NUTRI•KNOW

Inventory and analyses of engaged OGs outcomes on nutrient management

D1.1

June 2023

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1 PU = Public, fully open, e.g., web (Deliverables flagged as public will be automatically published in CORDIS project's page)

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Executive Summary

Deliverable 1.1 Inventory and analyses of engaged OGs outcomes on nutrient management (D1.1) is part of the NUTRI-KNOW work package (WP) 1. The main objective of WP1 is to identify, compile and analyse all the knowledge and outcomes generated by the engaged 12 EIP-AGRI OGs from 4 Member States (Spain, Italy, Belgium and Ireland) in the theme of nutrient management. The D1.1 aims to collect open data from the engaged OGs that are free to access, reuse, repurpose, and redistribute in other tasks in WP1 and other WPs. The dynamic compilation of outcomes will be generated by (i) screening into public information on EIP-AGRI OGs and project databases, regional and/or national Ministry of Agriculture and Rural Development websites; and (ii) complementary information from the partners involved in the different OGs. The results are summarised in a simple database which will be regularly updated once new outcomes from ongoing OGs engaged are available.

The D1.1 is divided into 5 chapters: Chapter 1 presents an introduction to the knowledge gaps between the primary sectors and practitioners in nutrient management within European agricultural systems, followed by the solutions proposed by the NUTRI-KNOW project and the main objectives of this deliverable. Chapter 2 describes the methodology for the data collection in D1.1 and the interlinks with other deliverables in WP1. The collected information from the 12 engaged OGs is presented in Chapter 3 with a summary as figures and a more detailed description in the format of factsheets. Apart from the OG-specific information, Chapter 4 provides a summary of the regulations at the EU and regional level that impact the OG activities for different steps of the value chain. By the end of this deliverable, Chapter 5 summarised the currently available information about the 12 engaged OGs and the linkages to other tasks in the frame of NUTRI-KNOW project.

Disclaimer

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Table of Abbreviation

BAT	Best available technology
BREF	Best Available Techniques Reference Document
CAP	Common Agricultural Policy
EEC	European Economic Community
EC	European commission
EIP-AGRI	European Innovation Partnership for Agricultural Productivity and Sustainability
EU	European Union
GHG	Greenhouse gas
IED	Industrial Emission Directive
NAP	Nitrate Action Program
NT	Non-Tillage
NVZ	Nitrate Vulnerable Zones
OG	Operational Groups
PAIR	Piano Aria Integrato Regionale
PPZ	Pollution Potential Zone
RENURE	Recovered nitrogen from manure
SDI	Sub-surface Drip Irrigation
WP	Work Package

1. Introduction

In recent years, significant knowledge has been accumulated through European Union (EU)-funded projects regarding managing practices, technologies, products, and recommendations in the primary sector. This wealth of knowledge includes advancements in agricultural management practices, the development of new technologies, and the introduction of innovative products. However, there is a substantial gap between the generation of this knowledge and its adoption by practitioners in the field. While efforts have been made to disseminate knowledge and facilitate collaboration among stakeholders, the knowledge generated from EU projects is not being effectively transferred to and embraced by practitioners in the primary sector. This gap hampers the potential benefits and impact of the knowledge and innovation generated through these projects.

The reasons for this knowledge uptake challenge could be multifaceted. It may stem from a lack of awareness among practitioners about the available knowledge and its relevance to their specific contexts. Additionally, there may be barriers related to the accessibility and usability of the information, including issues such as language barriers, complex technical jargon, or the absence of user-friendly tools and guidelines. Furthermore, the adoption of new practices and technologies often requires changes in established routines and practices, which can be met with resistance or scepticism from practitioners who may be hesitant to deviate from their traditional approaches.

Addressing this knowledge gap is crucial to unlock the full potential of innovative practices, technologies, and products developed in the primary sector. The European Innovation Partnership for Agricultural productivity and Sustainability (EIP-AGRI[1]) Operational Group (OG) brings together farmers, researchers, advisers, businesses, environmental groups, consumer interest groups, and non-government organizations (NGOs) to advance innovation in the agricultural sector. Despite the continuous flow of information, new or improved managing choices have not been appropriated by practitioners as expected. More efforts should be focused on developing effective knowledge transfer mechanisms that facilitate the dissemination of research outcomes and recommendations in a practical and user-friendly manner. Collaboration between researchers, practitioners, and other stakeholders should be strengthened to ensure that the knowledge generated aligns with the practical needs and challenges faced by those working in the primary sector. Ultimately, by narrowing the knowledge gaps and facilitating the adoption of innovative practices, the agricultural sector can evolve toward more sustainable, productive, and resilient systems.

To this end, the EU-funded NUTRI-KNOW project aims to broaden EIP-AGRI OGs outcomes across borders to modernise and dynamise the agri-food sector by collecting, translating and sharing an easy-to-understand and practice-oriented knowledge. A meta-database of OGs outcomes, legislation, market needs and outputs to support the appropriate adoption of the OG results and experience by relevant end-users through 12 OGs from 4 EU member states (Spain, Italy, Belgium, and Ireland). Thereby, NUTRI-KNOW will contribute to fostering and share of knowledge and innovation and aiming the most urgent needs, challenges and opportunities of farmers but also, building trust and establishing connections between main stakeholders, intensifying thematic cooperation, co-creation and transposition of innovative solutions, considering territorial specifications.

The work package (WP) 1 of NUTRI-KNOW aims to identify, compile and analyse the knowledge and outcomes generated by the engaged 12 EIP-AGRI OGs from 4 Member States in the theme of nutrient management. Specifically, Task 1.1 focuses on collecting all the relevant knowledge of the main outcomes from the 12 engaged OGs, through screening of the public information from the

[1] Since October 2022, the EIP-AGRI Network has become part of the EU Common Agricultural Policy (CAP) Network, new and up-to-date information will be available on the EU CAP Network website (https://eu-cap-network.ec.europa.eu/index_en) while the EIP-AGRI platform (https://ec.europa.eu/eip/agriculture/en.1.html) will remain available in a static form as a reference of all previous EIP-AGRI activities without further updates.

project or national websites, with complementary information from NUTRI-KNOW partners which have been also involved in the different OGs. The main aim of Deliverable 1.1 (D1.1) is to summarise the outcomes of Task 1.1 by creating a simple database with existing and regularly updated results from the engaged OGs. The results of this deliverable will serve as an important part of the meta-database (D1.4), which is the base of the following WPs, and in particular WP3, to access and disseminate the main outcomes.

2. Methodology

This deliverable presents the inventory and analyses of outcomes collected from the 12 engaged OGs in the frame of nutrient management, including a brief description of the objectives and activities of the OGs, the associated main results and legal aspects at the EU or regional level. The collected information covers the six main steps of the nutrient management value chain (Figure 1) where the activities of OGs are relevant.

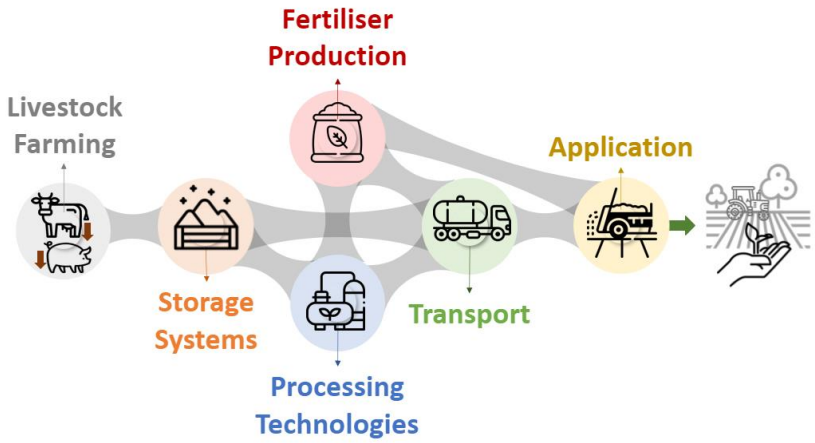

Figure 1–The 6 main steps of the Nutrient Management value chain considered by NUTRI-KNOW.

Livestock Farming: concerns the management and breeding of domestic, livestock or farm animals to obtain their meat or other products (milk, eggs, leather, etc.). Examples of nutrient management activities involved in livestock farming are animal density control, feed management, bedding material, stable cleaning, manure collection, etc.

Storage Systems: refer to the processes, technologies or facilities used to store the animal products (e.g. meat, milk, eggs, etc.) and by-products (manure, waste streams, spent bedding materials, etc.) from livestock farming for utilization at a later stage, with the aims to guarantee food security or to prevent environmental pollution.

Processing Technologies: mainly refer to the technologies used to process agricultural products for better quality, or to treat the agro-waste with the aim of fertiliser production, energy generation or mitigation of environmental impact. Examples of the involved technologies are anaerobic digestion, composting, solid-liquid separation, thermal drying, incineration, nitrification-denitrification, etc.

Fertiliser Production: includes the systems (processes, strategies, tools) to recover plant nutrients from agro-waste (e.g. animal manure, wastewater, crop residue, food waste, etc.) and produce mineral or organic fertilisers.

Transport: is involved when the products or by-products cannot be used or treated on-site, or surplus products have to be relocated to other sites in demand. For example, it is common for areas with intensive livestock farming but limited croplands to transport the surplus manure to other areas in a lack of locally available nutrients.

Application: mainly refers to the utilization of fertilisers, animal manure or other agro-waste on the field to support crop growth or maintain soil fertility. The 4R strategy (right source, right rate, right time, and right place) is usually highlighted for desired outcomes at economic, social, and environmental aspects.

Figure 2 presents the methodology scheme for the data collection approach in D1.1 and the interlinks with other tasks in WP1.

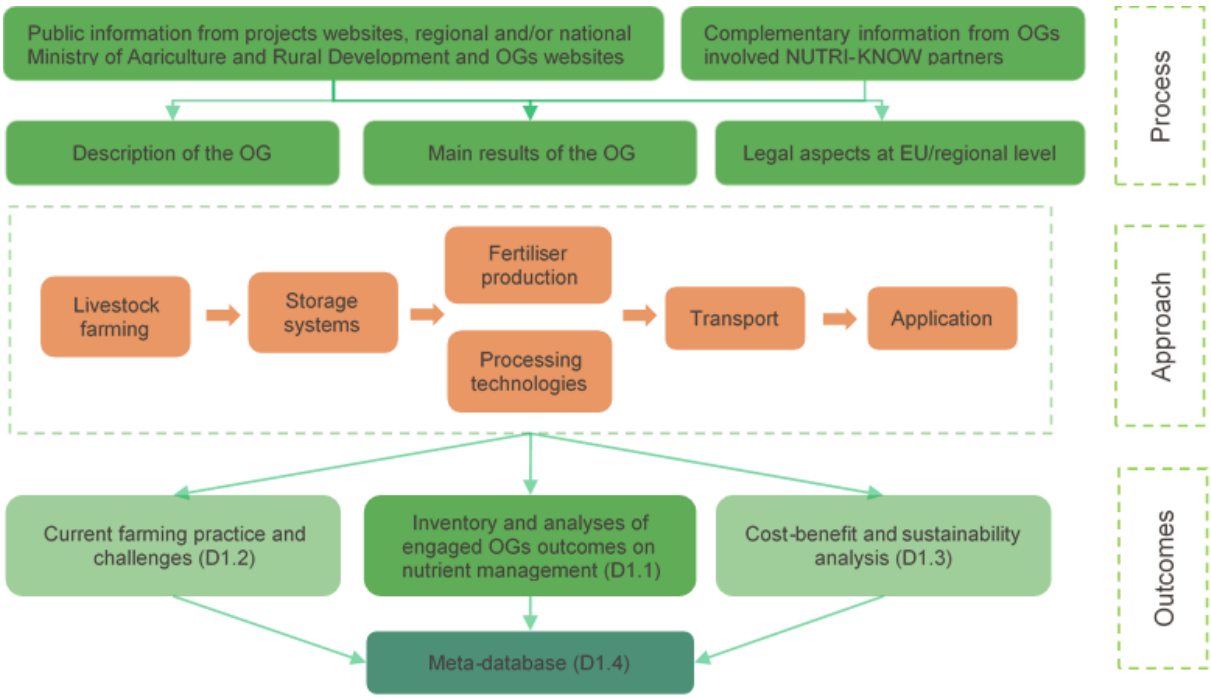

Figure 2 – Methodology of the inventory and analyses of outcomes collected from the 12 engaged operational groups.

The collection of technical data from the engaged OGs will firstly be done through a screening of the publicly available information on EIP-AGRI OGs websites, regional and/or national Ministry of Agriculture and Rural Development and other relevant projects databases. Apart from the online data screening, partners who are actively involved in the different OGs also provide complementary information such as English language translations of essential data. From there, a simple database will be created with the following information: a) tangible results and classify them in categories of outcomes; b) step of the value chain where the activities of OGs are relevant; c) status and maturity level of the OG activities (started, pilot, near to practice, on the market); d) legal aspects in each country/region/EU28.

The categories of outcomes from the engaged OGs are defined as follows:

Product: any substance or material that is used to supply nutrients or enhance soil fertility. It can include animal feeds, fertilizers, soil amendments, bio-stimulants, or microbial products. These products are specifically designed to provide essential nutrients to animals or plants, improve soil health, or enhance crop productivity. For example, ammonium sulfate is a product commonly used to supply nitrogen to crops, promoting their growth and development.

Tool: refers to a practical instrument or device that assists in the measurement, calculation, or assessment of nutrient-related parameters. It can include soil sampling tools, nutrient management software, nutrient calculators, or field monitoring devices. These tools help farmers and practitioners make informed decisions about nutrient application rates, timing, and methods. For instance, a handheld soil pH meter is a tool used to measure soil acidity levels, which can guide lime application decisions for optimal nutrient availability.

