request. While this ensures transparency for regulators, there is no mention of a publicly accessible database of authorised alternative fertilisers or registered sludge applications under this law. Authorisations are handled case-by-case by regional authorities rather than through a national registry.

5.3.3 Greek market standard for bio-based products and fertilisers

The regulatory framework for market standards is shaped by Law 4819/2021, which promotes the separate collection of biowaste and the recovery of organic waste streams, in line with EU waste directives. This law provides the legal conditions to produce compost and similar bio-based materials while ensuring environmental and public health protection. Once these materials meet end-of-waste status criteria, they are subject to the fertiliser legislation (Law 2538/1997 and EU Regulation 2019/1009), which defines their quality, safety, and marketing standards.

There is a growing trend in Greece to valorise organic waste through composting and anaerobic digestion, reflecting EU-level policy shifts toward the circular economy and climate-neutral farming. The establishment of mandatory separate biowaste collection across municipalities encourages higher quality organic inputs, which supports the production of fertiliser alternatives. Overall, there is increasing policy alignment between waste management and agricultural nutrient recycling.

A significant challenge is that end-of-waste criteria and fertiliser registration are separate procedures, creating legal and administrative complexity for producers. Moreover, the lack of a single, dedicated framework for alternative fertilisers can result in uncertainty or delays. On the opportunity side, however, Law 4819/2021 ensures a predictable supply of clean biowaste, supports nutrient recycling, and encourages the creation of high-quality organic fertilisers, with benefits for soil health and the environment. In the longer term, this integration of waste policy and agriculture could stimulate innovation in bio-based fertiliser products and promote sustainable farming practices.

5.3.4 Global assessment in Greece

Law 4819/2021 represents an important enabling framework for the uptake of AF in Greece. It strengthens the management of organic waste, guarantees separate collection of biowaste, and sets a basis for nutrient recovery, all of which are essential to producing compost and other organic fertilisers. However, the current arrangement still requires producers to navigate separate regulatory pathways to transform waste into a certified fertiliser product, creating administrative barriers. There is no single, unified approval scheme for AF, which could limit their commercial expansion. Nonetheless, the opportunities for integrating organic fertilisers into the circular economy are

substantial, as the law provides a foundation for high-quality, safe, and environmentally sound fertiliser alternatives that can contribute to climate goals and sustainable agriculture. Over time, improved coordination between waste and agricultural regulation could help unlock the full potential of alternative fertilisers in Greece.

5.4.1 Finnish agricultural, waste management, and circular economy key elements of legislation

In Finland, the authority responsible for fertiliser registration/certification is the Finnish Food Authority (Ruokavirasto). The main legal framework on AFs is the Fertiliser Products Act (711/2022)[125]. Its purpose is to ensure that all fertiliser products placed on the market in Finland are safe, of good quality and suitable for plant production. The Act also aims to promote the use of by-products suitable for use as fertilisers, provided that they have a proven positive effect on plant growth and do not cause damage or danger to humans, animals, plants or the environment. Moreover, under the Fertiliser Products Act, a Decree of the Ministry of Agriculture and Forestry on Fertiliser Products (964/2023)[126] is in force. The Decree regulates the applicable raw materials, production processes and characteristics of the products. The Decree and its Annexes lay down requirements and limit values for the product function categories and allowed component materials, similar to those in the EU Fertiliser Regulation.

This section compiles the key elements of EU-derived legislation as implemented at the national level in Finland. Table 4 reports the AFs relevant national regulations, covering aspects from raw materials to certification and market standards. It highlights the competent body, outlines the main impacts on AF (both challenges and opportunities), and classifies the relevant policy area along with the effective dates.

Table 4. Key legislation affecting alternative fertilisers in Finland.

Legislation	Policy area (Agriculture, Circular Economy, Waste Management)	Competent body (level of government, department, etc.)	Effective since	Potential challenges for alternative fertilisers	Potential opportunities for alternative fertilisers
Decree on Fertiliser Products (964/2023)	Circular economy, Waste management, agriculture	Government/Ministry of Agriculture and Forestry	11/10/2023	The decree regulates the applicable raw materials, production processes and characteristics of the products. It	It might improve the product's trust for those already available on the market.

[125] https://www.finlex.fi/fi/lainsaadanto/2022/711
[126] https://www.finlex.fi/fi/lainsaadanto/saadoskokoelma/2023/964

				might not yet include novel fertiliser product components or technologies. The new decree significantly tightens the limits for impurities in compost and digestate compared to the previous regulation, which may present challenges for some producers.	
Decree on conducting activities concerning fertiliser products and their supervision (965/2023)	Circular economy	Government/Ministry of Agriculture and Forestry	11/10/2023	NA	NA
Decree on Use of Phosphorus-Containing Fertiliser Products and Manure (64/2023)	Agriculture	Government	17/01/2023	In some recycled fertiliser products, the N:P ratio is very low. In this case, the P application limit restricts the amount of N that can be applied, which is insufficient for plants.	Reduce P loads to water bodies and P concentrations in fields. Safeguarding the P needs of crops.
Fertiliser Product Act (711/2022)	Circular Economy, waste management, agriculture	Government	16/07/2022	Increase the number of competitors of AF producers	The production of all fertilising products is regulated in a similar way

					and by the same legislation. This ensures equal treatment for all parties involved.
Decree on support for biogas plants to promote the production of recycled fertiliser products in the years 2024-2026	Circular Economy	Government	10/02/2024 (valid until 31/12/2026)	It was a 'price competition', meaning not all applicants were able to receive funding. The regulation has been criticised for only applying to certain processing technologies.	It encourages processing digestate further and transferring manure-based phosphorus from P surplus regions to P-deficient ones.
Decree on Limiting Certain Emissions from Agriculture (1250/2014), decree regarding nitrate emissions	Agriculture	Government	1/04/2015	limiting consumption of fertilisers in general	It might boost the consumption of some AFs, due to lower nitrate emissions
Act on Waste (646/2011)	Waste management	Government	1/05/2012	End-of-waste criteria for fertilising products are not clear, and there are no national EoW Decrees for them yet.	NA

5.4.2 Finnish certification scheme for bio-based products and fertilisers

In Finland, only fertilisers that have defined quality and safety requirements, either in national or EU legislation, can be offered to the market freely. Products available on the markets in other EU member states can be offered to the Finnish markets based on mutual recognition.

The key steps are the following:

1. Registration for the fertiliser control register.
2. Placing fertiliser products on the market, including imports from another Member State, requires registration in the Finnish Food Authority's fertiliser control register. The registration

must include a description of the organisation of the operations and information about the products.

3. Bookkeeping. The manufacturer must maintain an up-to-date batch-specific file to ensure product traceability. The file must record the import quantities of fertiliser products.
4. Self-monitoring according to the quality system. The manufacturer of fertiliser products must have a quality system in place, which ensures that the fertiliser product, packaging and information provided about the product meet the requirements set out in legislation.
5. Annual notifications. The operator must notify the Finnish Food Authority of the information it requires on imported fertiliser products once a year. This annual notification is submitted to the Finnish Food Authority in January of the year following the calendar year.
6. Establishment approval (only valid with the processing of animal by-products). Establishment approval is required for establishments that process animal by-products or store products derived from them. The requirements for approval of establishments are laid down in the by-product legislation. Establishment approval is applied for from the Finnish Food Authority.

The Finnish Food Authority maintains a national fertiliser control register, which contains information on the manufacturers and products[127].

5.4.3 Finnish market standard for bio-based products and fertilisers

In Finland, mandatory market standards for AFs are reported in the Decree 964/2023 in terms of the limits for harmful metals and organic contaminants. Alongside those mandatory standards are also voluntary schemes that report further standards, for example, the 'Laatulannoite'[128]. This voluntary quality assurance scheme was initiated in 2020 and provides additional and higher standards in terms of the limits for harmful metals and organic contaminants. This quality assurance system aims to increase transparency in the production and operation of recycled fertilisers. The voluntary scheme is operated by the Biocycle and Biogas Association. The system's rules are set out in a handbook. This handbook sets out the development and maintenance principles of the system, the quality of raw materials and products, sampling and analysis of batches, internal and external audits, quality management principles, and compliance with legislation.

5.4.4 Global assessment in Finland

In Finland, the regulations regarding bio-based and AF align closely with EU regulations. While conventional fertiliser products are well-recognised in legislation, some novel technologies may not yet fit into the component categories. However, Finnish fertiliser manufacturers can apply to add new components to the national list of fertiliser components. This list contains similar categories to those in EU legislation, but it provides more detailed information on individual components, their origin and how they are handled. The regulation in place ensures the market for safe fertilising products. Nevertheless, there is ongoing discussion in Finland about the use of sewage sludge-based fertilising products in agriculture. While these products are permitted from a regulatory standpoint, some actors in the supply chain, particularly cereal mills, are reluctant to purchase cereals fertilised with sludge-based products. Additionally, debate about the levels of contaminants such as pharmaceuticals, microplastics, and other organic contaminants in sludge matrices is hindering the utilisation of these products. Currently, there are no legislative limits for these contaminants in Finnish legislation. Macroplastics have also been identified as a visible contaminant in fertiliser products, e.g. digestates

[127] https://avointieto.ruokavirasto.fi/#/kasvi/lannoitetoimijat
[128] https://laatulannoite.fi/laatujarjestelma/kriteerit/

from urban waste treatment, and there has been some debate about the utilisation of these products in agriculture. However, the Fertilising Products Decree regulates macro-plastics.

Nutrient recycling is promoted through the EU's CAP measures, and the Rural Development Programme for Mainland Finland has financed investments in bioenergy and manure processing by rural and farm enterprises since 2007, and these will continue to be financed under the CAP plan 2023-2027. The CAP plan's environmental compensation scheme also allows farmers to receive support for the use of organic recycled nutrient products and manure in fertilisation.

Market trends show that in recent years, there has been increased demand for bio-based and locally produced fertilisers due to the price and availability of mineral ones. However, demand for mineral fertiliser has increased again recently. Bio-based products are widely used in organic farming, and organic farming is growing in popularity in Finland. However, funding for the production of bio-based products and AFs is needed, as the products do not yet have a proper market price.

From 2024 to 2026, there is a support system for anaerobic digesters that treat livestock manure. A subsidy is paid according to the amount of phosphorus in manure processed. The aim was to increase the transportation of P from regions with a P surplus to regions with a P deficit. The government is planning to extend the support system to include other treatment technologies beyond digestion.

One challenge is encouraging farmers to use bio-based and AF products. Often, farms would require new investments to begin using these materials, such as new storage or spreading equipment. In addition, manufacturers may require financial support to further develop fertilising products. Currently, farms can receive investment support from the state, but there are not many funding options available to manufacturers. Support for nutrient recycling is currently only available for anaerobic digestion plants.

5.5.1 Polish agricultural, waste management, and circular economy key elements of legislation.

In Poland, the authority responsible for fertiliser registration and certification is the Ministry of Agriculture and Rural Development. The national legislation that regulates fertilisers is the Act on fertilisers and fertilisation (Journal of Laws 2007, item 1033)[129] and its implementing regulation: Regulation of the Minister of Agriculture and Rural Development on the implementation of certain provisions of the Act on fertilisers and fertilisation (Journal of Laws 2024, item 1261)[130]. Key legislation affecting AF in Poland is summarised in the following Table.

Table 5. Key legislation affecting alternative fertilisers in Poland.

Legislation	Policy area (Agriculture, Circular Economy,	Competent body (level of government,	Effective since	Potential challenges for	Potential opportunities for alternative fertilisers

[129] https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=wdu20071471033
[130] https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20240001261

	Waste Management)	department, etc.)		alternative fertilisers	
Regulation of the Minister of Agriculture and Rural Development of October 12, 2023, on a detailed list of substrates that can be used in agricultural biogas plants (Journal of Laws 2023, item 2230)	Agriculture, waste management	Ministry of Agriculture and Rural Development	2023	Not all waste suitable for use in biogas plants is included in the regulation	The regulation enables the quality of digestate to be ensured, ensuring the use of waste that is safe for technology and its subsequent use for fertilisation
Regulation of the Minister of Climate of 2 January 2020 on the waste catalogue (Journal of Laws 2020, item 10)	Waste management	Ministry of Climate	2020	The waste database needs to be updated regularly to include new types of waste.	It defines the types of waste that can be recovered from the field and the recovery methods in a single legal act. Amendments allow for updates based on current knowledge and available technologies
Nitrate Program (Journal of Laws 2023, item 244)	Agriculture	Ministry of Agriculture and Rural Development	2017 (as amended)	The dates of fertiliser application do not take into account the specificity of new fertiliser products	Additional regulations to ensure the safe use of all nitrogen-containing fertiliser products
Regulation of the Minister of the Environment of 20 January 2015 on the	Waste management	Ministry of the Environment	2015 (as amended)	Complicated legal and administrative procedures limit the agricultural use of waste.	As the ones provided by the legislation effective since 2020

R10 recovery process (Journal of Laws 2015, item 132)				It increases safety, but limits the amount of recycled waste.	
Waste Act of 14 December 2012 (Journal of Laws 2013, item 21)	Waste management	Ministry of Economy, Ministry of the Environment	2012 (as amended)	Difficult conditions for obtaining end-of-waste status for selected waste groups, which makes it difficult to process waste into fertiliser products	The Act classifies types of waste depending on their origin and regulates methods of their management (recycling), which facilitates the development of appropriate technology
Regulation of the Minister of Agriculture and Rural Development on the implementation of certain provisions of the Act on fertilisers and fertilisation (Journal of Laws 2024, item 1261)	Agriculture (Partly Waste management)	Ministry of Agriculture and Rural Development	2008 (as amended)	Quality criteria and acceptable levels of contaminants are, in some cases, insufficient to ensure adequate fertiliser product effectiveness. Additional guidelines are needed to exclude certain types of waste and ensure product quality for fertilisation effectiveness.	Quality criteria and permissible pollutant levels are specified in detail for all fertiliser groups, as well as administrative and scientific units certifying the products, which facilitates the process of introducing fertiliser products to the market

Act on fertilisers and fertilisation (Journal of Laws 2007, item 1033)	Agriculture	Ministry of Agriculture and Rural Development	2007 (as amended)	NA	Requirements for all fertilisers are harmonised and transparent. The certification process is logical and is included in the implementing regulations to the Act.