Technology: refers to innovative tools, systems, or processes that facilitate the efficient and

precise production and application of products. It can involve advancements in machinery, equipment, sensors, or software that assist in nutrient management decision-making. For instance, precision agriculture technologies like GPS-guided variable rate application systems enable farmers to apply fertilizers only where and when they are needed, minimizing waste and optimizing nutrient utilization.

Recommendation: refers to specific guidance or advice provided to farmers or practitioners regarding the management of fertilizers or other nutrient inputs. These recommendations are based on scientific research, soil testing, crop nutrient requirements, and local conditions. They aim to optimize nutrient use efficiency, minimize environmental impact, and maximize crop productivity. For example, a recommendation may suggest applying a certain amount of phosphorus fertilizer based on soil test results and the specific crop's nutrient demands.

This database will also be regularly updated once new outcomes from ongoing OGs engaged are available. Combining the current practice and challenges identified in Task 1.2, the results of this deliverable will be used in the cost-benefit and sustainability analysis in Task 1.3. All the outcomes from Task 1.1, 1.2 and 1.3 l be integrated into a meta-database (Task 1.4) for further use and dissemination in other WPs.

Data collected in this deliverable is free to access, reuse, repurpose, and redistribute.

3. Outcomes of the engaged operational groups

3.1 Summary of the main results of the 12 engaged OGs

The 12 engaged EIP-AGRI OGs in NUTRI-KNOW project are well distributed in the 4 member states (Belgium, Ireland, Italy, and Spain), being 3 in each of the involved countries. Among them, 8 OGs were finalised between 2017 to 2022, while the other 4 are on-going with an expected finishing date before the end of this project. Figure 3 summarises the maturity level of the OGs activities, being 1 at the started stage, 2 at the pilot level, 6 near to practice, and 3 already on the market. Figure 4 shows the coverage of engaged OGs in the 4 outcome categories including Product, Recommendation, Technology, and Tool. Some of the outcomes fit into 2 categories, which is the case for 5 of the 12 engaged OGs, therefore in Figure 4 the categories were listed as main result 1- main result 2 (e.g., Product-Recommendations). There are 4 OGs targeting Product, 4 targeting Technology, and 2 targeting on development of nutrient management tools. The most mentioned outcome category, with 7 OGs involved, is providing Recommendation for practitioners to implement an innovation. The relevance of the OGs' activities at different value chain steps (Livestock Farming, Storage Systems, Fertiliser Production, Processing Technologies, Transport, and Application) is summarised in Figure 5. Among them, some of the OGs have been involved in more than one value chain step. Results showed that 8 OGs are involved in the value chain step of Processing Technologies, and 7 OGs involve activities in the Application step.

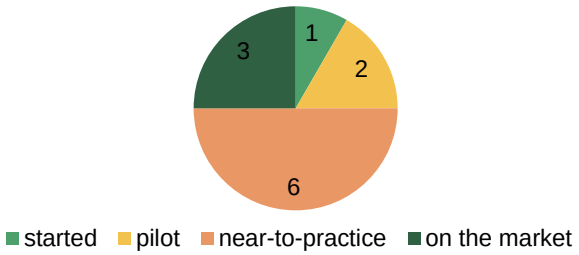

Figure 3 – Summary of the status of the 12 engaged EIP-AGRI OGs at the time of writing of this deliverable.

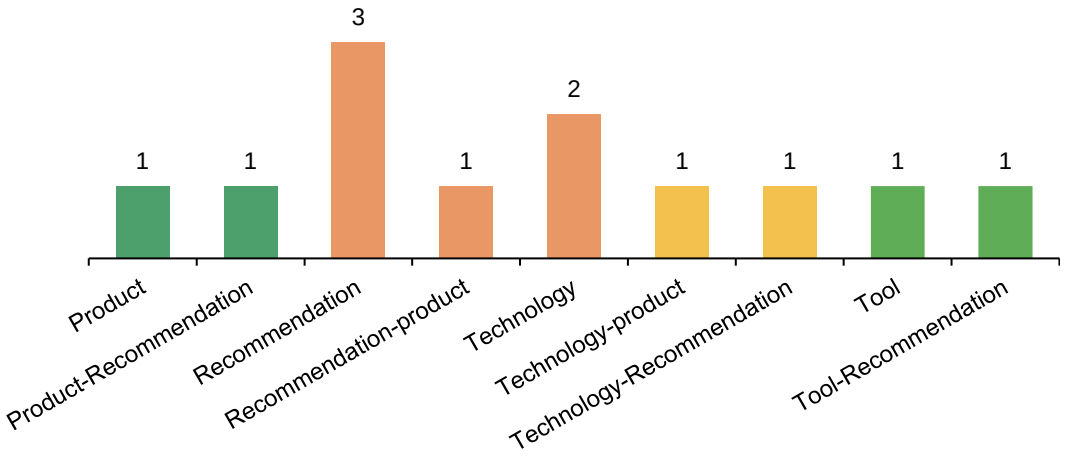

Figure 4 – Summary of the main outcomes targeted by the 12 engaged EIP-AGRI OGs.

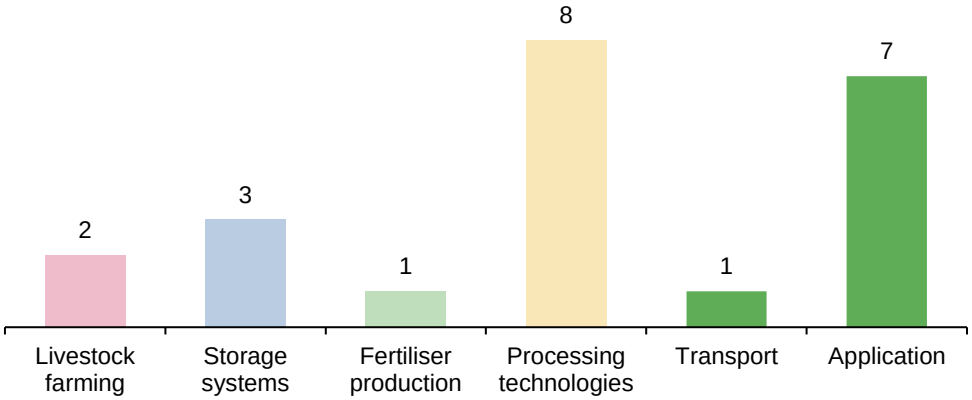

Figure 5 – Numbers of OGs involved at each value chain step.

3.2 Descriptive factsheet of the 12 engaged OGs

Detailed information about the 12 engaged OGs was collected by partners involved in the different OGs based on the screening of online open data. The collected information (including the name, region/country, main objectives, methodology, keyword categories, tangible results categories, relevant value chain steps, main outcomes, key performance, and further communication materials) were presented in Table 1-12, as descriptive factsheets for each OG.

Table 1 Factsheet of OG1: Development of a slurry concentrator with continuous total nitrogen data collection

Factsheet of OG1: Development of a slurry concentrator with continuous total nitrogen data collection	
Region, Country	Catalonia, Spain
Involved project partners	UVIC-UCC, FCAC
Duration	November 2015 - September 2017

Status	Finished
Maturity level	On the market
Main objectives	The main objective of the pilot project is to reduce the costs associated with the management of livestock waste.
Methodology	This OG implements a new process that separates the slurry into two phases: a semi-liquid phase containing the majority of the organic fraction, nutrients, and larger particles, and a liquid phase with a low nutrient concentration. The differentiated management of these two phases allows for minimized transport costs and optimized application of nutrients in the soil, benefiting both agronomic and environmental aspects.
Keyword categories	Farming equipment and machinery; Fertilisation and nutrients management
Tangible results categories	Technology
Relevant value chain steps	Processing Technologies
Main outcomes	The concentrator prototype used in the project demonstrates successful outcomes. It effectively obtains diluted and concentrated effluents from pig slurry, with the concentrated phase retaining the majority of phosphorus and nitrogen. The system enables continuous monitoring of conductivity and exhibits low energy consumption. Technologically and economically viable, it provides significant benefits to farms and cooperatives in terms of efficient manure management.
Key performance	The innovative nutrient concentration technology employed in the project achieves impressive results. It concentrates 85-95% of total solids, 45-55% of total nitrogen, and 85-95% of phosphorus initially present in a unit volume of raw slurry, reducing the volume by 20-30% while retaining the concentrated liquid fraction. This concentration process is cost-effective, minimizes additional emissions, and requires minimal energy consumption. As a result, transport costs are reduced, and the economically viable export of nutrients to non-vulnerable areas becomes feasible while ensuring environmental sustainability.
Further communication materials	https://ruralcat.gencat.cat/documents/20181/8594516/2015_GO_execucio_en_060/64259f91-fe5c-4f27-89a0-663eda7cdfdd https://grupsoperatius.cat/fitxes/2015_2_1.pdf

Table 2 Factsheet of OG2: Development of tools for optimising the joint management of livestock manure and the improvement of agricultural fertilisation, crop quality and environmental protection

Factsheet of OG2: Development of tools for optimising the joint management of livestock manure and the improvement of agricultural fertilisation, crop quality and environmental protection	
Region, Country	Catalonia, Spain
Involved project partners	FCAC
Duration	2016-2019
Status	Finished
Maturity level	Near to practice
Main objectives	The main objective of this OG was to develop innovative tools that optimize livestock manure management and agricultural fertilisation from both economic and environmental perspectives. It focused on four fundamental areas of improvement: 1. Improving slurry application through fertilisation planning. Soil analyses, use of conductivity meters, precision machinery, GPS, etc; 2. Improving management logistics: optimization of transport routes, registering applications, etc., by means of computer tools to facilitate tasks and to obtain traceability of the applications on the plot; 3. Improving cereal quality: increasing protein through fertilisation; 4. Reduced environmental impact.
Methodology	The project followed a systematic methodology with several steps: 1. Selection of pilot farms for testing, including 10 farms from the cooperative AGROCAT, samples from cooperative of IVARS, 25 farms in Empordà from foundation Mas Badia, and 3 farms from cooperative of Plana de Vic. 2. Utilization of suitable software, specifically Aplipur, for optimizing and managing livestock manure. 3. Implementation of conduct meter devices to measure nutrient content in situ. 4. Monitoring and optimization of treatment technologies, including liquid manure in ponds and composting.
Keyword categories	Soil management and fertilisation
Tangible results categories	Tool, Recommendation
Relevant value chain steps	Storage Systems; Processing Technologies;

	Transport; Application.
Main outcomes	The project validated innovative tools and strategies for optimizing livestock manure management and agricultural fertilisation, with a focus on economic and environmental aspects.
Key performance	1. The use of conductivity meters during application for the in-situ determination of the NPK content allows the fertilisation to be optimized; 2. A computer application has been tested to generate the livestock management book as well as fertilisation plans more quickly and accurately using devices installed in transport tanks, with real-time monitoring, control of the vehicle's location, routes, timetables, number of operations per loading and unloading point, total kilometres travelled, etc.; 3. Application of emission reduction strategies during slurry storage, such as acidification and the addition of plant material (straw), is relatively economical tools that allow the reduction of ammonia and greenhouse gas emissions, also the use of flexible bags; 4. Improvements to be implemented in the agricultural management of livestock manure, mainly slurry, have been identified: the use of hose equipment to apply liquid manure; the use of conductivity meters to estimate the nutrient content of slurry; the application of liquid manure in crop cover; the adequacy of the dose of nutrients to be applied to crops.
Further communication materials	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/desarrollo-de-herramientas-para-la-optimizaci%C3%B3n-de https://grupsoperatius.cat/fitxes/2016_2_44.pdf https://youtu.be/xY5AUO2zurQ

Table 3 Factsheet of OG3: FERTICOOP-GO Innovations to adapt to the best available techniques (BAT) in the Catalan cooperative agricultural sector

Factsheet of OG3: FERTICOOP-GO Innovations to adapt to the best available techniques (BAT) in the Catalan cooperative agricultural sector	
Region, Country	Catalonia, Spain
Involved project partners	FCAC
Duration	2020-2023
Status	Finished
Maturity level	Near to practice
Main objectives	The main objective was to develop innovative tools for improved management of livestock manure and agricultural fertilisation, with a focus on reducing phosphorus, improving the agricultural management of slurry, to enhance the valorisation and the quality of the extensive crops produced.
Methodology	Step 1. Strategies to reduce soil phosphorus content where livestock manure is applied. Step 2. Test and development of fast methods to estimate the chemical fertility of agricultural soils, in extensive crops. Step 3. Digitalization and integration of databases of agricultural plots and their management for fertilisation recommendations. Step 4. Evaluation of the production of biogas in the storage of slurry in a flexible pond. Step 5. Evaluation of ammonia and greenhouse gas emissions in the storage of slurry and other fractions extracted from it. Step 6. Assessment of the emissions in pig and poultry farms, and strategies to minimize them. Step 7. Calculations of the final quality of composting with different substrates, and the losses due to ammoniacal emissions.
Keyword categories	Agricultural practice; Fertilisation and nutrient management; Waste and by-product management
Tangible results categories	Tool
Relevant value chain steps	Livestock Farming; Storage Systems; Processing Technologies;

	Application.
Main outcomes	The project will determine the effect of applying different cultivation practices and doses of fertiliser on the soil's nutritional level using various rapid testing systems and IT platforms to enable the fertilisation advisor to obtain fast and reliable recommendations for fertilisation. Various methods to reduce ammonia and greenhouse gas (GHG) emissions in farms and slurry pools will also be assessed for the application of the best available techniques (BAT) in livestock farming.
Key performance	1. Valorisation of slurry based on its fertilizing capacity, making it a competitive and attractive product for agricultural use. 2. Savings in mineral fertilisers due to the calculations of the nitrogen needs, the treatment systems and the tasks of advice and optimization of the contributions in cases of double harvest. 3. Rationalization of nitrogen inputs in crops with the consequent minimization of nitrate losses due to leaching and precise applications to the soil. 4. Minimization of emissions and discomfort due to bad smells, having a consequent positive impact.
Further communication materials	https://grupsoperatius.cat/fitxes/2019_2_2.pdf https://ec.europa.eu/eip/agriculture/en/find-connect/projects/ferticoop-go-innovaciones-para-adaptarse-las

Table 4 Factsheet of OG4: Livestock manure and digestates treatment to reduce emissions and produce Struvite

Factsheet of OG4: Livestock manure and digestates treatment to reduce emissions and produce Struvite	
Region, Country	Emilia-Romagna, Italy
Involved project partners	CRPA
Duration	2021-2023
Status	On-going
Maturity level	Started
Main objectives	The objective of the project is to decrease the N, P and dry matter content in livestock manure and digestates to reduce ammonia, methane and nitrous oxide emissions into the atmosphere, both from the storage phase and from the spreading.
Methodology	The nitrogen recovered from the effluents will produce a slow-release renewable recovery fertiliser (Struvite) which will be able to replace synthetic fertilisers in areas characterized by nutrient deficiencies due to a reduced livestock presence.
Keyword categories	Farming equipment and machinery; Fertilisation and nutrients management; Climate and climate change.
Tangible results categories	Technology; Product
Relevant value chain steps	Storage Systems; Processing Technologies; Application.
Main outcomes	The monitoring activities carried out will allow the quantification of the ammonia and GHG emissions avoided with the prototype treatment of the effluents compared to the existing management. Lower emissions of ammonia, greenhouse gases and odours will produce an increase in the environmental and social sustainability of the farm in the area in which it is located. The reduction of ammonia emissions affects the reduction of the concentration of PM10. The results achieved will facilitate the farms in integrating and/or renewing the Integrated Environmental Authorization.
Key performance	The prototype for the crystallization of struvite was installed at the Colombaro Company, following the creation of the prototype for the treatment of pig effluents and digestates. The first tests were carried out to verify its correct functioning and evaluate its

	treatment efficiency. Tests were conducted to regulate the flow rates of the pumps that feed the crystallization and precipitation reactor and to be able to accurately dose any reagents to make the process more efficient, such as an acid solution, a basic solution and magnesium.
Further communication materials	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/trattamento-degli-effluenti-e-digestati-zootecnici https://struvite.crpa.it/nqcontent.cfm?a_id=22745&tt=t_bt_app1_www&aa=blog%5F22325

Table 5 Factsheet of OG5: SOS-AQUAE Sustainable farming techniques and renewable fertilisers to combine agriculture, water and environment

Factsheet of OG5: SOS-AQUAE Sustainable farming techniques and renewable fertilisers to combine agriculture, water and environment	
Region, Country	Emilia-Romagna, Italy
Involved project partners	CRPA
Duration	2020-2022
Status	Finished
Maturity level	On the market
Main objectives	The project aims to combine innovative and sustainable farming-techniques with the use of 'renewable' fertilisers, to optimize the use efficiency of nutrients already available on the farm and reduce the use of mineral fertilisers (both nitrogen and phosphorus), to reduce pollution generated by agricultural activity and improve water quality.
Methodology	Individual farming techniques and a combination of different techniques and renewable fertilisers will be tested in the three partner farms: 1) no-tillage (NT), with spring-summer crops alternated with autumn-winter cover crops, fertigation with ammonium sulphate derived from stripping, distributed through sub-surface drip irrigation (SDI); 2) minimum tillage, with double crops first for food and after for non-food purposes, fertigation with microfiltered agro-industrial digestate distributed through sub-surface drip irrigation; 3) conventional tillage, with double crops for food and non-food purposes, fertigation with microfiltered agro-zootechnical digestate distributed through a ranger irrigation system.
Keyword categories	Farming equipment and machinery; Fertilisation and nutrients management; Climate and climate change.
Tangible results categories	Technology; processing
Relevant value chain steps	Application
Main outcomes	The main results for farms consist in the identification and application of agro-technological 'packages' that allow increasing in both productivity and environmental sustainability, improving the efficiency of the use of inputs and at

	the same time reducing nutrient losses to water.
Key performance	1. The greater benefit of NT+SDI with renewable fertilisers on corn, compared to business as usual (negligible chemical N needs and lower water), especially in dry years 2. Sub-irrigation with drip lines at a distance of 70 cm + fertilisation with stripping ammonium sulfate (SDI-70) allowed greater uniformity of distribution of water and fertiliser, which increased yields and nitrogen use efficiency in corn. 3. SDI-70 with renewable fertilisers showed lower N_2O emissions than SDI-140 (i.e. Sub-irrigation with drip lines at a distance of 70 cm + fertilisation with stripping ammonium sulfate) and ASP (i.e. sprinkler irrigation + urea fertilisation).
Further communication materials	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/agrotecniche-sostenibili-e-fertilizzanti https://sosaquae.crpa.it/nqcontent.cfm?a_id=21064&tt=t_bt_app1_www&aa=blog%5F21056

Table 6 Factsheet of OG6: Gas Loop - Emissions capture for a virtuous nitrogen cycle in pig livestock

Factsheet of OG6: Gas Loop - Emissions capture for a virtuous nitrogen cycle in pig livestock	
Region, Country	Emilia-Romagna, Italy
Involved project partners	CRPA
Duration	2021-2022
Status	On-going
Maturity level	Near to practice
Main objectives	The general objective is to pursue a nitrogen virtuous cycle (Loop) in pig farming, which, starting from the ammonia emissions reduction by washing the air of the pigsties, generates a GHG emissions reduction per kg of meat produced, with specific aims to： 1. bring the “Ammonia Washing Machine” prototype system to a maximum level equal to TRL 9; 2. produce a fertilizing solution of ammonium sulfate by converting ammonia emissions into a resource; 3. reduce GHG and ammonia emissions per kg of meat produced following the reduction of inputs; 4. evaluate the positive effects on the health and productivity of pigs.
Methodology	The device draws ammonia rich-air from the stable through suction ducts located below the slatted floor and the air treatment is based on the chemical absorption of ammonia by counter-current acid washing into a tower. The process takes place at pH 4.5 and the sulfuric acid solution is used as an absorbent matrix. Indoor air quality (NH_3, N_2O, CH_4, H_2O, CO_2, Olfactometric analyses T08, Temp, RH) was monitored by an INNOVA gas analyser in the treated pig house compared to an identical untreated pig house.
Keyword categories	Animal husbandry and welfare; Climate and climate change.
Tangible results categories	Technology; Product.
Relevant value chain steps	Processing Technologies
Main outcomes	The expected results and opportunities from the OG’s actions will be: 1. an air washing system with ammonia capture characterized by a

	Technological Maturity Level equal to TRL 9 (real and qualified system, ready for diffusion and applicability); 2. a reduction of ammonia emissions into the atmosphere from the pig housing phase thanks to its capture: ammonia emissions avoided also means a reduction in the associated indirect emissions of nitrous oxide; 3. continuous production of ammonium sulfate (fertiliser recovered from the capture of ammonia emissions from the pigsty), thanks to which greenhouse gas emissions (t CO2eq) that would have been generated by the production of equal quantities of industrial fertilisers will be avoided; 4. the evaluation of the effect that increasing animal welfare can have on productivity (food conversion index, daily growth, reduction of lung injury); 5. the evaluation of the GHG reduction per kg of meat produced as a result of lower inputs; 6. the evaluation of the cost-benefits of applying the new technology, also economically quantifying the production benefits deriving from the increase in animal welfare; 7. the raising awareness of the entire sector and all stakeholders on the use of innovative technology through training, technical-scientific dissemination and dissemination activities; 8. the improving of the sustainability and social acceptability of pig farms.
Key performance	1. Avoided emissions per 1.5 - 2.4 kg NH_3/animal place per year, resulting in 1.2 – 2 kg N recovered/animal place per year; 2. Production of ammonium sulfate (4 %N – 6,4 %N); 3. positive effects of the treatment on the productivity of pigs: assessment by the animal feed conversion index and the state of health of the pig's lungs at the slaughterhouse; 4. Quantification of GHG (t CO2eq) reduction due to replacement of industrial fertilisers and to better animal live weight yield per kg of feed inputs; 5. Dissemination of the activities and the results, Training courses on the topic of emissions reduction and training visits.
Further communication materials	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/cattura-delle-emissioni-un-ciclo-virtuoso-dell https://gasloop.crpa.it/nqcontent.cfm?a_id=22705&tt=t_bt_app1_www&aa=blog%5F22324

Table 7 Factsheet of OG7: RENURE REcoverd Nitrogen from manURE

Factsheet of OG7: RENURE REcoverd Nitrogen from manURE	
Region, Country	Flanders, Belgium
Involved project partners	UGent
Duration	01/09/2021 – 30/08/2023
Status	On-going
Maturity level	Near to practice
Main objectives	The main goal of this OG is to test ammonium salts from stripping-scrubbing for the first time in a farmer's full field so that, after the project, the use of these fertilisers can be gradually expanded to the rest of the agricultural and horticultural sector.
Methodology	RENURE products are produced from animal manure through a physical, chemical or biological process to obtain a high active(mineral) nitrogen in the end products with stable quantity. Mineral concentrations and ammonium salts, obtained after thorough treatment of animal manure or digestate via, for example, membrane filtration or stripping-scrubbing, appear to have the greatest chance of being recognized.
Keyword categories	Fertilisation and nutrients management
Tangible results categories	Product; Recommendation.
Relevant value chain steps	Fertiliser Production; Application.
Main outcomes	In the long term, the operational group hopes to ensure that agriculture becomes more sustainable through more local processing of the manure surplus and (partially) avoiding the purchase of fertiliser.
Key performance	1. Produced ammonium nitrate + Achieved derogation for fields 2. The ammonium nitrate was eventually applied to five plots for 2 years (alternating strips with ammonium nitrate and synthetic fertiliser) to monitor the Agri-environmental effects on fields, the results showed equal performance as synthetic fertilisers. 3. A Meta-analysis is on-going to examine the impact of the roll-out of ammonium salts after stripping scrubbing on the Flemish agricultural context. 4. one demo event (field visit) and one workshop were organized at the West Flanders Research and Development Department for Agriculture

	(INAGRO) with around 30 participants (more than 50% are farmers)
Further communication materials	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/operationele-groep-renure https://inagro.be/projecten/renure https://nutricycle.vlaanderen/onderzoek/renure/

Table 8 Factsheet of OG8: POCKETBOER 2 - More performant operation of pocket digesters

Factsheet of OG8: POCKETBOER 2 - More performant operation of pocket digesters	
Region, Country	Flanders, Belgium
Involved project partners	Biogas-E
Duration	2019-2021
Status	Finished
Maturity level	On the market
Main objectives	Pocketboer 2 is tapping into the experiences of dairy farmers who are already using farm-scale anaerobic digesters, to find solutions for common problems and improve performance. Pocketboer 2 is the follow-up project of the Operational Group Pocketboer. The main outcome of these Operational Groups is supporting the small-scale biogas sector with adjustments for the quality and operation of the installations.
Methodology	1. Knowledge and information exchange between (future) operators, partners and other stakeholders (via dedicated partner meetings and stakeholder consultations, Facebook groups, publications in the trade press and newsletters, posters with tips & tricks) so that the sector is optimally informed; 2. Analysing, addressing or solving technical bottlenecks (via anaerobic digestion tests, market studies, measurements, cost-benefit analysis and by strengthening the negotiating position of operators); 3. Supporting farmers with administrative aspects and details on support schemes.
Keyword categories	Climate and climate change; Energy management; Waste, by-products and residues management.
Tangible results categories	Technology; Recommendation.
Relevant value chain steps	Processing Technologies
Main outcomes	The main achievements in this OGs are: 1. More performant digester operation. This contributed to the increase in the operational Flemish small-scale digester capacity from 723 kWe in 2017 to 1098 kWe in 2021; 2. Hands-on information increased awareness of (interested) farmers;

	3. Demonstration of the positive impact of pocket digestion with increasing interest.
Key performance	1. Facebook Group for knowledge exchange (+/- 90 members) --> still in use 2. Better performance of pocket digesters (improved knowledge about technology and operation) 3. Poster with tips and tricks for operators of pocket digesters 4. 'Dossier pocketvergisting' (Boer & Tuinder 21/03/2019) 5. The knowledge transfer during and after the project via stakeholder meetings and events 6. Technical support (anaerobic digestion tests, research on technological solutions, case-specific cost-benefit analysis) 7. Support with current and changing legislation (e.g. certificates) 8. Positive feedback from farmers (77% was convinced of the added value of the OG).
Further communication materials	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/pocketboer-2-performantere-werking-van https://biogas-e.be/tipsandtricks https://drive.google.com/file/d/10BQStJ4qm8_YCkh2kOCpda2VGfQfUVAX/view https://www.facebook.com/groups/324270077992893/https://inagro.be/projecten/pocketboer-2 https://biogas-e.be/pocketboer2

Table 9 Factsheet of OG9: Grass2Algae - From grass juices to the cultivation of microalgae