5.5.2 Polish certification scheme for bio-based products and fertilisers

The procedure for assessing fertilisers and agents supporting plant cultivation in Poland includes the following stages:

1. Carrying out physical, physicochemical, chemical, and biological tests in authorised laboratories on a sample of the product taken by a sampler accredited in this respect.
2. Conducting field tests (in justified cases) to confirm the beneficial effect of the fertilising product on soil properties or plant development.
3. Obtaining an opinion on whether the fertiliser or agent supporting the cultivation of plants meets the quality requirements (in terms of the declared quality parameters) and the requirements regarding the permissible values of contaminants.
4. Obtaining an opinion on the suitability of fertiliser or agent supporting plant cultivation for soil reclamation or use in specific crops (i.e., field crops, vegetable crops, fruit crops, ornamental plants and lawns, forest crops, grasslands).
5. In the case of fertilisers and agents supporting the cultivation of plants produced from raw materials that are waste or animal by-products, it is necessary to obtain additional opinions issued by: Institute of Rural Medicine (on the impact of fertilising products on human health), National Veterinary Research Institute and State Research Institute (on the impact of the fertilising product on animal health), Institute of Environmental Protection and National Research Institute (regarding the impact of the fertilising product on the environment).

Opinions on the fulfillment of quality requirements and the opinion on the suitability of fertilisers for use in specific crops are issued by units authorized in this respect by the Minister of Agriculture, separately for each group of crops, i.e. by the Institute of Soil Science and Plant Cultivation for field crops; Institute of Horticulture in the cultivation of vegetable plants, fruit plants, ornamental plants, and lawns; Forest Research Institute for use in forest crops and Institute of Technology and Life Sciences - for use in grasslands.

5.5.3 Polish market standard for bio-based products and fertilisers

The marketing authorisation procedure and quality requirements for fertilising products applying for sale on the Polish market are regulated by the Act on Fertilisers and Fertilization of July 10, 2007, and the implementing Regulations of the Minister of Agriculture of June 18, 2008.

Fertilisers and agents supporting the cultivation of plants that apply for admission to sale on the Polish market should meet certain requirements that enable their proper classification following the law in

force in Poland. They must have confirmation that they do not pose a threat to human health, animals, or the environment. Fertilisers and agents supporting plant cultivation are subject to quality tests to confirm that they contain the appropriate amount of nutrients, they do not exceed the permissible levels of contaminants, and sometimes some of them are subject to field tests to confirm their beneficial effect on the soil or impact on plant yields.

All fertiliser products (fertilisers and soil improvers) are assessed for their contaminant content. Inorganic, organic and organic-mineral fertilisers must meet the requirements of the minimum content of quality parameters (amount of nutrients). Soil improvers do not require a minimum nutrient content.

Following the regulation of the Minister of Agriculture and Rural Development of June 18, 2008, organic and organic-mineral fertilisers must meet the criterion of minimum content of declared nutrients and organic matter.

Organic-mineral and organic fertilisers and agents improving soil properties are often produced from various types of waste, and in such cases, are subject to additional tests for the presence of biological contaminants. Such products must not contain live eggs of *Ascaris sp., Trichuris sp., Toxocara sp. parasites, or Salmonella bacteria.*

Fertilisers that meet the described quality requirements are most often produced from various types of plant and animal waste biomass from food production or sewage sludge subjected to composting or sanitisation with lime. Mineral components such as rock flour, waste from flue gas desulfurization, or ashes from biomass combustion may also be used for their production. It is also allowed to mix these groups of substrates to obtain an organic-mineral product.

5.5.4 Global assessment in Poland

Polish regulations support nutrient recycling, especially in the context of manure and sewage sludge. Regulations on the circular economy exist, but their implementation is a challenge due to meeting set requirements and some discrepancies in the interpretation of regulations. The costs of processing biomass are high, which affects the final cost of RNFs. Access to suitable biomass for processing is not constant in many cases, which causes difficulties in maintaining continuity of production. There are financial support programs, such as EU funds and national subsidies for nutrient recycling technologies, but they are often insufficient or difficult to obtain, especially for smaller entities. There is also a lack of coherent economic mechanisms that would encourage companies to invest in recycling on a larger scale. The technology sector related to recycling organic waste is developing in Poland, and universities and research institutes are conducting projects in this area. However, there is a need for broad cooperation between science and business and access to modern technologies in smaller enterprises. The development of effective nutrient recovery technologies requires further research and funding support. The acceptance of RNFs by end users is low when their prices are not competitive in relation to mineral fertilisers, especially taking into account the price-nutrient ratio.

Further action is needed to more efficiently separate and process municipal and industrial waste, as well as to improve the logistics of transport and distribution of recovered nutrients.

In Poland, there is a large potential and demand for technology-based installations for wastewater treatment, manure management and organic waste processing. The development of such technology would positively affect the efficiency of nutrient recycling in Poland. However, despite technological support, Poland will continue to face challenges related to gaps in the recycling chain, limited financial incentives and the need to better use modern waste treatment methods. Further actions should focus

on optimising recovery processes, increasing cooperation between the public and private sectors and introducing more effective support mechanisms to close the nutrient cycle and reduce their losses to the environment.

The EAFF is a regional farmers' organisation representing an estimated 25 million smallholder farmers in 10 countries in the Eastern African region. The organisation is based in Kenya, which is the country that has been chosen for this analysis at the national level, whose outcomes aim to be extrapolated to the broader Africa Union context. Developing and adopting AF is very interesting and highly needed in this country to help reduce dependency on imported inputs, enhance agricultural productivity and contribute to circular waste management.

5.6.1 Kenyan agricultural, waste management, and circular economy key elements of legislation.

In Kenya, the authority responsible for fertiliser registration and certification is the Kenya Plant Health Inspectorate Service (KEPHIS)[131], under the Ministry of Agriculture and Livestock Development, which is responsible for regulating, registering, inspecting, and certifying fertilisers in Kenya. The main legislation is the Fertilisers and Animal Foodstuffs Act (Cap. 345)[132] and the Seeds and Plant Varieties Act (Cap. 326)[133]. Additionally, the Kenya Bureau of Standards (KEBS)[134] plays a key role in setting standards and technical requirements for fertilisers. KEBS develops national standards and specifications, including for nutrient content, contaminants, labelling, and quality benchmarks of fertiliser products. The National Environment Management Authority (NEMA)[135] and the Kenya Pest Control Products Board (KPCB) are also relevant authorities. NEMA is responsible for ensuring that AF and related bio-products comply with the Environmental Management and Coordination Act (EMCA)[136] and the associated EIA/EA procedures for waste-derived or bio-based inputs. KPCB is involved only if the fertiliser product includes any pesticide claims or components, in which case the product must also undergo assessment under the Pest Control Products Act (Cap. 346)[137].

The main key legislation affecting AF in Kenya is summarised in the following Table.

Table 6 Key legislation affecting alternative fertilisers in Kenya.