Factsheet of OG9: Grass2Algae - From grass juices to the cultivation of microalgae	
Region, Country	Flanders, Belgium
Involved project partners	UGent
Duration	01/01/2021 – 31/12/2021
Status	Finished
Maturity level	Near to practice
Main objectives	The Grass2Algae OG aimed to create value from waste grass from farms, i.e., clippings from the edges of fields or with too low quality for feed purposes. For that, Grass2Algae proposes a first pressing step to separate the juice from the fibres. The fibres can then be used as an input for anaerobic digestion or be sold as a feedstock for the production of biomaterials. And the juice can be used to cultivate microalgae as an additional source of income for farmers.
Methodology	1. Investigate a sequence of sedimentation, coarse filtration and pH adjustment to make the juice more suitable as a nutrient source for algal growth. 2. Check the quality of the produced microalgae biomass; 3. Investigate if the quality of the grass affects the quality of the juice and the growth of the microalgae; 4. Compare different mowing equipment, pressing possibilities, algae cultivation configurations, and end-use applications of the fibres and assess if we can use the sediments from the juice for some application, creating further value in the process.
Keyword categories	Agricultural production system; Waste, by-products and residues management.
Tangible results categories	Product
Relevant value chain steps	Processing Technologies
Main outcomes	This OG evaluated the economic viability of the proposed value chain based on the amount of grass available from 3 partner farms, the grass processing data gathered by the Grassification project (Interreg 2 Seas – Ghent University as Lead Partner), and the microalgal cultivation data gathered during the OG from 2 partners (Thomas More and AnKo Projects). Also, it assessed how different possibilities to use the fibre fraction, such as composting or selling to specialized companies such as Gramitherm, can improve the economic feasibility of the process. This OG stimulates innovation by allowing farmers to earn an income with the remnants of their business and ensure a circular

	economy on their farms.
Key performance	1. Poster presented at the AlgaEurope conference (Dec 2022) 2. An oral presentation was given at RRB (June 2022) 3. Grass2Algae final factsheet 4. Grass2Algae pitch at PERM4 (European Sustainable Phosphorus Platform - 4th Phosphorus in Europe Research Meeting (PERM)) 5. Grass2Algae at European Sustainable Phosphorus Platform - ESPP webinar on regulatory questions for nutrient recycling from waste-derived algae 6. Published experimental paper: Microalgal cultivation on grass juice as a novel process for a green biorefinery
Further communication materials	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/grass2algae https://nutricycle.vlaanderen/onderzoek/grass2algae/

Table 10 Factsheet of OG10: Biorefinery Glas - Small-scale Farmer-led Green Biorefineries

Factsheet of OG10: Biorefinery Glas - Small-scale Farmer-led Green Biorefineries	
Region, Country	SouthWest, Ireland
Involved project partners	TEAGASC
Duration	2019-2021
Status	Finished
Maturity level	Near to practice
Main objectives	This OG aims to improve the overall sustainability, value and resource efficiency of Ireland's agriculture sector through diversification into the bioeconomy, using a widely replicable small-scale farmer-operable grass biorefinery. Ensure that each component of grass is used at its highest value, with the simultaneous production of multiple products from grass, including an improved fodder press-cake fibre for cattle, protein concentrate feed for monogastric, high-value prebiotic sugars (for the food and feed markets) and recovery of nutrients for use as fertiliser.
Methodology	Biorefinery Glas activities include: 1. Demonstrating a small-scale mobile grass biorefinery on multiple farms in South West Ireland. 2. Producing and validating multiple products from grass through biorefining, including an improved fodder press-cake fibre for cattle, protein concentrate feed for monogastric, high-value prebiotic sugars (for the food and feed markets) and recovery of nutrients for use as fertiliser. 3. Promoting farm-to-farm bioeconomy symbiosis and new business models. 4. Facilitating several bioeconomy knowledge exchange activities with Irish farmers. 5. Delivering an extensive dissemination package, including digital storytelling, with farmers playing a central role.
Keyword categories	Biomass, value chain, bioeconomy, circular economy, nutrients, fertiliser
Tangible results categories	Technology
Relevant value chain steps	Processing Technologies
Main outcomes	Biorefining can improve the resource efficiency of Irish grass providing diversification opportunities and feed independence. All four co-product streams compared comparably well with existing products and offer key opportunities for emission displacement. Integration between biorefining and

	bioenergy can be a win-win. Bioeconomy can be delivered economically at a small scale with three products. Farmers and primary producers can and should play a more central role in bioeconomy value chains.
Key performance	1. Four streams tested five applications (cattle feed, pig feed, prebiotic, biogas, fertiliser) which achieved a 30% reduction in N in cattle excrement, a 25% reduction in P in cattle excrement, a 15% reduction in rumen methane (RUSITEC) based on press cake replacing silage in dairy cows with similar milk performance. 2. The average weight gain of the pigs increased by 8% when grass protein concentrate was included in a traditional weaner diet to replace soybean meal, barley and wheat. 3. Extracted fructan sugars showed similar prebiotic activity compared to positive standards. 4. Residual nutrient whey stream promoted grass growth and similar performance to cattle slurry. 5. Residual whey stream was tested for biogas and biomethane potential with modelled energy that was capable of meeting most of the plant's needs.
Further communication materials	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/biorefinery-glas-small-scale-farmer-led-green https://biorefineryglas.eu/

Table 11 Factsheet of OG11: MOPS - Maximizing Organic Production Systems Through integrated cropping systems

Factsheet of OG11: MOPS - Maximizing Organic Production Systems Through integrated cropping systems	
Region, Country	Ireland
Involved project partners	IOA
Duration	June 2018 - December 2021
Status	Finished
Maturity level	Pilot
Main objectives	This OG sought to optimize organic horticulture production and improve supply consistency through organic grower collaboration. This included developing and implementing organic cropping programs to provide better continuity of supply resulting in a greater volume of local organic produce available on retail shelves, improving land and crop management and using green manures to improve sustainable practices and reduce reliance on imported nutrients.
Methodology	The main strategy is building capacities for enabling a platform for trade and collaborative supply amongst growers and establishing current and future retail market demands and requirements for organic horticultural fresh produce. Soil and farm productivity will be assessed on an on-going basis to determine an appropriate cropping system suitable for the individual farmer as well as make the most efficient and economic use of collaborative supply. Therefore, each farmer shall work within the collaborative group of organic producers, while still optimizing their productivity.
Keyword categories	Plant production and horticulture, fertilisation and nutrients management, supply chain, marketing and consumption, farming competitiveness and diversification, organic farming, cooperation
Tangible results categories	Tool, Recommendation
Relevant value chain steps	Application
Main outcomes	1. Improved land management and crop performance; 2. Significant increases in trade and sales year-on-year; 3. Development of Stakeholder Guidance and outreach.
Key performance	1. Better sampling/interpretation of soil and crops in terms of nutrient management needs and effective organic material use based on an analysis of various organic materials used on-farm including farmyard manure, compost, anaerobic digestate, other organic waste and organic fertilisers.

	2. Optimized cropping plans, complemented by grower collaboration, resulted in improvements to soil and nutrient management, and increased yields. There were also increases in the consistency of supply of produce leading to significant increases in sales and trade amongst the growers as well as other organic growers nationwide. 3. Short-term mixed species green manures between successive cash crops (summer and winter) achieved consistent positive effects increased nutrient availability, better weed control, more beneficial insects, greater functional diversity of soil bacteria and SOM content. Their use also resulted in earlier-developing cash crops, with cost-benefit analysis showing extra financial returns.
Further communication materials	https://www.irishorganicassociation.ie/mops

Table 12 Factsheet of OG12: Duncannon Blue Flag Farming & Communities Scheme

Factsheet of OG12: Duncannon Blue Flag Farming & Communities Scheme	
Region, Country	South-East, Ireland
Involved project partners	TEAGASC
Duration	2018-2022
Status	On-going
Maturity level	Pilot
Main objectives	The main aim of this scheme is to improve the bacterial quality of the two coastal streams that flow onto Duncannon beach, by linking to reducing nutrient pollution from agricultural and domestic sources. This should contribute to the recovery and long-term retention of the Blue Flag status at Duncannon beach. The scheme focuses on addressing rural point sources of faecal (and associated phosphorus) pollution. However, it does this within a framework of integrated catchment management, whereby a range of pollution sources and types are considered in unison, for multiple benefits in an integrated, holistic manner. The main objectives are; 1. Sustainably restore, protect and enhance the quality of the bathing and riverine waters at Duncannon by reducing pollution (mainly faecal bacteria but also nutrients and sediments) from rural agricultural and domestic sources whilst also protecting farm incomes. 2. To develop an effective model for future sustainable management of similar catchments. 3. To foster positive relations between the farmers and householders in the catchment area and the local natural landscape, particularly the water environment and associated biodiversity.
Methodology	The Sustainability Manager will conduct annual surveys of each Pollution Potential Zone (PPZ) using the maps described above. The condition and management of each PPZ will be scored using a 'traffic light' system – red for poor, yellow for good and green for excellent. Individual results will be combined to provide a farm-level PPZ status (i.e. red, yellow or green). Farms achieving yellow or green status will be eligible for annual 'Water Protection Payments'. The Sustainability Manager will then guide any works which may be needed to improve the farm-level PPZ status and associated payments. Farmers will be given the freedom to choose and design which measures they want to implement on their own farms. This gives the farmers the freedom to implement actions in ways that suit them and their environment, whilst also providing expert involvement via the Operational Group.
Keyword categories	Nutrient use efficiency, leaching, water quality
Tangible results categories	Recommendation
Relevant value chain steps	Livestock Farming;

	Application
Main outcomes	1. A template for the development of farm-specific pollution potential zone maps and how they could be used as education and engagement tools to show farmers in a simple visual way, the water-quality risks specific to their farms. 2. Demonstration of a range of innovative and cost-effective farm management practices for water-quality protection. 3. A template for a water-quality-focused, results-based, reward scheme which could be used to improve water quality in particularly sensitive catchments.
Key performance	1. All watercourses surrounding the location of interest were fenced off (16km in total) to prevent livestock from entering. 2. Water troughs were centrally field based to prevent livestock from congregating near waterways. 3. 1.5km of arable grass margins were implemented to create a riparian buffer zone to stabilise the river bank, increase biodiversity and intercept runoff. 4. Levels of contamination have decreased and the stream water quality has improved. 5. Duncannon Beach is on target to reach Blue Flag status by 2025.
Further communication materials	https://ec.europa.eu/eip/agriculture/en/find-connect/projects/duncannon-blue-flag-farming-communities-scheme http://duncannonblueflag.ie/home/the-project/

4. EU and regional regulations impacting the OGs' activities along the value chain

Activities of the 12 engaged OGs are regulated by EU and regional regulations along the 6 main steps of the nutrient management value chain considered by NUTRI-KNOW: Livestock Farming, Storage Systems, Fertiliser Production, Processing Technologies, Transport, and Application (Figure 1). These regulations address issues such as waste classification, nutrient recovery, application practices, and adherence to national and EU directives regarding animal and crop management, fertiliser matrices and organic farming. By complying with these regulations, the engaged OGs contribute to sustainable and efficient nutrient management practices in agriculture. Table 13-17 summarized the OGs involved at each value chain step and the relevant regulations at the EU or regional level. More details about the EU and regional regulations are available in Annexe 1 differentiating for each value chain step (A1.1-A1.6).

Table 13 Regulation at EU/national/regional level for nutrient management value chain step: Livestock Farming

OGs involved in Livestock Farming	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
OG3: FERTICOOP-GO Innovations to adapt to the best available techniques (BAT) in the Catalan cooperative agricultural sector (Table 3) **OG12**: Duncannon Blue Flag Farming & Communities Scheme (Table 12)	**Action Plan 'Towards Zero Pollution for Air, Water and Soil' (COM/2021/400)** and **Farm to Fork Strategy (COM/2020/381)** aim for the reduction of environmental impact, improvement of animal welfare, reduction of drug use	- **Decree 40/2014** management of livestock farms. - **Royal Decree 306/2020** establishes basic rules for the management of intensive pig farms and amends the basic rules for the management of extensive pig farms. - **Royal Decree 1053/2022** establishes the basic rules for the management of bovine farms. - **Royal Decree 637/2021** establishes the basic rules for	- **Legislative Decree 2006 No. 152** (Testo Unico sull'Ambiente) is the current national regulatory reference for the environment and pollution.	- **The Common Agricultural Policy (CAP) 2023-2027 for Flanders** to support farmers in their search for sustainable opportunities for their businesses and give them opportunities to invest, innovate and develop resilient and future-oriented farming income models.	-

OGs involved in Livestock Farming	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
		the management of poultry farms. - **Royal Decree 364/2023 of 16 May**, establishes the bases for the development of the European Union regulations on animal health, in relation to the surveillance obligations of the holder of the holding and the comprehensive health plan for livestock holdings, and amending various livestock management regulations.			
	CAP Strategic Plan Regulation 2021/2115 defines the objectives of future agricultural policy and sets out basic requirements for farmers engaged in livestock farming in receipt of public money as well as other incentives which are implemented by Member States	**ORDINANCE TES/80/2021**, revising the vulnerable zones in relation to nitrate pollution from agricultural sources and implementing the measures of the action program in vulnerable zones. - **DECREE LAW 17/2021**, which adopts extraordinary measures to limit stocking densities.	-	-	-

OGs involved in Livestock Farming	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
	- **European Council Directive 91/676/EEC (Nitrates Directive)** and **Directive 2000/60/EC (Water Framework Directive)** set rules to prevent water pollution from nitrates, specifying an annual limit of 170 kg N ha^{-1} from livestock manure; - **European Communities Good Agricultural Practice for Protection of Waters Regulations 2022 (S.I. No. 113 of 2022)** specify measures to protect surface waters and groundwater from nutrient pollution arising from agricultural sources	- **ORDINANCE ACC/25/2023**, amending Annexes 2, 3 and 8 of **Decree 153/2019,** on the management of soil fertilization and livestock manure and approval of the action program in vulnerable areas in relation to nitrate pollution from agricultural sources. - **Royal Decree 47/2022** on the protection of water against diffuse pollution caused by nitrates from agricultural sources.	-	-	The **5th Nitrates Action Programme** is given effect by European Union Good Agricultural Practice for the Protection of Waters) Regulations 2022 (Statutory Instruments No. 113 and 393)
	- **Directive 2016/2284/EU (National Emission Ceiling Directive)** and **Directive 2010/75/EU (Industrial Emission Directive)**	- **Directive 2001/81/EC** of the European Parliament and of the Council of 23 October 2001 on national emission	- **Po River Basin Agreement (PAIR 2020 and PAIR 2030)** for the implementation	-	-

OGs involved in Livestock Farming	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
	regulate the emissions from livestock farms and the application of good practices at every stage of livestock farming from housing to spreading, storage to treatments	ceilings for certain atmospheric pollutants. - **Royal Decree 306/2020, Article 10** regulates the emissions from livestock pig farms. - **Royal Decree 1053/2022, Article 11** regulates the emissions from livestock bovine farms. - **Royal Decree 637/2021, Article 12** regulates the emissions from livestock poultry farms. **- Decree153/2019 Moratorium** that prevents expanding and building of farms in 4 years in vulnerable areas (Decree 17/2021) - **Decree 153/2019 Annual Nitrogen Declaration** related to the origin and destination of livestock manure and other nitrogen fertilisers.	of joint measures to improve air quality; - The **Emilia Romagna Air Plan** with the "Guidelines for the reduction of atmospheric emissions from agricultural and livestock activities"; **- Italian National Legislative Decree No. 81 of 5/30/2018** which regulates the control of ammonia emissions; - **Decree No. 46 of 4/03/2014** regulates emissions from livestock farms and the application of good practices at every stage of livestock farming from housing to spreading, storage to treatments		

OGs involved in Livestock Farming	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
	EU Regulation No 2018/848 of 30 May 2018 on organic production and labelling of organic products	-	-	-	**- Irish Organic Food and Farming Standards** implement the requirements of EU Regulations on organic livestock production

Table 14 Regulation at EU/national/regional level for nutrient management value chain step: Storage Systems

OGs involved in Storage Systems	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
OG2: Development of tools for optimising the joint management of livestock manure and the improvement of agricultural fertilisation, crop quality and environmental protection (Table 2)	- **European Council Directive 91/676/EEC (Nitrates Directive)** and **Directive 2000/60/EC (Water Framework Directive)** set rules to prevent water pollution from nitrates with specific requirements set out in national action plans	- **Decree 153/2019** establishes the basic rules for soil fertilisation and livestock manure management. - **Royal Decree 1051/2022** establishes standards for sustainable nutrition in	- **National Decree of February 25, 2016**, the Regional Regulation of the Emilia-Romagna Region December 15, 2017, No. 3, and the **Emilia-Romagna Piano Aria Integrato Regionale** (PAIR 2020) regulate the storage of livestock manure differentiated in solid	- **Decree of the Flemish Government of 1 June 1995** concerning General and Sectoral provisions relating to Environmental Safety (VLAREM II) regulates the storage sites for animal manure/digestate to limit odour nuisance and ammonia emissions	The **5th Nitrates Action Programme** is given effect by European Union Good Agricultural Practice for the Protection of Waters) Regulations 2022 (Statutory Instruments No. 113

OGs involved in Storage Systems	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
OG3: FERTICOOP-GO Innovations to adapt to the best available techniques (BAT) in the Catalan cooperative agricultural sector (Table 3) **OG4**: Livestock manure and digestates treatment to reduce emissions and produce Struvite (Table 4)		agricultural soils. - **Royal Decree 306/2020** establishes the basic rules for livestock management of intensive pig farms, manure management and storage. - **Royal Decree 1053/2022** establishes the basic rules for livestock management of bovine farms, manure management and storage. - **Royal Decree 637/2021** establishes the basic rules for livestock management of poultry farms, manure management and storage.	manure, slurry, and manure-derived materials like struvite		and 393)
	- Directive 2016/2284/EU (National Emission Ceiling Directive) and **Directive**	- **Decree 153/2019 Moratorium** that prevents expanding and building of farms	- **Regional Council Regulation No. 3** of December 15, 2017, "Regional regulations on	- **Flemish Decree of 6 February 1991** on the	-

OGs involved in Storage Systems	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
	2010/75/EU (Industrial Emission Directive) regulate the emissions from livestock farms listing good practices that cover various stages of livestock farming	in 4 years in vulnerable areas (Decree 17/2021). - **Decree 153/2019** on the management of soil fertilisation and livestock manure prohibits the application of slurries and other liquid livestock manure in vain or fan so as to reduce ammonia emissions. - **Royal Decree 306/2020** regulate the emissions from livestock pig farms. - **Royal Decree 1053/2022** regulates the emissions from livestock bovine farms. - **Royal Decree 637/2021** regulates the emissions from livestock poultry farms.	the agronomic utilization of livestock manure, digestate, and wastewater";	prevention and management of waste materials. - **The Government of Flanders of 17 February 2012** regulated the sustainable storage of animal by-products, e.g. storage of dangerous liquids in aboveground containers	

OGs involved in Storage Systems	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
		- **DIRECTIVE 2001/81/EC** regulates national emissions of certain atmospheric pollutants for livestock manure of animal species other than pigs, bovines and poultry.			

Table 15 Regulation at EU/national/regional level for nutrient management value chain steps: Processing technologies and Fertiliser Production

OGs involved in Fertiliser Production and Processing Technologies	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
OG1: Development of a slurry concentrator with continuous total nitrogen data collection (Table 1) **OG2**: Development of tools for optimising the joint management of livestock manure and the	- **Regulation (EU) 2019/1009 Fertilising Products (FPR)** harmonizes EU rules for products derived from recycled or organic materials and by-products, providing rules to recover nutrients into materials for use as fertilising products.	- **Decree 153/2019** classifies the wastes and the obtained products as Fertilisers of Type 1 and type 2; - **Royal Decree 999/2017** to obtain an approved fertiliser;	- **Legislative Decree No. 75 of April 29, 2010**, "Reorganization and revision of the regulations on fertilisers, according to Article 13 of Law No. 88 of July 7, 2009	- Annex I of the **Royal Decree of 28 January 2013** listed the fertiliser, soil improver, growing media, sewage sludge or related products that can be marketed in Belgium.	- Currently fertiliser manufacturers can choose to market their products under relevant EU Regulations and Statutory Instrument 248/1978 (Marketing of Non-EEC

OGs involved in Fertiliser Production and Processing Technologies	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
improvement of agricultural fertilisation, crop quality and environmental protection (Table 2) **OG3**: FERTICOOP-GO Innovations to adapt to the best available techniques (BAT) in the Catalan cooperative agricultural sector (Table 3) **OG4**: Livestock manure and digestates treatment to reduce emissions and produce Struvite (Table 4) **OG6**: Gas Loop - Emissions capture for a virtuous nitrogen cycle in pig livestock (Table 6) **OG7**: RENURE REcoverd Nitrogen from manURE (Table 7)					Fertilisers Regulations, 1978)
	- **Regulation (EC) No 1069/2009 (Animal By-Product Regulation)** to ensure a high level of protection of animal and public health during further usage and disposal of animal by-products; - **Directive 2008/98/EC (Waste Framework Directive**) regulates the standard processing for animal by-products such as manure, which have a legal status of waste.	- Annexes 2, 3 and 8 of **ORDINANCE ACC/25/2023,** of **February 10**, **Decree 153/2019, of July 3**, for management of soil fertilization and livestock farming and approval of the action program for vulnerable areas in relation to nitrate contamination from agricultural sources.	- The **Ministerial Decree of February 25, 2016** "Criteria and general technical standards for the regional regulation of the agronomic use of livestock manure and wastewater, as well as for the production and agronomic use of digestate" in Annex V in Part A; - **Regional Council Regulation No. 3 of December 15, 2017,** "Regional regulations on the agronomic utilization of livestock manure, digestate, and wastewater“; - **Legislative Decree 152/06** regulates the agronomic use of	- The **Programmatic Approach to Nitrogen on 10 March 2023** for manure treatment in Flanders. - **Flemish Environmental Permitting Regulations (VLAREM)** regulates the discharge of wastewater effluent (e.g. from microalgae cultivation) into water bodies	-

OGs involved in Fertiliser Production and Processing Technologies	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
OG8: POCKETBOER 2 - More performant operation of pocket digesters (Table 8) **OG9**: Grass2Algae - From grass juices to the cultivation of microalgae (Table 9) **OG10**: Biorefinery Glas - Small-scale Farmer-led Green Biorefineries (Table 10)			livestock effluents (Article 112) wastewater from the agro-food sector (Article 101, paragraph 7, letters a), b), c)); - **Legislative** Decree 99/92 regulates the agronomic use of sludge.		
	The following regulations promote the manure treatment technologies for the animal intensity in livestock farms above the thresholds and require Integrated Environmental Authorization:- **The Best Available Techniques Reference Document (BREF)** for Intensive Rearing of Poultry or Pigs.	- **Royal Decree 1051/2022** establishes standards for sustainable nutrition in agricultural soils.	- **The Regional Regulation December 15, 2017, no. 3** "Regional Regulation on the agronomic use of livestock effluents, digestate and wastewater" defines processing as any operation carried out on materials and substances within the scope of this topic (manure and digestate), including storage and anaerobic digestion, that is suitable to modify their agronomic characteristics by enhancing their effects or	-	-

OGs involved in Fertiliser Production and Processing Technologies	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
			reducing sanitary and environmental risks.		
	Commission Implementing Regulation (EU) 2021/1165 authorising certain products and substances for use in organic production and establishing their lists.				**Irish Organic Food and Farming Standards** aligned with the EU Organic Regulations on organic materials and fertilisers for appropriate use in organic farming.

Table 16 Regulation at EU/national/regional level for nutrient management value chain step: Transport

OGs involved in Transport	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
OG2: Development of tools for optimising the joint management of livestock manure and the improvement of agricultural fertilisation,	- **Waste Shipment Regulations (96/61/EC)** and **Hazardous waste directive (91/689/EEC)** apply in transporting animal feeds, veterinary	- The "**livestock manure management plan" Decree 153/2019** indicates the required management of storage	- **Legislative Decree No. 75 of April 29, 2010**, "Reorganization and revision of the regulations on fertilisers, according to Article 13 of Law No. 88 of July 7, 2009" regulate	- **The Flemish Climate Policy Plan (VKP) 2013-2020** consists of an overall framework and two separate but closely related sections: the **Flemish**	-

OGs involved in Transport	EU Regulation	Associated local regulation in each region (country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
crop quality and environmental protection (Table 2)	biologicals, and other products designated for non-human use	and transport of manure;. - Decree 144/2017, of October 3, which regulates the handling and use of livestock manure; - Order ARP/135/2018, of June 4, which establishes the requirements for the transport of livestock manure; -Law 5/2019, of 15 March, on the promotion of circular economy; - Decree 90/2019, of 25 June, on the management of livestock manure; - Order AAM/104/2019, of 9 April, on the authorization of companies for the transport of livestock manure	the transport of fertilisers with a sales document and invoice; - **Ministerial Decree Feb. 25, 2016** (livestock manure) "Criteria and general technical standards for the regional regulation of the agronomic use of livestock manure and wastewater, as well as for the production and agronomic use of digestate" and the Regional Regulation Dec. 15, 2017, No. 3 (Nitrate Action Program) regulate the transport of manure or non-fertiliser products.	**Mitigation Plan (VMP)** aims to reduce emissions of greenhouse gasses in Flanders between 2013 and 2020 as a means of combatting climate change, and the **Flemish Adaptation Plan (VAP)** aims to understand the Flemish vulnerability to climate change and then improve its ability to defend against its effects	

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Table 17 Regulation at EU/region/country level for nutrient management value chain step: Application.

OGs involved in Application	EU Regulation	Associated local regulation in each region (Country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
OG2: Development of tools for optimising the joint management of livestock manure and the improvement of agricultural fertilisation, crop quality and environmental protection (Table 2) **OG3**: FERTICOOP-GO Innovations to adapt to the best available techniques (BAT) in the Catalan cooperative agricultural sector (Table 3) **OG4**: Livestock manure and digestates treatment to reduce emissions and produce Struvite (Table 4) **OG5**: SOS-AQUAE Sustainable farming techniques and renewable fertilisers to combine agriculture, water and environment (Table 5)	- **The Emissions Directive (Directive (EU) 2016/2284)** regulates national emission ceilings for certain atmospheric pollutants.	- **Decree 153/2019** on the management of soil fertilisation and livestock manure prohibits the application of slurries and other liquid livestock manure in vain or fan so as to reduce ammonia emissions. - **Directive 2001/81/EC** of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants. - **Royal Decree 306/2020, Article 10** regulates the emissions from livestock pig farms. - **Royal Decree 1053/2022, Article 11** regulates the emissions from livestock	- **National Code of Good Agricultural Practices** promoted by The Ministry of Agriculture, food sovereignty and forestry (MASAF) for the control of ammonia emissions	-	-

OGs involved in Application	EU Regulation	Associated local regulation in each region (Country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
OG7: RENURE REcoverd Nitrogen from manURE (Table 7) **OG11**: MOPS - Maximizing Organic Production Systems Through integrated cropping systems (Table 11) **OG12**: Duncannon Blue Flag Farming & Communities Scheme (Table 12)		bovine farms. - **Royal Decree 637/2021, Article 12** regulates the emissions from livestock poultry farms.			