Legislation	Policy area (Agriculture, Circular Economy, Waste Management)	Competent body (level of government, department, etc.)	Effective since	Potential challenges for alternative fertilisers	Potential opportunities for alternative fertilisers

[131] Homepage | Kenya Plant Health Inspectorate Service (KEPHIS)
[132] https://kenyalaw.org/kl/fileadmin/pdfdownloads/Acts/FertilizersandAnimalFoodstuffsAct_Cap345.pdf
[133] Cap. 326
[134] Kefffnya Bureau of Standards – Standards for Quality Life
[135] https://nema.go.ke/
[136] Environmental Management and Coordination (Amendment) Act (EMCA) - Climate Change Laws of the World
[137] Cap. 346

Fertilisers and Animal Foodstuffs Act (Cap. 345)	Agriculture (Partly Waste management)	Ministry of Agriculture and Livestock Development	2012	Limited provisions for organic/alternative fertilisers	Could be revised to explicitly support biofertilisers
Environmental Management and Coordination Act (EMCA)	Agriculture (Partly Waste management)	National Environment Management Authority (NEMA)	1999	AFs may be categorised as hazardous without a specific classification	Offers potential integration of nutrient recycling standards
Seeds and Plant Varieties Act (Cap. 326)	Agriculture (Partly Waste management)	Ministry of Agriculture and Livestock Development	1975 (last update 2022)	If AFs are used in seed production or trials, they may be excluded or questioned if they don't align with the prescribed standards or affect the seed	Seed performance trials can be used to validate the effectiveness of AFs in improving seed performance
Standards Act (Cap. 496)	Circular Economy, Waste Management, Agriculture	Ministry of Trade, Investments and Industry	1974 (last update 2024)	Standards for conventional fertilisers, but bio-fertilisers and organic alternatives often lack clear, enforceable standards	allows the Council to declare new specifications or codes of practice as Kenya Standards, including AFs

5.6.2 Kenya certification scheme for bio-based products and fertilisers

In Kenya, the procedure for commercialising AFs at the national level goes through registration and certification by the KEPHIS, and it includes the following steps:

- Submission of a formal application to KEPHIS via the Fertiliser Approval Committee.
- Provision of technical documentation (composition, formulation, nutrient content, etc.).
- Independent laboratory testing (through KEPHIS or accredited labs).
- Field efficacy trials (for novel or bio-based formulations).
- Review and classification of the fertiliser (organic, inorganic, biofertiliser, etc.).
- Issuance of a registration certificate if the product meets all requirements.

The registry of authorised fertilisers is maintained by KEPHIS and is accessible via its official website. It provides searchable listings of registered fertiliser products, including details on product type, approval status, and certified suppliers.

The multi-agency structure ensures that fertiliser certification in Kenya incorporates both agronomic effectiveness and environmental safeguards, but it also leads to delays, especially for small-scale AF innovators, due to overlaps and multiple agency approvals.

To get a fertiliser approved for sale in Kenya, a producer must follow these key steps, which ensure that fertilisers are safe, effective, and meet the regulatory standards for sale in Kenya.

- Submission of Application: The producer submits an application to KEPHIS with the necessary technical documentation, such as: chemical composition of the fertiliser, nutrient content analysis (e.g., nitrogen, phosphorus, potassium levels), safety data e.g., toxicity, environmental impact, labelling and packaging details complying with regulations. In the cases where the fertiliser has pesticidal or biostimulant components (e.g., microbial agents or plant growth regulators), the applicant must also submit the product for clearance to the Pest Control Products Board (PCPB) under the Pest Control Products Act (Cap. 346). PCPB evaluates such products for safety and efficacy related to pest control or plant protection before co-authorisation.
- Laboratory Testing: the fertiliser sample undergoes laboratory analysis to verify its chemical and physical properties. The tests are conducted at certified laboratories, such as KALRO, to assess nutrient content and ensure compliance with Kenyan standards.
- Field Trials: in some cases, field trials may be conducted to test the fertiliser's performance in real agricultural conditions. This is done to confirm its effectiveness and safety in the Kenyan agricultural environment.
- Evaluation by the Fertiliser Evaluation Committee (FEC): the technical data from laboratory testing and field trials are reviewed by the Fertiliser Evaluation Committee at KEPHIS for final approval.
- Registration and Certification: upon successful evaluation, KEPHIS issues a certificate of registration and includes the fertiliser in the official fertiliser registry.
- Market Authorisation: the fertiliser is authorised for sale, and the producer can distribute it through the market under the KEPHIS guidelines.

5.6.3 Kenya market standard for bio-based products and fertilisers

Kenya's market for AF and bio-based inputs is gaining momentum, driven by growing awareness of soil degradation, rising chemical fertiliser costs, and the shift toward climate-smart agricultural practices. Farmer cooperatives, organic farming associations, and agroecology platforms have actively promoted the use of compost, fortified manures, biofertilisers, and microbial soil conditioners across various value chains including horticulture, maize, and coffee.

The commercial landscape includes both formal enterprises and informal producers. Companies like Wanda Organic, Plant Health Care Kenya, and community-level producers of Bokashi and enriched compost have created niche markets, particularly in peri-urban, horticulture-driven areas like Kiambu, Murang'a, and Nakuru regions in Kenya. However, informal markets remain dominant, particularly in regions with limited agro-dealer infrastructure.

Barriers to adoption include farmer perceptions of product efficacy, lack of clear labelling and certification, and limited last-mile distribution networks. This is compounded by weak extension systems that do not consistently promote alternative inputs. Despite this, demand is rising among youth-led agribusinesses, organic certified producers targeting export markets, and climate-conscious

development programs (e.g., Regenerative Agriculture Initiative, IFAD's KCEP-CRAL, and GIZ's soil health interventions).

A strong opportunity lies in better segmenting consumer profiles (e.g., certified organic, climate-smart, low-income, export-oriented) to inform targeted product development, distribution, and awareness. The rising cost of synthetic fertilisers and government subsidy constraints may further push adoption of bio-based options, especially if linked to verified quality, certification, and performance information.

5.6.4 Global assessment in Kenya

Several global and regional models offer lessons for Kenya as it seeks to streamline its certification systems. In countries such as India, Brazil, and members of the EU, governments have implemented single-window clearance systems or joint review committees that evaluate fertiliser products across multiple parameters, agronomic, environmental, and safety, within one coordinated process. These approaches reduce redundancy, clarify approval timelines, and build investor confidence.

In India, for example, the Fertiliser Control Order (FCO) provides a harmonised system for the approval of fertilisers, including organic and bio-fertilisers. The Indian Council of Agricultural Research (ICAR) supports multi-location field trials, while the Department of Agriculture coordinates with environmental authorities to avoid duplication. Similarly, in Brazil, the Ministry of Agriculture (MAPA) collaborates with the Ministry of Environment through a digital portal for real-time clearance tracking of bio-based inputs.

In the EU, the Fertilising Products Regulation (EU) 2019/1009 creates a common market for CE-marked fertilisers across Member States, including criteria for organic fertilisers, plant bio-stimulants, and recovered waste-derived materials. The EU model includes conformity assessment bodies (CABs) that provide third-party verification, a model Kenya could explore for improved trust and decentralisation of certification.

Adapting such models in Kenya could involve formalising a "National AF Certification Coordination Committee" co-chaired by KEPHIS and KEBS, with technical input from NEMA, PCPB, and academic/research institutions. A digital application and tracking platform, modelled after the e-cert systems used in Brazil and India, could further enhance transparency and accountability.

The current multi-agency approach though well-intentioned creates significant duplication, high transaction costs, and unpredictable timelines for approval. Innovators, particularly small and medium enterprises (SMEs), face a fragmented pathway when introducing bio-based products, with inconsistent guidance from regulators and insufficient alignment on data requirements, field testing protocols, and standards for efficacy or environmental safety.

This regulatory fragmentation has prompted calls from industry associations, farmer groups, and agroecology networks for a more harmonised and transparent certification process. Stakeholders have proposed the development of a single-window approval framework or streamlined joint-review committees involving KEPHIS, KEBS, NEMA, and other relevant agencies. Such a coordinated approach would reduce redundancies, fast-track approvals, and enhance investor confidence in the sector.

Additionally, Kenya lacks dedicated provisions for end-of-life environmental risk management of bio-based fertilisers, such as residual buildup, microbial shedding, or long-term soil impacts. Lessons could be drawn from EU and Latin American models where post-marketing monitoring and risk-based

tiered approval systems are applied to bio-based agri-inputs. Establishing similar mechanisms locally would strengthen environmental safeguards while enabling innovation.