OGs involved in Application	EU Regulation	Associated local regulation in each region (Country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
	- **Water Framework Directive (2000/60/EC)** (on water resources management), the **Nitrates Directive (91/676/EEC)** and the **Floods Directive (2007/60/EC).**	- **Regulation CE no. 1069/2009, of October 21** (SANDACH regulations) on the use of animal by-products and non-intended for human consumption - **Royal Decree 47/2022 of 18 January** on the protection of water against diffuse pollution caused by nitrates from agricultural sources. - **ORDINANCE ARP/225/2019**, establishing a methodology for the calculation of nitrogen from manure.	- **Ministerial Decree February 25, 2016**, and the regional regulations of the Emilia-Romagna Region No. 3 of December 15, 2017, regulate manure and digestate applications from the perspective of impacts on soil and water.	- **The 6th manure action plan for the period 2019-2022** amis to ensure that fewer nitrates and phosphates from fertilizers end up in the water.	The 5th Nitrates Action Programme is given effect by European Union Good Agricultural Practice for the Protection of Waters) Regulations 2022 (Statutory Instruments No. 113 and 393)

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OGs involved in Application	EU Regulation	Associated local regulation in each region (Country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
	EU Regulation No 2018/848 of 30 May 2018 on organic production and labelling of organic products				**- Irish Organic Food and Farming Standards** implement the requirements of EU Regulations on organic crop production and land management

OGs involved in Application	EU Regulation	Associated local regulation in each region (Country)			
		Catalonia (Spain)	Emilia-Romagna (Italy)	Flanders (Belgium)	(Ireland)
	CAP Strategic Plan Regulation 2021/2115 defines the objectives of future agricultural policy and support the sustainable use of fertilisers in agriculture, which are implemented by Member States				

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5. Conclusions

This deliverable summarised the main outcomes collected from the 12 engaged EIP-AGRI OGs concerning nutrient management, including the focus outcome categories (Product, Recommendation, Technology, and Tool), the involved value chain steps (Livestock Farming, Storage Systems, Fertiliser Production, Processing Technologies, Transport, and Application), status and maturity level (started, pilot, near to practice, on market) and the relevant EU/national/regional regulations.

Among the 12 engaged OGs, 8 were finished with various information and raw materials available in English or native languages on public websites or from involved partners. These materials were collected and currently stored confidentially in the project folder with limited access only among the consortia. There are also 4 OGs ongoing with further updates to be included in the meta-database (D1.4), after the complement of the state-of-the-art (D1.2) as well as the cost-benefit and sustainability analyses (D1.3). Results of this deliverable will be contextualized with the current market and legislative situation through a bottom-up approach (Task 2.1) and support the creation of a general policy brief in Task 4.6.

Challenges remain in the dissemination and implementation of outcomes from the OGs, especially for those aiming to provide nutrient-management recommendations for practitioners. Efforts are still needed for more efficient knowledge exchange with targeting practitioners, including (1) identifying the relevant stakeholders based on the outcome categories and involved value chain steps; (2) collecting the opinion from stakeholders on the OG outcomes and how the OGs help with their activities at different value chain steps; (3) creating easy-understanding practical materials matching the outcomes with the needs of practitioners. These challenges will be addressed with further updates in the OG outcomes and the multi-actor activities in other WPs.

References

European Council of the European Union. (2019). EU adopts new rules on fertilisers. https://www.consilium.europa.eu/en/press/pressreleases/2019/05/21/eu-adopts-new-rules-on-fertilisers/

Code goede praktijk duurzaam gebruik van digestaat. Retrieved from https://vlaco.be/sites/default/files/generated/files/page/code-goede-praktijk-duurzaam-gebruik-van-digestaat_0.pdf

Commission Implementing Regulation (EU) 2021/1165 of 15 July 2021 authorising certain products and substances for use in organic production and establishing their lists (Text with EEA relevance). https://eur-lex.europa.eu/eli/reg_impl/2021/1165/oj

Commission Regulation (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control. https://eur-lex.europa.eu/eli/reg/2008/889/oj

Common Agricultural Policy (CAP) 2023-2027 for Flanders, Belgium. https://lv.vlaanderen.be/subsidies/perceelsgebonden/gemeenschappelijk-landbouwbeleid-2023-2027

Council Directive 89/107/EEC of 21 December 1988 on the approximation of the laws of the Member States concerning food additives authorized for use in foodstuffs intended for human consumption. http://data.europa.eu/eli/dir/1989/107/oj

Council Regulation (EEC) No. 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91. http://data.europa.eu/eli/reg/2007/834/oj

Decret 153/2019, de 3 de juliol, de gestió de la fertilització del sòl i de les dejeccions ramaderes i d'aprovació del programa d'actuació a les zones vulnerables en relació amb la contaminació per nitrats que procedeixen de fonts agràries. https://residus.gencat.cat/web/.content/home/consultes_i_tramits/normativa/normativa_catalana_en_materia_de_residus/decret_153_2019.pdf

Decret Llei 17/2021, de 20 de juliol, pel qual s'adopten mesures extraordinàries de limitació a la densitat ramadera https://portaldogc.gencat.cat/utilsEADOP/PDF/8462/1863283.pdf

Decreto Interministeriale n. 5046 del 25 Febbraio 2016 "Criteri e norme tecniche generali per la disciplina regionale dell'utilizzazione agronomica degli effluenti di allevamento e delle acque reflue di cui all'art. 112 del Decreto legislativo 3 aprile 2006 n. 152, nonché per la produzione e l'utilizzazione agronomica del digestato di cui all'art. 52, comma 2-bis del decreto legge 22 giugno 2012, n. 83, convertito in legge 7 agosto 2012 n. 134. https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/9780

Decreto legislativo 29 aprile 2010, n.75 - Riordino e revisione della disciplina in materia di fertilizzanti, a norma dell'articolo 13 della legge 7 luglio 2009, n. 88. https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/10087

Ordre ACC/25/2023, de 10 de febrer, per la qual es modifiquen els annexos 2, 3 i 8 del Decret 153/2019, de 3 de juliol, de gestió de la fertilització del sòl i de les dejeccions ramaderes i d'aprovació del programa d'actuació a les zones vulnerables en relació amb la contaminació per nitrats que procedeixen de fonts agràries https://portaldogc.gencat.cat/utilsEADOP/PDF/8855/1956784.pdf

Ordre ARP/225/2019, de 16 de desembre, per la qual s'estableix una metodologia de càlcul del nitrogen de les dejeccions ramaderes de bestiar porcí https://portaldogc.gencat.cat/utilsEADOP/PDF/8028/1776580.pdf

Ordre TES/80/2021, de 9 d'abril, per la qual es revisen les zones vulnerables en relació amb la contaminació per nitrats procedents de fonts agràries i s'apliquen les mesures del programa d'actuació a les zones vulnerables. https://portaldogc.gencat.cat/utilsEADOP/PDF/8386/1845782.pdf

Real Decreto 1051/2022, de 27 de diciembre, por el que se establecen normas para la nutrición sostenible en los suelos agrarios. https://www.boe.es/boe/dias/2022/12/29/pdfs/BOE-A-2022-23052.pdf

Reference Document on Best Available Techniques on Emissions from Storage 2006, Retrieved from https://eippcb.jrc.ec.europa.eu/sites/default/files/2022-03/efs_bref_0706_0.pdf

Regolamento Regione Emilia-Romagna 15 Dicembre 2017, N.3 - Regolamento regionale in materia di utilizzazione agronomica degli effluenti di allevamento, del digestato e delle acque reflue. https://ambiente.regione.emilia-romagna.it/it/acque/approfondimenti/normativa/regolamento-di-giunta-regionale-n-3-del-15-dicembre-2017-201cregolamento-regionale-in-materia-di-utilizzazione-agronomica-degli-effluenti-di-allevamento-del-digestato-e-delle-acque-reflue201d

Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed. http://data.europa.eu/eli/reg/2003/1829/oj

Regulation (EC) No 183/2005 of the European Parliament and of the Council of 12 January 2005 laying down requirements for feed hygiene. Retrieved from https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32005R0183

Regulation (EC) No 1831/2003 of the European Parliament and of the Council of 22 September 2003 on additives for use in animal nutrition (Text with EEA relevance). http://data.europa.eu/eli/reg/2003/1831/oj

Regulation (EC) No 258/97 of the European Parliament and of the Council of 27 January 1997 concerning novel foods and novel food ingredients. http://data.europa.eu/eli/reg/1997/258/oj

Regulation (EC) No 767/2009 of the European Parliament and of the council of 13 july 2009 on the placing on the market and use of feed. http://data.europa.eu/eli/reg/2009/767/oj

Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs. http://data.europa.eu/eli/reg/2004/852/oj

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003 (Text with EEA relevance). http://data.europa.eu/eli/reg/2019/1009/oj

Relazione 2021 sul piano strategico della PAC (Italy CAP Strategic Plan 2023-2027). https://www.reterurale.it/downloads/Piano_Strategico_Nazionale_PAC_31-12-2021.pdf

Resolució ARP/1860/2020, de 23 de juliol, per la qual s'aproven els criteris tècnics per a l'elaboració dels plans de gestió de dejeccions ramaderes per personal tècnic habilitat https://portaldogc.gencat.cat/utilsEADOP/PDF/8189/1807167.pdf

VLAREM II Besluit van de Vlaamse regering van 1 juni 1995 houdende algemene en sectorale bepalingen inzake milieuhygiëne. https://navigator.emis.vito.be/detail?woId=25043&woLang=en

Annex 1 Additional remarks for the EU/regional regulations affecting the activities of the engaged OGs

A1.1. Livestock Farming

EU level

The EU has defined with **Action Plan 'Towards Zero Pollution for Air, Water and Soil' COM/2021/400** and the **Farm to Fork Strategy COM/2020/381** some precise objectives for the livestock sector, in particular reduction of environmental impact, improvement of animal welfare and reduction of the use of drugs, with particular reference to antimicrobials. **Regulation 2021/2115 (EU)** of the European parliament and council dictates the objectives of future agricultural policy, and consequently livestock farming, at the European level.

The European regulations that apply to livestock farms concerning water and soil aspects are the **European Council Directive 91/676/EEC**, better known as the **Nitrates Directive**, of December 12, 1991, issued to prevent water pollution from nitrates from livestock sources, and **Directive 2000/60/EC (Water Framework Directive).**

Directive 2016/2284/EU known as the new **National Emission Ceiling Directive**, and **Directive 2010/75/EU** known as the **Industrial Emission Directive (IED)** regulate emissions from livestock farms and the application of good practices at every stage of livestock farming from housing to spreading, storage to treatments.

The main legislative instrument (basic act) regulating organic production, is **Regulation (EU) No 2018/848** of 30 May 2018 on organic production and labelling of organic products which entered into force on 01 January 2022. This includes both organic plant and livestock production which are often intrinsically interlinked. **EU Regulation No 2018/848** repealed and replaced **Council Regulation No 834/2007** and **Commission Regulation (EC) No 889/2008**. The new regulation provides for transitional periods for the implementation of certain new provisions, in particular on trade with third countries where previous legal provisions will apply for a limited period. The basic act is supplemented by a series of secondary legal acts, comprising both delegated and implementing regulations, which address specific organic production and labelling. For example, **Implementing Regulation (EU) 2021/1165** of 15 July 2021 authorising certain products and substances for use in organic production and establishing their lists, sets out the products and substances which can be used in organic production. The Organic Regulations are often transposed into existing national standards.

Catalonia, Spain

In the Catalan region, there are several decrets in livestock manure management:

(1) **Decree 153/2019 Moratorium** that prevents expanding and building of farms in 4 years in vulnerable areas (Decree 17/2021);

(2) **Decree 153/2019 Annual Nitrogen Declaration** related to the origin and destination of livestock manure and other nitrogen fertilisers. It must be submitted by the owners of livestock holdings, agricultural holdings and livestock waste management centres.

The **Decree 153/2019 by Generalitat de Catalunya** is the actual and more important legislation in Catalonia, that regulates the manure management, its storage and its spread on the crops. It regulates those areas identified as vulnerable, so the farmers can spread less amount of nitrogen. This decree establishes that every farm must have a "livestock manure management plan" and a "book of fertilisers management" with information on (1) the amount of manure from ponds (storage systems), (2) characteristics of used fertilisations, and (3) information of the storage systems. In addition, the **Decree 2010/75/EU** about industrial emissions, establishes the "Best Available Techniques (BAT)" as the most environmentally respectful way to take an activity. These are rules that will take part in the management of manure.

In addition, in reference to the approval of Decree 153/2019, a series of measures and

amendments have also been approved:

- ORDINANCE ARP/225/2019, establishing a methodology for the calculation of nitrogen from pig manure.
- ORDINANCE TES/80/2021, revising the vulnerable zones in relation to nitrate pollution from agricultural sources and implementing the measures of the action program in vulnerable zones.
- DECREE 17/2021, which adopts extraordinary measures to limit stocking densities.
- ORDINANCE ACC/25/2023, amending Annexes 2, 3 and 8 of Decree 153/2019, of July 3, on the management of soil fertilization and livestock manure and approval of the action program in vulnerable areas in relation to nitrate pollution from agricultural sources.

Emilia-Romagna, Italy

The Italian regions promote livestock-related mitigation measures through the **Rural Development Program** under the **Common Agricultural Policy (CAP 2023-2027)**, financed by the European Agricultural Fund for Rural Development under Regulation (EU) 1305/2013 and Regulation (EC) 1698/2005. At the national level the **Nitrate Action Programs (NAPs)** with the issuance of the **Ministerial Decree on February 25, 2016** "Criteria and general technical standards for the regional regulation of the agronomic use of livestock manure and wastewater, as well as for the production and agronomic use of digestate" which in turn originated regional regulations (regulations periodically revised). The regional regulations of the Emilia-Romagna Region (the region that hosts the OGs) are regulated by **Regional Council Regulation No. 3** of December 15, 2017, "Regional regulations on the agronomic utilization of livestock manure, digestate, and wastewater" also known as the "effluent and digestate regulations, " which updated previous regulations.
Another important Italian regulation is **Legislative Decree 2006 No. 152** (Testo Unico sull'Ambiente), which is the current national regulatory reference for the environment and pollution.

The regional reference regulations apply to livestock farms concerning air aspects are the **Po River Basin Agreement (PAIR 2020 and PAIR 2030)** for the implementation of joint measures to improve air quality, and the **Emilia Romagna Air Plan** with the "Guidelines for the reduction of atmospheric emissions from agricultural and livestock activities" for the entire Po River Basin (Piedmont, Lombardy, Emilia Romagna and Veneto). Italian National **Legislative Decree No. 81** of 5/30/2018 which regulates the control of ammonia emissions and **Decree No. 46** of 4/03/2014 regulates emissions from livestock farms and the application of good practices at every stage of livestock farming from housing to spreading, storage to treatments. For now, only the intensive rearing of pig and poultry are subject to them but with the current revision, cattle farms will also be subject to them in relation to thresholds (LSU - LiveStock Unit).

Flanders, Belgium

The **Common Agricultural Policy (CAP) 2023-2027 for Flanders** entered into force on 1 January 2023, aiming to support farmers in their search for sustainable opportunities for their businesses and give them opportunities to invest, innovate and develop resilient and future-oriented farming income models. Flanders also dedicates specific support to certain groups such as young farmers, farmers who make additional efforts for the environment and climate and the suckle cow sector (suckle cows are kept for producing high-quality meat). Among the 20 eco-schemes and agro-environment-climate measures, 3 are animal-related, specifying the reduction of antibiotic use, preservation of local breeds and supply of feed with a methane-reducing effect in cattle by adding an additive or feed material.

Ireland

Ireland's **Nitrate Action Program** (NAP) is given effect by the EC Regulations 2022 (S.I. No. 113 and 393 of 2022) "Good Agricultural Practice for Protection of Waters" and is designed to prevent the pollution of surface waters and ground water from agricultural sources and to protect and improve water quality. The 5th NAP of Ireland came into operation in 2022 and will be reviewed in 2025. The principal elements of the NAP include limits on farm stocking rates, legal maxima for

nitrogen and phosphorus application rates, prohibited spreading periods preventing the application of organic and chemical fertilisers during more environmentally vulnerable times of the year, minimum storage requirements for livestock manures and set-back distances from waters.

The development of organic livestock production is informed by the **Irish Organic Food and Farming Standards** which implement the requirements of EU Regulations on organic production as well as additional national standards. This sets out specific organic production rules for livestock and crop production. This includes for example maintaining and increasing the fertility and biological activity of the soil, limits on stocking densities and the prohibition of mineral nitrogen fertilisers. The use of livestock manure also influences organic crop production (see sections below.

A1.2. Storage Systems

EU level

The **Commission Regulation (EC) No 889/2008** laying down detailed rules for the implementation of **Council Regulation (EC) No 834/2007** on livestock production also regulates the definition of a production unit which includes premises for the storage of livestock products.

Catalonia, Spain

The Spanish Government in the **Royal Decree 306/2020** establishes the basic rules for livestock management of intensive pig farms.

For example, for existing farms with a productive capacity of 120 UGM (in accordance with the equivalences established for each type of livestock): Empty the pits 2 times a week; Empty the pits once a month + cover the pool with a technique that reduces ammonia emissions by at least 40%; Empty the pits once a month + another BAT that allows at least a 30% reduction in ammonia emissions.

Some different laws and decrees legislate the storage systems depending on the animal manure comes from. Poultry manure must be stored over all their reproductive circle; cow manure and slurry must be stored for at least 4 months; sheep and goat manure can be stored on the farm as long as the floor is waterproof and watertight. The characteristics of every storage system must be included in the "livestock manure management plan".

Article 116 of the Statute of Autonomy of Catalonia establishes that the Generalitat has exclusive jurisdiction over agriculture and stockbreeding, which includes, among others, the regulation of production processes, farms, agricultural structures and their legal regime.

Decree 153/2019 of the Generalitat de Catalunya is the current and most important legislation that regulates manure storage. Livestock manure management centres may have storage facilities containing manure from different livestock farms, as long as they are intended for agricultural application. These facilities must meet certain requirements and, in the case of liquid manure, must have a cover, which may be flexible or floating, as defined by the best available techniques. In addition, they must respect the minimum distances established and are subject to an environmental intervention regime, subject to a report from the department responsible for livestock farming. Storage facilities external to the buildings must undergo periodic verification of their impermeability and structural condition, which must be carried out by a competent technical person. The result of the verification must be documented and submitted to the competent agriculture and livestock department.

Livestock farms must have individual storage facilities for livestock manure that are impermeable, prevent leaching and do not affect the public water domain. In semi-intensive farms, the storage volume is reduced in proportion to the grazing time, while in fully extensive farms no storage system is required. In some situations, storage on the floor of the buildings is permitted, provided that it is impermeable. The facilities must be maintained in good condition, and leachates and effluents can be incorporated into the storage. In addition, environmental inspections and controls are carried

out, and external facilities must be checked periodically.

Emilia-Romagna, Italy

The storage of livestock manure in Italy is regulated by the **National Decree of February 25, 2016**, the **Regional Regulation of the Emilia-Romagna Region December 15, 2017, No. 3**, and the **Emilia-Romagna Regional Integrated Air Plan (PAIR 2020)**, which stipulates the obligation from January 1, 2020, that the mandatory storage capacity as below:

a) for slurry:

- covering of manure storage tanks or construction of tanks with an area/volume ratio less than or equal to 0.2 m^2/m^3;
- on new farms, it is prohibited to store slurry in lagoons;
- minimize the frequency of handling and introduce slurry below the free surface level;
- natural crust formation or floating covers or other techniques that reduce ammonia emissions by at least 40%;
- at least three sequential storage facilities must be provided for slurry stabilization if the livestock farm produces > 6,000 kg N/y;
- The maximum volume of each new slurry storage may not exceed 6,000 m^3.

b) for solid manure: a concrete storage slab with leachate collection

c) for storage of materials such as struvite, the guidance found in IED Directive 2010/75/EU has to be followed and specifications contained in chapters 3 and 4 of Bref Emissions from Storage 2006 should be considered.

The mandatory storage period is summarized in Table 13:

Table A1 Storage period requirements for different manure types in NVZs and non-NVZs.*

Manure Type	Non-NVZs	NVZs
Solid Manure	90 days	90 days
Slurry With Permanent Crops	90 days	120 days
Slurry Without Permanent Crops	120 days	180 days
Digestate	180 days	180 days

* NVZs: Nitrate-vulnerable zones

Flanders, Belgium

The Flemish government has regulations related to the storage of agricultural products, such as the **Flemish Decree of 6 February 1991** on the prevention and management of waste materials. The storage of manure-derived ammonium salts (promoted as RENURE products) also needs to follow the **EU National Emissions Ceilings Directives (2001/81/EC)** regarding the potential risk of emissions including NH_3 and NO_x.

In Flanders, storage sites for animal manure/digestate must meet various conditions listed in the **Decree of the Flemish Government of 1 June 1995** (**VLAREM II**) concerning General and Sectoral provisions relating to Environmental Safety, to limit odour nuisance and ammonia emissions, for example, in Subsection 5.17.4.3. Furthermore, storage of dangerous liquids in aboveground containers requires that all storage sites are adequately cleaned and removed without prejudice to the order of the Government of Flanders of 17 February 2012 adopting the Flemish

regulations on the sustainable storage of animal by-products.

Ireland

Under **Ireland's NAP** (5th programme implementing the Nitrates Directive - 91/676/EEC) all organic fertilisers (e.g., slurry, farmyard manure, soil water, spent mushroom compost etc.) produced on-farm must be stored in a way that will prevent run-off or leaching. Solid organic materials such as farmyard manure can only be stored in a field outside the prohibited spreading period (mid-September to the end of January) depending on the farm location or if adverse weather conditions could lead to the risk of run-off or leaching.

A1.3. Fertiliser Production

EU level

Regulation (EU) 2019/1009 on Fertilising Products (FPR) lays down rules on the making available on the market of EU fertilising products. It came into effect in 2022 and it includes fertilising products which are not currently covered by harmonization rules, such as organic and organo-mineral fertilisers, soil improvers, inhibitors, plant bio-stimulants, growing media or blends. It introduces the CE marking of EU fertilising products for the first time. It harmonizes EU rules for products derived from recycled or organic materials and by-products and provides rules to recover nutrients into materials for use as fertilising products. It lays down common rules on safety, quality and labelling requirements for fertilising products. The FPR introduces limits for contaminants and pathogens to guarantee a high level of soil protection and reduce health and environmental risks. More detailed labelling requirements are laid down to improve the information that is available to farmers and fertiliser users. It puts in place a new conformity assessment system to provide quality assurance for fertiliser products that are available on the market.

For European marketing, it must meet the characteristics contained in the new Regulation on Fertilisers (EU Regulation 2019/1009), in particular, to be a simple liquid inorganic fertiliser based on macro-elements-Category PFC 1(C)(I) (b)(i) as defined in Annex 1, Part II.

Fertilisers for use in organic production are permitted under Commission Implementing Regulation (EU) 2021/1165 based on Regulation EU 848/2021. New substances may be permitted based on examination and recommendations from the EC Expert Group for Technical Advice on Organic Production (EGTOP). For example, recovered struvite and precipitated phosphate salts, were recently added under Commission Implementing Regulation (EU) 2023/121 amending Regulation (EU) 2021/1165 (Annex II).

Catalonia, Spain

The largest part of the products obtained from the treatment of the livestock are the solid and liquid fractions obtained through physicochemical processes for the separation of manure, together with the compost, the digestate and the effluent of a nitrification-denitrification coming from of the biological processes of the treatment. **Decree 153/2019** classifies the wastes and the obtained products as Fertilisers of Type 1: They contain organic nitrogen and a high C/N ratio (greater than 10) and most of the nitrogen they contain is slow mineralization. Livestock droppings associated with materials hard-to-degradable carbonaceous plants (for example, chicken coops with sawdust), despite having a C/N ratio greater than 10, are considered Type 2 fertilisers: They contain organic nitrogen and a low C/N ratio (less than 10) or, if is higher, they contain carbonaceous materials that are difficult to degrade. Most of the nitrogen they contain is mineral or easily mineralizable.

It is important to take into account Royal Decree 999/2017, of 24 November, amending Royal Decree 506/2013, of 28 June, on fertiliser products when the final objective of the treatment is to obtain an approved fertiliser and the **SANDACH regulations (Regulation CE no. 1069/2009**, of October 21) on the use of animal by-products and non-intended for human consumption. The regulatory framework for treatments within the agricultural framework in the Catalan area is limited by Decree 153/2019 for a part, but the Execution Decision (EU) 2017/302 also affects entirely the farms included in Annex I.1 of Law 20/2009, of December 4, on prevention and environmental control of the activities, and partially to a large part of the rest of the pig and poultry farms in

accordance with the state regulations for the organization of these sectors.

In addition, the obligations of how to spread the manure to the soil, are regulated by the Common agricultural policy and different national laws "real decrees" to contribute to the reduction of ammonia emissions. In Catalonia, it has been considered to facilitate a gradual adaptation of farms to more efficient slurry application systems, establishing some exceptions (for example, having a progressive adaptation schedule).

Emilia-Romagna, Italy

At the Italian level, there is a distinction between fertiliser matrices such as manure, digestate and sludge and commercial fertilisers.

Fertiliser matrices such as manure and digestate are regulated by the **Nitrates Directive 91/676/EEC** and consequently at the Italian level by the **Ministerial Decree of February 25, 2016** "Criteria and general technical standards for the regional regulation of the agronomic use of livestock manure and wastewater, as well as for the production and agronomic use of digestate" in Annex V in Part A, where nitrogenous fertiliser is defined as "any substance containing one or more nitrogen compounds applied to the soil to promote crop growth. This includes livestock effluents as per Article 112 of **Legislative Decree 152/06**, wastewater from the agro-food sector as per Article 101, paragraph 7, letters a), b), c) of **Legislative Decree 152/06**, digestate regulated by the aforementioned decree, sludge regulated by **Legislative Decree 99/92**.

At the national level for commercial fertilisers, the reference law is **Legislative Decree No. 75** of April 29, 2010, "Reorganization and revision of the regulations on fertilisers, according to Article 13 of Law No. 88 of July 7, 2009."

These commercial fertiliser products if they fall within the limits and characteristics provided by the decree are no longer regulated by the Nitrates Directive and can be applied according to crop needs by going over 170 kg N/ha and are no longer considered manure even if they are derived from the manure or digestate treatment. It applies to:

(a) products placed on the market as EC fertilisers, as defined by Regulation (EC) No. 2003/2003;
(b) domestic fertilisers, soil conditioners, correctives and related products placed on the market as defined below, described and classified in Annexes 1, 2, 3, 4, 5, 6 and 13.