The country needs a comprehensive policy shift grounded in system reform, multi-actor coordination, and evidence-based implementation. This implementation should be phased and adaptable, with strong monitoring and feedback loops at national and county levels.

- Strengthen the legal and institutional framework. Expedite the development and adoption of dedicated regulations or standards for alternative fertilisers and bio-based inputs under the Fertilisers and Animal Foodstuffs Act (FAFA). Clarify mandates and coordination mechanisms between the Ministry of Agriculture, KEBS, PCPB, KEPHIS, and county-level authorities to streamline certification and compliance oversight. Develop guidelines to differentiate between organic amendments, biofertilisers, biostimulants, and biopesticides to reduce classification confusion during registration and market access.
- Enhance scientific validation and quality assurance. Invest in field-level validation protocols and laboratory infrastructure (e.g., KALRO[138], universities, county labs) to improve confidence in product efficacy and safety. Create a national performance database for certified alternative fertilisers, linking product registration to trial results and environmental safety profiles.
  Promote digital tools for traceability, label verification, and geo-tagged field trials to support monitoring and transparency.
- Promote harmonised certification and market incentives. Engage with regional harmonisation platforms (e.g., COMESA, EAC) to align certification of bio-based products and facilitate cross-border trade. Establish a tiered certification model for different categories of alternative fertilisers (e.g., formal commercial, community-based, artisanal) to encourage innovation while maintaining safety thresholds. Expand incentives, such as procurement guidelines, tax incentives, and green labelling, to stimulate private-sector investment and adoption by farmers.
- Improve awareness, extension, and demand creation. Integrate alternative fertiliser modules into national and county-level extension curricula, with targeted training for agro-dealers, farmer groups, and youth agribusinesses. Collaborate with development programs and agricultural cooperatives to deliver participatory demonstrations and feedback mechanisms on product use. Support consumer education campaigns to address perceptions, mislabeling, and the value proposition of certified alternatives.
- Establish a multi-stakeholder governance mechanism. Create a national coordination platform on alternative fertilisers and bio-based products, involving public agencies, the private sector, academia, and farmer organisations. Leverage existing bodies (e.g., taskforces, technical working groups) to support evidence-based reform, data sharing, and policy alignment. Encourage donor and research alignment with national policy priorities to support innovation, scalability, and monitoring.

[138] KALRO Kenya: Branches, Products & Research (2025)

6. Results of the external consultation

A total of 89 responses were collected through the Microsoft Forms survey. The results, grouped by question number, revealed the following:

1. Most responses came from **Spain** (40), followed by **Poland** (14).
2. Within Spain, the most represented region was Murcia.
3. The most represented stakeholder category was "**Academic/Researcher**" (52), followed by "**Others**" (12).
4. The most commonly available feedstock in respondents' areas was **agricultural biomass**.
5. Respondents reported familiarity with using **compost** as an AF product.
6. The most frequently identified production sites were **compost production facilities**.
7. The majority of the respondents indicated that the **local fertiliser market supports the transition** from traditional fossil-based fertilisers to alternative products and promotes technological development.
8. Regarding the optional question on technologies, techniques, or practices being developed to increase the availability of AF, most of the respondents **did not provide an answer**. Among those who did, **biostimulants** were the most frequently mentioned.
9. The most commonly cited barrier to the use of AF was the **Rate volume/nutrient plant availability.**
10. The EU regulation most frequently identified as positively influencing the development of alternative fertilisers was **Regulation (EU) 2019/1009 on the market of EU fertilising products**.
11. The most relevant local or regional initiative contributing to the development of alternative fertilisers was **Financial incentives for using and/or developing alternative fertilisers**.
12. Most participants **observed a significant increase in the consumption** of AF by end-users over the past six years.
13. Respondents agreed that the final product obtained using AF should be **recognisable and valorised** (e.g., through certifications such as Bio or FSC).
14. On a scale from 1 to 5 (where 1 indicates a small, easily reducible gap and 5 a large, likely irreducible gap), the current adoption gap of alternative fertilisers compared to traditional fossil-based ones was rated as **3**.
15. Respondents believe this gap could be reduced in the coming years **by increasing economic incentives and supporting research for technology development.**
16. The current adoption rate of alternative fertilisers, as a percentage of total fertiliser use in respondents' areas, was estimated to be between **10% and 20%.**
17. Most participants **did not express** interest in staying informed about the latest developments in alternative fertiliser production.
18. However, **30%** of respondents provided their email addresses to receive updates on alternative fertiliser developments.

Moreover, as aforementioned, to gather over 100 responses and strengthen the conclusions of the survey, a simplified version of the survey was circulated using the Mentimeter Platform during the second Expert Panel meeting. This meeting was attended by a total of 23 members, and at least 17 responded to all the questions. In general, opinions, summarised as follows, closely align with those

extracted from the initial survey, except for response regarding the significant increase in the consumption of AF:

1. The most commonly available feedstock in respondents' areas was **agricultural biomass**.
2. EP reported familiarity with using **compost** as an alternative fertiliser product.
3. The most commonly cited barrier to the use of alternative fertilisers was **"Rate volume/nutrient plant availability".**
4. Respondents agreed that the final product obtained using AF should be **recognisable and valorised** (e.g., through certifications such as Bio or FSC).
5. EP **did not observe a significant increase in the consumption** of alternative fertilisers by end-users over the past six years.
6. The current adoption rate of alternative fertilisers, as a percentage of total fertiliser use in EP areas, was estimated to be between **10% and 20%**.

Therefore, out of this consultation, results reinforce previous findings. From the responses it can be extracted that challenges are related to insufficient nutrient availability and technology development, and the lack of financial incentives or recognisable certification, with the gap still being high and the perceived adoption being low. These challenges represent opportunities to improve in order to decrease that identified gap. In addition, respondents identified drivers such as Regulation 2019/1009, the importance of the local market, and opportunities related to the development of biostimulants

This Section features aggregated responses to some topics of interest/questions following individual expert consultation.

- **Main advantages and drawbacks of conventional fertilisers (CF)**
  Some conventional fertilisers are inexpensive and relatively simple to produce. For example, potassium chloride (KCl, also known as muriate of potash) and phosphate rock are extracted from surface or deep mines and merely crushed to the desired size, without the need for further processing or chemical transformation.
  In contrast, other fertilisers, such as thermophosphates or ammonium-based products, require energy-intensive production processes and may generate undesirable chemical by-products or waste streams.
- **Market size and prospect of CF**
  Globally, large broadacre commodity crops continue to depend predominantly on conventional fertilisers. In contrast, the market for premium or non-conventional fertilisers remains largely confined to high-value crops, such as certain fruits, as well as niche sectors including turfgrass, ornamentals, and horticulture. Overall, of the 179 million tonnes of fertiliser consumed worldwide in 2022, the share attributed to these specialised sectors was very small and concentrated within specific agricultural enterprises. Below are some stats from the sector.
- **Gaps and drivers of Alternative Fertilisers (AF) and interest for the industry**
  A wide range of materials can be considered AF. These include organic sources such as composts and manures; recycled fertilisers derived from wastewater treatment (e.g., struvite, sewage sludge, biochar); bio-based products such as biostimulants, humic acids, algae

extracts, *Rhizobium* inoculants, and seaweed extracts; mineral or ground rocks such as kieserite; and animal-based fertilisers such as blood meal, among others.
The main advantages of these alternatives are their contribution to the circular economy, reduced reliance on imported inputs, and their potential to mitigate environmental problems by recycling nutrients and preventing contamination (e.g., eutrophication). However, they also present challenges, including limited nutrient concentration, variability in composition, presence of potential contamination such as heavy metals, and logistical constraints related to collection, transport, and application.

- **Potential for replacing CF with AF**
  Although the transition may take time, AF have the potential to replace CF in many situations. The most promising opportunities arise where organic residues are produced close to agricultural land. For example, animal feedlots generate large volumes of manure that can be readily applied to nearby maize fields, while wastewater treatment plants in major cities produce biosolids that can be used in croplands or horticultural systems within surrounding green belts.
  In such cases, AF can substitute for a significant share of CF. However, their widespread adoption ultimately depends on logistical factors - particularly the proximity between where organic by-products are generated and where they are needed for crop production.
- **Approximate replacement percentage**
  This is indeed a challenging question. As noted earlier, in broadacre cropping systems only a very small proportion of fertiliser use currently comes from AF.
  CF tend to be more nutrient-dense (i.e., higher concentration of nutrients per kilogram of product) and therefore more cost-effective for growers when viewed purely from a financial perspective, measured as euros per kilogram of nutrient supplied.
  However, legislation is becoming a major driver of change Europe, for example, in relation with requirements to recover nutrients from wastewater streams and then market these recovered nutrients as agricultural inputs.
  Although it is difficult to predict exact figures, it is clear that the share of AF in the fertiliser market will continue to grow steadily in the coming years.
- **Are AF real alternative or more (and firstly) complement and a requirement in terms of circular economy and closing nutrient cycling?**
  In some cases, AF can fully replace CF. However, AF are more often seen as a complement CF, either for practical reasons (e.g. they provide organic matter to the soil) or because growers are motivated by environmental considerations and the desire to support a circular economy. Potassium fertilisers remain a particular challenge, as most organic residues are inherently poor sources of K.
- **AF with the highest potential**
  Recycled Phosphate fertilisers, such as struvite, hold significant potential and are already commercially available in many regions. Their value lies in the maturity of the recovery technology and the well-documented agronomic performance, which has proven highly competitive with CF. In addition, the slow-release characteristics of struvite are advantageous, as they align nutrient solubilisation with crop demand, ensuring better synchronisation between phosphorus availability and plant uptake.
- **Secondary feedstock with the highest potential**
  Waste from livestock production and the food industry represents an excellent source for producing AFs. These residues are typically rich in essential nutrients and, in most cases, contain minimal chemical contaminants.

- **Should we keep investing in AF, or better focus on improving the performance of the existing ones, unlocking nutrients from soils, improving the nutrient access to plants…?**
  These goals are not mutually exclusive, and Europe should continue to invest in AF for several reasons: (i) Europe has very limited potential for cropland expansion, making it essential to safeguard and sustainably manage existing agricultural land; (ii) AF are generally more environmentally friendly and contribute to long-term soil health; (iii) legislative requirements already being implemented across many regions create clear opportunities for scaling up AF use; and (iv) education and eco-labelling can help ensure consumers recognise and value products produced with more sustainable fertiliser options.
  At the same time, growers must continue to refine their agronomic practices, particularly by following the 4R nutrient stewardship principles (using the right source, at the right rate, at the right time, and in the right place)[139]. Maintaining these best practices remains pivotal for the long-term success and sustainability of European agriculture.
- **Actions to be taken to boost the production/adoption of AF from a market/legislation perspective and the main issue/bottleneck/limiting factor**
  Taking for example P which is essential for food security but poses challenges due to its limited geological distribution, price volatility, and environmental risks when mismanaged. Recycling P from urban waste can reduce eutrophication, diversify supply, and support circular economy goals. However, adoption depends on regulation, market competitiveness, and public trust. Recycled phosphorus fertilisers are marketable when strategies address cost, risk perception, and local context.
- **Next needed R&D&I developments of the fertiliser industry for both CF and AF**
  Overall, these are some of the challenges in the Fertiliser sector, both for CF and AF: (i) Establish standard evaluation frameworks for testing novel fertilisers (lab → greenhouse → field pipeline); (ii) increase multidisciplinary, global collaboration and open innovation to share data and methods; (iii) focus on pre-competitive research and public-private partnerships to de-risk innovation; (iv) develop biodegradable, safe, and affordable formulations aligned with circular economy principles; and (v) encourage publication of all outcomes (including null results) to improve meta-analyses.
- **Potential of AF to correct the main concern in Europe when dealing with fertilisation which is pollution**
  A long-standing challenge in the EU (and elsewhere) has been overfertilisation. Crop advisors should encourage farmers to conduct soil testing and apply nutrients strictly according to recommended rates. AF can help recover lost nutrients in certain situations, but only to a limited extent, and therefore cannot be considered an ultimate solution. The most effective approach remains the responsible use of fertilisers by selecting the right source, applied at the right rate, at the right time, and in the right place.
  These fundamental principles should not be overlooked, as they remain paramount in nutrient management. While AF can provide important benefits, they should be seen as part of a broader strategy, not as a silver bullet.

[139] 4R Principles - The Fertilizer Institute

7. Drivers and barriers for the broader adoption of alternative fertiliser products

Based on the collected information and assessment of the AF market and regulatory conditions, this Section highlights the main drivers and barriers regarding AFs adoption and use, which can be used to identify possible challenges and opportunities. It is important to note that some factors (e.g., policy) can be drivers and barriers at the same time. Overall, this document highlights the ongoing need for technological innovation, supportive policy frameworks, effective contaminant management, and interdisciplinary approaches to fully realise the benefits of nutrient recycling in sustainable agriculture (Cordeiro & Sindhöj, 2024).

Drivers:

- Policy and regulation represent one of the most effective drivers at the European and national level for AF adoption. In general, they promote AF market boosting and adoption directly (e.g. through eco-design, biowaste valorisation, product standardisation, incentives) and indirectly (through shared objectives such as waste valorisation, circular economy, soil conservation, sustainable agriculture, climate goals, etc.). Based on the reported regulations, countries such as Kenya and Greece have relatively few rules affecting AFs. This regulatory simplicity may facilitate the introduction of new AFs and encourage broader adoption. However, Kenya's transition to AFs and bio-based products requires a comprehensive policy shift grounded in system reform, multi-actor coordination, and evidence-based implementation.
- Growing demand for nutrients obtained from secondary sources, as seen in countries such as Poland and Spain, which improves the introduction of new AFs and boosts their adoption.
- Access to better and more sophisticated systems for assessing the availability and quality of feedstocks for AF for all countries and at the EU level. This would allow AFs companies to select production locations for specific AFs and for the selection and adoption of BATs for the production of AF.
- Organic farming expansion. Countries such as Sweden, Finland, and Greece have the highest percentage of organic farming relative to their total utilised agricultural area, which is directly linked to increased consumption of organic food products.
- The existence of voluntary standards, which act as drivers in the industrial sector by promoting the development of new cost-effective products and enhancing consumer trust. At the market level, they also enable the positioning of more sustainable products across different segments of the traditional fertiliser market.
- Geopolitical factors, which encourage and boost research into alternative raw materials suitable for AFs production.
- Increasing recognition of the importance of ensuring soil health conditions.
- In Kenya, a strong opportunity lies in better segmenting consumer profiles (e.g., certified organic, climate-smart, low-income, export-oriented) to inform targeted product development, distribution, and awareness. The rising cost of synthetic fertilisers and government subsidy constraints may further push adoption of bio-based options especially if linked to verified quality, certification, and performance information.

Barriers:

- Policy and regulation, due to their complexity, overlapping, contradictions… this is, for example, the case of waste categories definition, end-of-waste status, etc. Another issue related to legislation is the fact that it does not adapt quickly enough as compared with market changes and technological developments. The analysis provides evidence that in countries like Spain, Poland and partially Sweden and Finland, AF products are subject to regulations from multiple sectors, which complicates and overloads the process of introducing new products to the market.
- Legislation regarding raw materials and their standards for fertiliser production still needs to be improved, depending on the technology used and the final application sector. For example, manure is a valuable feedstock for organic farming. However, if it originates from factory farming, it is not permitted for use in organic agriculture under EU regulations. This may limit the range of products available for organic farming compared to conventional agriculture. Therefore, additional measures should be taken to promote non-intensive livestock systems to ensure the availability of suitable feedstock for organic production.
- Moreover, the analysis suggests a lack of defined objectives in current polices to foster a change towards AFs, as a minimum percentage of AFs adoption at the national level by a foreseen period, or regulate the amount of farming factory compared to non-intensive livestock systems.
- Investment costs for extracting nutrients (i.e., N or P) from secondary feedstocks can represent a barrier depending on the raw material and technologies used. For example, in Finland, the cost to extract nutrients from sewage water to produce AFs that are attractive to farmers is too high for a municipality to cover and requires national incentive funds[140]. Therefore, the availability and quality (i.e. concentration of nutrients and presence of contaminants) of feedstocks might represent key barriers to the widespread adoption of BATs.
- The low awareness about the benefits of AF and the existing perception of relatively low nutrient content.
- In Kenya, barriers to adoption include farmer perceptions of product efficacy, lack of clear labelling and certification, and limited last-mile distribution networks. This is compounded by weak extension systems that do not consistently promote alternative inputs. Despite this, demand is rising among youth-led agribusinesses, organic certified producers targeting export markets, and climate-conscious development programs.

8. Conclusions

This report describes the key market dynamics and regulatory conditions for boosting the adoption of AF. In terms of market dynamics, results indicate that there is a global interest in developing AF from secondary feedstocks. The demand for such fertilisers and the need to better manage secondary feedstocks exist. This is translated into relatively good perspectives for the AF sector. However, some serious challenges related to the mapping of feedstock quality and quantity, BAT readiness, product logistics, stakeholder awareness, regulation development and adaptation still need to be addressed. There is another very important aspect preventing AF from expanding, which is related to the general lack of evaluation systems to assess their real impact on receiving soils. Alternative fertilisers are, in

[140] *TREASoURcE-D1.3-Legislative-and-Regulatory-Framework-for-Target-Value-Chains.Pdf*

general, characterised not only by providing nutrients, but also by benefiting the recipient soil. In the case of biostimulants, their commercialisation is favoured by the fact that they are needed in relative smaller amounts. In general, the challenge so far is in demonstrating such co-benefits to the derived soil ecosystem services.

Regulatory conditions seem to benefit AF but results highlight the significant need for continuous legislative review and updates. Specifically, ongoing technical updates to AF legislation are essential, encompassing a review of feedstocks and AF standards, end-of-waste status definitions, technological limitations, and mandatory fertiliser market certifications.

The report also highlights how Kenya's growing interest in AFs (which include bio-based products) mirrors global shifts toward sustainable agriculture and climate-resilient input systems, facing similar barriers and drivers in AFs adoption as well as in EU countries. For Kenya, aligning national processes with EU and global standards is a strategic opportunity to boost trade readiness, quality assurance, and private-sector innovation. Informal market innovations offer scalability potential, especially if supported through targeted certification incentives and stronger extension systems.

Apart from these key insights for boosting the AF market, results from this deliverable are intended to feed other project tasks and inform key stakeholders:

- WP2 on the selection of BAT, and key messages for C&D and specific to policy makers (see Next Section).
- Activities in T 3.4 which are focused on the development of sustainable business models for BAT's adoption. They will be fed by the current and projected market size of secondary feedstock and AFs, along with trends and opportunities at EU and National level.
- T5.2 and T5.3 in WP5 (Communication, Dissemination and Exploitation). Findings from this report will shape tailored messages and exploitation strategies to address the needs and interests of specific market segments or regulatory bodies, thus improving the project's impact and uptake.
- Last but not least, the outcomes from this report are also important in terms of project management and reporting (WP6 and 7), from the perspective of anticipating and managing risks related to market and regulatory changes, which can be useful for adapting and planning strategies related to nutrient recovery and AF production.

9. Recommendations and takeaways

This deliverable has been designed and developed in such a way to be as useful as possible for different purposes, stakeholders, and other project tasks. Therefore, and based on the obtained results, this Section gathers recommendations and takeaways messages which are organised in 1) C&D, 2) Policy suggestions, 3) Insights to inform the process of selection of the BAT.

C&D Takeaways

The assessment included in this report has also been important in crafting targeted communication and dissemination (C&D) strategies since understanding the market dynamics and regulatory framework crucially supports tailoring messages and exploitation strategies to match the needs and interests of specific market segments and regulatory bodies. With this in mind, key C&D takeaways from this report come as follows:

- The production and commercialisation of AFs has huge potential.
- Alternative fertilisers are a great source of nutrients and contribute to soil-related ecosystem services.
- There is a need to map the availability, quantity and quality of secondary feedstocks.
- Selective collection of biowaste is crucial for the obtention of high-quality AF
- Production and commercialisation of AF is more efficient if it attends local/regional levels, and adapted to the actual needs
- Regulation, certification and standardisation need to advance in line with the sector.
- More technology development is needed to progress on the adoption of flexible and robust BAT.

Policy suggestions

These suggestions based on the knowledge and evidence from the market dynamics and regulatory assessment target policy makers and public administration to help deliver successful strategies/instruments for the market deployment of AF:

- Precepts from the WFD need to be adopted by the member countries. For the specific case of biowaste selective collection, not only does the collection system need to be in place, but also, to ensure the quality of the obtained products.
- End-of-waste status: to stimulate recycling markets, it is crucial to establish the point in the recovery process where quality feedstock materials can lose their waste status via end-of-waste criteria. This is for example, the case of feedstocks including animal by-products in their composition.
- In general, the role of the administration is very important in terms of ensuring reliable, in sufficient quantity and quality, feedstocks.
- At national level, there is a need to speed up and simplify the processes to evaluate applications for new producers of AF.
- Definitely, regulation can help boost the AFs market by incentivising their use through proven benefits to the receiving soil-plant systems.
- Recognition of fertiliser products through standardisation is a powerful tool which can be boosted/promoted by the administration.
- Promoting local markets for AF production and use is crucial in terms of resiliency against external geopolitical factors and issues related to transport and logistics.

Insights to inform the process of selection of the BAT

This report provides critical context which influences the selection of the BAT for nutrient recovery from the perspective of focusing on technologies that besides fulfilling the technical feasibility requirements, are also commercially viable, aligned with market demands and compliant with current regulations. The first and most important consideration is that technologies need to be able to produce AF products which can compete with the traditional ones, ensuring plant response, and, if possible, provide the added value of improving soil-related ecosystem services. From this perspective, BAT needs to take into account the volatile and changing global market environment. This can be translated into the need to favour flexible, adaptable and robust technologies able to deal with different feedstocks and produce a range of products. Such flexibility and robustness are also beneficial from a point of view of dealing with the changing availability and quality of secondary feedstocks. We advocate for this kind of flexible solutions under biorefinery models, which can handle and attend to

changeable scenarios. Feedstock pre-treatment is also very important in terms of quality, but also to get the mixtures which are needed for some BATs to be able to operate. Another important point is related to the production and commercialisation which, ideally, should be as local as possible using the locally available feedstocks, something that also conditions the selection of BATs. This is to reduce costs associated to the transport of both feedstock and fertiliser, and to ensure that they are processed and used as soon as possible. The local factor is also important in terms of the requirements of the local sector. For example, when deciding on the physical format of the AF (i.e. liquid or solid), it is important to take into account how local farmers are applying and demanding the fertilisers.

Related to legislation, the composition of secondary feedstock (e.g., presence of ABP) is another crucial factor to be considered when deciding about BAT. Also, if they are ready to comply with the exigencies of the composition of the final products, which is not always easy, taking into account the potential presence of contaminants in the secondary feedstocks.

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11. Annex: online survey

Market dynamics and regulatory analysis of alternative fertilisers

Introduction: FERTITEC is an EU-funded project focused on bring a comprehensive solution for waste recycling and sustainable fertiliser production from secondary raw materials. FERTITEC aims to impact at national and regional levels, by deploying the best available fertilising techniques for recovering/recycling nutrients to produce alternative fertilisers in several EU countries as well as extending the result to the African Union. Due to this, a report on market dynamics and regulatory analysis of alternative fertilisers will be conducted through desk research, and the findings will be feed with the valuable information obtained from this questionnaire. The questionnaire aims to recollect direct and specific information regarding alternative fertilisers from market and policy actors across multiple countries, in order to analyse differences within EU countries and between EU and African Union countries.

Definition used in the survey: Alternative fertiliser products – organic or inorganic fertilisers and soil improvers recovered from main and secondary raw materials. Examples include:

- Agricultural Biomasses (Livestock manure and slurry, crop residues, waste feed, agricultural processing residues and digestate, composted manure or crop residues, ash from biomass combustion, biochar from pyrolysis of manure or other residues, struvite or ammonium sulfate from manure processing).

- Urban Wastewater (Sewage sludge, wastewater, dewatered sludge, digested sludge, struvite, biochar from sludge pyrolysis, ashes from incineration of sludge, precipitated phosphorus salts)

- Municipal Biowaste (Household food waste, restaurant food waste, green landscape waste, supermarket food waste, digestate, compost, biochar, or hydrolyzed biowaste, ash from incineration of biowaste)

- Industrial side-streams (Food industry by-products, wood/pulp and paper industry by-products, mining by-products, chemical industry by-products and biochar, ash, gypsum)

- Blue Biomasses (Fish and shellfish by-products, seaweed and microalgae residues, aquaculture sludge, eutrophication biomass and digestate, compost, hydrolyzed waste, biochar).

The collected answers, along with the analysed and managed data, will be processed in accordance with the European General Data Protection Regulation (2016/679/EU) and ethical requirements. Answers will be totally anonymous, and no results can be connected to individual persons. All of this will be overseen by the FERTITEC Open Science and Data Manager. By participating, you accept these conditions.

1. Country

2. Region

3. Which of the following stakeholder groups do you represent?

- Advisors (e.g.: fertilizer market experts, technology consultants)
- Fertilizer producers (e.g.: SME owners, fertilizer industry managers)
- Fertilizer industry supporters (e.g.: agri-food & bio-based industry experts, tech providers,)
- Financing experts
- Academic/Researcher (e.g.: experts, researchers)
- Government/policymakers
- Fertilizer industry unions & associations
- End users (e.g.: farmers, farm managers)
- Other…

4. From your knowledge which of the following feedstocks are the most available in your area/country? (Order from 1 to 6, being 1 the most available and 6 the least available)

- Agriculture biomasses
- Urban Wastewater
- Municipal Biowaste
- Industrial side-streams
- Blue biomasses
- Other…

5. Are you familiar with using any of the following alternative fertilizer products? (Multiple choice)

- Ammonium nitrate/sulfate
- Biochar
- Compost
- Processed digestate
- Hydrochar
- Processed sludge
- Struvite

- Vivianite
- Other…

6. Can you identify any production site or company of the above-mentioned alternative fertilizers located in your area? If yes, which of them?

- Ammonium nitrate/sulfate production
- Biochar production
- Processed Compost production
- Digestate production
- Hydrochar production
- Processed sludge production
- Struvite production Vivianite production
- Other…

7. Does the local fertilizer market promote the change from traditional fossil-based system fertilizers to alternative fertilizer products, and technology development?

- Yes
- No

8. (Optional) Can you identify any of these technologies/techniques/practices that are being developed in your area to increase alternative fertilizer offers?

9. From your point of view which of these aspects represent the biggest barrier to alternative fertilisers use? (Order from 1 to 6, being 1 the most relevant and 6 the least relevant)

- Limited availability the most suitable forms (Liquid, Solid-granular Solid- powdered, etc.)
- Rate volume/nutrient plant availability
- Rate price/nutrient content
- Limited availability of the specific formulations and long time for plant up taking
- Social or logistical restriction (e.g., distance limits for application due to smell issues)
- Limited knowledge of their effectiveness in the field

10. From your perspective which of the current or upcoming legal regulations at EU level influence through their transposition into national regulations, most positively impact the development of technologies/techniques/practices for producing alternative fertilizer products? (Order from 1 to 7, being 1 the most relevant, and 7 the less relevant)

- Regulation (EU) 2019/1009 on the market of EU fertilizing products
- Nitrate Directive 91/676/EEC
- Common Agriculture Policy CAP
- Soil Monitoring Law
- Carbon Removal certification framework
- Urban Wastewater Treatment Directive
- Waste Framework Directive
- EU Taxonomy
- Other…
- I have no opinion on this subject

11. Can you identify any of the following local/regional initiatives in your area that contribute to alternative fertilizer products development at local scale?

- Financial incentives for using and/or developing alternative fertilisers
- Market valorization of the end product obtained through alternative fertilizers
- Certification of more sustainable fertilizers production
- Mandatory use of alternative fertilizing to “bio” named agricultural products
- Voluntary schemes certification of alternative fertilisers
- New legislative propositions development
- Other initiatives:
- None

12. Have you noticed a significant increase in alternative fertilizer consumption by the end-users in the last six years?

- Yes
- No

13. Do you consider that final product obtained with alternative fertilizer need be recognizable and valorized? (i.e., Bio, Fsc, certification etc.…)

- Yes
- No

14. From your perspective how big is the current broader adoption gap of alternatives fertilizers product compared to traditional fossil-based systems fertilizers available on the market? (Rate from 1 to 5, being 1 a small gap easy to reduce and 5 a large likely irreducible gap)

15. Could this gap be reduced in the coming years? How?

- By promoting the use of alternative fertilizers among the end users (explaining technical, social and economic benefits)
- By updating legislation
- By increasing economic incentives to users and research support for technologies production
- No

16. From your perspective, what is the current adoption rate of alternative fertilizers as a percentage of the total fertilizer usage in your area?

- 0 to 10%
- 10 to 20%
- 20 to 40%
- 40 to 50%
- More than 50 %

17. Would you like to stay informed of the latest developments in production of alternative fertilising products?

- Yes
- No

18. Please provide your email to subscribe to our newsletter

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Funded by the European Union under Grant Agreement 101181513. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Funded by the European Union