In Italian regulation "Fertilisers" means the following defined products and materials:

(a) "fertilisers" means products whose main function is to provide nutrients to plants; fertilisers are divided into "EC fertilisers" and "national fertilisers," the types and characteristics of which are listed in Regulation (EC) No. 2003/2003 and Annex 1, respectively:

(f) "mineral fertiliser" means a fertiliser in which the declared nutrients are present in the form of mineral compounds obtained by extraction or industrial physical and chemical processes;

(p) "organic fertiliser" means a fertiliser derived from organic materials of animal or plant origin, consisting of organic compounds to which the main elements of fertility are chemically bound in organic form or otherwise form an integral part of the matrix;

(q) "organic-mineral fertiliser" means a fertiliser obtained by reaction or mixture of one or more organic fertilisers or one or more organic matrices, authorized for this purpose in Annex 5, or both, with one or more mineral fertilisers;

(z) "soil conditioners" means the materials to be added to the soil in situ, primarily to preserve or improve its physical or chemical characteristics or biological activity, severally or together, the types and characteristics of which are given in Annex 2;

(aa) "correctives" means the materials to be added to the soil in situ primarily to modify and improve abnormal chemical properties of the soil dependent on reaction, salinity, sodium content, the types and characteristics of which are given in Annex 3.

In Italy at the regulatory level to date, Struvite is not specifically defined but can be included as a

commercial fertiliser product if it complies with Decree of April 29, 2010. N.75 “Reorganization and revision of the regulations on fertilizers”(**Legislative Decress 75/2010**) under the heading "Mixed phosphate salts or phosphate scraps" classified among "solid phosphate fertilisers" (product no. 5 of point 2.3 of Annex 1): A product obtained chemically or by mixing or precipitation and containing one or more types of phosphate salts. Phosphorus evaluated as P_2O_5 soluble in mineral acids must be > 10% (w/w). The declaration of the various phosphate components (e.g., normal superphosphate, deforestation slag, soft rock phosphate, etc.) in descending order of the amount present in the fertiliser is mandatory. The term "low titer" is mandatory for titers in a total P_2O_5 less than 12%.

Delegated Regulation (EU) 2021/2086 of July 5, 2021, amended Annexes II and IV of Regulation (EU) 2019/1009 of June 5, 2019, and establishes the rules concerning the making available on the market of fertiliser products - to add precipitates of phosphate salts (of which struvite is one) and their derivatives as a category of constituent materials.

in addition, for fertiliser products such as ammonium sulphate,

In Italy ammonium sulphate to be defined as a commercial fertiliser product must comply with **Legislative Decress 75/2010** "suspension of ammonium sulphate" classified among "fluid nitrogenous fertilisers" (product No. 3 of point 2.2 of Annex 1): Obtained by stripping process or from air industrial cleaning system and ammonia absorption with sulfuric acid.

Definition: Chemically obtained liquid product containing ammonium sulfate with ammonia nitrogen content > 6% N (w7w). The term "low titer" is mandatory for ammonia nitrogen titers less than 10% Ammonium nitrogen. Optional additional indications: sulfur evaluated as SO_3

Any organic matter present must be biodegradable.

It is mandatory to specify the process from which the product is derived.

Flanders, Belgium

A fertiliser, soil improver, growing media, sewage sludge or related products can only be marketed in Belgium if the fertilising product: complies with the **Fertilizing Product Regulation (EU) No 2019/1009** or is listed in Annex I of the **Royal Decree of 28 January 2013**. The Fertilizing Product Regulation 2019/1009 establishes a common legal framework for fertilizing products in the form of a toolbox of measures, with different pathways depending on the product category and its content. The new legislation in force since June 2022 regulates both the end characteristics (contaminants, nutrient levels – though less stringent than today) as well as the input materials contained in every fertilizing product (e.g. REACH registration). However, the waste status of the recycling-derived fertilizing (RDF) materials proves to be problematic because of the differences in national approaches to the waste, end-of-waste, and by-product status in the different EU countries.

Ireland

Organic fertilisers must be appropriate for use in organic farming. This is based on a positive list, with restrictions set out in the **Irish Organic Food and Farming Standards** aligned with the **EU Organic Production Regulation (Regulation (EU) No. 2018/848**.

A1.4. Processing Technologies

EU level

The Regulation (EC) No 1069/2009 (Animal By-Product Regulation) aims to prevent risks arising from animal by-products not intended for human consumption and to ensure a high level of protection of animals and public health during further usage and disposal of such materials. Some animal by-products, such as manure, have a legal status of waste and should therefore follow the provisions laid down in the Directive 2008/98/EC (Waste Framework Directive). The standard processing method that such materials must undergo includes a heat treatment process of at least 70 °C for at least 60 minutes and they shall have been subjected to a reduction in spore-forming bacteria and toxin formation, where they are identified as a relevant hazard. The European Commission intends to prepare an addition to the regulation on animal by-products (Regulation

(EC) No. 1069/2009) so that products from manure processing (such as digestate) would have an end point, and can thus in the future fall under the Fertilizing Product Regulation.

If the livestock farm, according to Industrial Emissions Directive (IED) regulations, is above animal thresholds and requires Integrated Environmental Authorization (IEA), the treatment technologies must also comply with the requirements dictated by IED 2010/75/EU, the Best Available Techniques Reference Document (BREF) for the Intensive Rearing of Poultry or Pigs, and to be subject to the monitoring control if they are considered emission points.

Catalonia, Spain

A processing technology for livestock manure is the practice that is carried out on a livestock farm individually, which changes the physical-chemical conditions of the manure with the option of adding other organic materials (according to **state law 22/2011 of July 28 of Residues and contaminated soils**). Not all manure treatment technologies have the same degree of development and implementation. In accordance with the criteria established by the committee of experts in livestock manure treatment systems (GETDR coordinated by the Department of Climate Action, Food and Rural Agenda (DACC)), a consolidated technology for the treatment of livestock manure is a technology or combination of treatment processes that have been sufficiently verified under field conditions and that is viable at a technical, economic and environmental level. Currently the DACC considers solid-liquid separation, composting, anaerobic digestion, solar drying and nitrification-denitrification treatments as consolidated. Most of these technologies are in what is known as the BATs, as established in point 4.7 of the Executive Decision (EU) 2017/302.

Emilia-Romagna, Italy

Effluent treatment is regulated at the national level by the national Decree 'effluents and digestate' (M**inisterial decree February 25, 2016**) and at the regional level of Emilia Romagna by the **Regional Regulation December 15, 2017, no. 3** "Regional Regulation on the agronomic use of livestock effluents, digestate and wastewater" where treatment means any operation carried out on materials and substances within the scope of this topic (manure and digestate), including storage and anaerobic digestion, that is suitable to modify their agronomic characteristics by enhancing their effects ... or reducing sanitary and environmental risks. In addition, the regulations promote treatments to improve the management of storage and spreading.

The regulations also report the average efficiencies of the various treatments, the flows they generate, and the nitrogen removal or recovery efficiencies to be considered at the level of drafting livestock farm PUAs (Agronomic Effluent Utilization Plan for the Livestock Farm).

Flanders, Belgium

On 10 March 2023, the Flemish Government reached an agreement on the Programmatic Approach to Nitrogen. The new measures from that agreement are not final until they have been laid down in a decree. Until then, transitional measures will apply to new permit applications. This causes difficulties for farmers that want to proceed with their investments.

For microalgae cultivation, as the culture is categorized as aquaculture, Flemish legislation on the water is very important. In Flanders, all permits affecting the water system are subjected to the 'watertoets'. This is an online tool by which the authorities who decide on a permit assess the impact of the facility on the water system. New rules for the **Flemish Environmental Permitting Regulations (VLAREM)** regarding the discharge of wastewater effluent into water bodies in Flanders will mean more strict limits on discharges. Currently three types of permits, based on an assessment of environmental risk, are employed in the Flanders region. Category 3 is very low risk, and Category 1 is the highest. For Class 1 installations, operators must apply to the Provincial Environmental Licenses Division Committee, which is obliged to either grant or deny a permit within 4-5 months. Applications for Class 2 and 3 facilities should be directed to the municipal authorities where the development will take place. The Act of 26 March 1971 on the protection of surface waters against pollution, following the first version of 1 January 1989 and updated to 12 September 2003. It is composed of 50 items divided into three chapters. The initial section defines certain terms, such as, "public water system", "coastal", "pollution", etc. General Provisions 1) specific for

the Flemish Region on the non-priority public sewer provisions (and small sewage treatment facilities) 2) Special provisions for the Flemish Region in pollution charges of water.

Ireland

Novel fertilisers obtained by stripping of ammonia e.g., methods using an 'acid air scrubber' and 'bio trickling filter' are not permitted for use in organic farming owing to their high solubility and the principle of feeding the soil and not the plants whereby emphasis of soil fertility is on the biological aspects of fertility not solely nutrient supply. It is also considered that biological methods should be favoured over chemical ones. e.g., using air scrubbers with sulfuric acid.

A1.5. Transport

EU level

The **Waste Shipment Regulations (96/61/EC)** and **Hazardous waste directive (91/689/EEC)** may apply in transporting animal feeds, veterinary biologicals, and other products designated for non-human use. Importers could be asked to prove product and operator traceability by providing details such as a sanitary certificate and valid certification of operators with verification of addresses and names.

Catalonia, Spain

In the **"livestock manure management plan" Decree 153/2019**, it indicated that every farm must include the correct management of storage and transport of manure. It must be carried out in compliance with health. The transport equipment must have a GPS and an electronic device for the transmission of data about the characteristics of the manure.

Decree 144/2017, of October 3, which regulates the handling and use of livestock manure: This decree establishes the requirements and procedures for the handling, transport, storage, and use of livestock manure in Catalonia. It aims to prevent environmental pollution and promote proper manure management practices.

Order ARP/135/2018, of June 4 which regulates the handing and use of livestock manure: This order sets out the specific requirements and conditions for the transport of livestock manure in Catalonia. It covers aspects such as containers, labeling, documentation, and hygiene measures during transportation.

Law 5/2019, of 15 March, on the promotion of circular economy: This law establishes the framework for promoting a circular economy in Catalonia, including the reduction of waste and the promotion of sustainable resource use. It also establishes the obligation to use manure as a fertilizer, and encourages the transport of manure from livestock farms to crop fields.

Decree 90/2019, of 25 June, on the management of livestock manure: This decree establishes the requirements for the management of livestock manure, including the transport of manure from livestock farms to crop fields. It requires that manure be transported in a way that minimizes the risk of environmental contamination, and that the transport be carried out by authorized companies.

Order AAM/104/2019, of 9 April, on the authorization of companies for the transport of livestock manure: This order establishes the requirements for companies that transport livestock manure, including the need to have appropriate equipment and to comply with environmental regulations. It also establishes the procedure for obtaining authorization to transport livestock manure.

Emilia-Romagna, Italy

If the product from the treatments is a fertiliser that complies with the national law for commercial fertilisers and the producer is registered in the national register of fertiliser producers, transportation is governed by the Italian legislation **Legislative Decree No. 75 of April 29, 2010,** "Reorganization and revision of the regulations on fertilisers, according to Article 13 of Law No. 88 of July 7, 2009" and the fertiliser travels with a sales document and invoice as fertilisers.

If, on the other hand, the product of the treatments is non-compliant or it is manure, the reference

regulation for transportation remains the **Ministerial Decree Feb. 25, 2016** (livestock manure) "Criteria and general technical standards for the regional regulation of the agronomic use of livestock manure and wastewater, as well as for the production and agronomic use of digestate" and the **Regional Regulation Dec. 15, 2017, No. 3** (Nitrate Action Program) that provide:

- that farms make mandatory written communications if in non-NVZ farms distributing > 3,000 kg N/y, if in NVZ farms distributing > 1,000 kg N/y or biogas plant;
- that farms with the above nitrogen allocations prepare and communicate to the region and controlling agencies an Agronomic Utilization Plan (PUA) and that, unless there are substantial changes that require it to be amended or updated, the Agronomic Utilization Plan has a duration of 5 years. The transferring farm must fill in its PUA the quantities of nitrogen and manure transferred, the mode of transport and the recipient farmer. In turn, the farm or livestock receiving these nitrogen shares must declare them in its PUA. Not only that, but all agronomic application operations with timing and doses also falling within the farm must be declared in the PUAs of the farm.

Flanders, Belgium

Many conditions apply to the import and export of animal manure and other fertilisers to or from Flanders. For example, an import or export contract must be submitted to the **Vlaamse Land Maatschappij (VLM)** Mestbank. According to European regulations (EC) no. 1069/2009 and (EU) no. 142/2011, a health declaration or trade document must be present on top of the manure disposal document for every transport to or from other member states. In addition, every cross-border transport of unprocessed manure must be reported online in TRACES[2].

When a farmer deposits digestate from proprietary streams on his own land, no transport documents are required.

Responsibilities for environmental protection in Belgium are allocated to the regional level (Brussels, Wallonia and Flanders), so separate legal and permitting systems exist in these jurisdictions. The **Flemish Climate Policy Plan (VKP)** 2013-2020 consists of an overall framework and two separate but closely related sections: the **Flemish Mitigation Plan (VMP)** and the **Flemish Adaptation Plan (VAP)**. The purpose of the VMP is to reduce emissions of greenhouse gasses in Flanders between 2013 and 2020 as a means of combatting climate change. The purpose of the VAP is to understand the Flemish vulnerability to climate change and then improve its ability to defend against its effects. On 12 May 2023, the Flemish Government approved a new **Flemish Energy and Climate Plan (VEKP)**. With this plan, efforts in the transport, buildings, agriculture, industry and the waste sector will be improved. The ambition in the new VEKP 2021-2030 with regard to the reduction of greenhouse gas emissions is increased to -40% by 2030 (compared to 2005).

Ireland

Under the Nitrates Regulations farmers are obliged to farm within the limit of 170 kg of nitrogen per hectare (or 250kg N/ha for those who hold an approved derogation). One of the measures farmers can take to reduce nitrate levels is to export slurry to another holding, which can be recorded on an online system.

A1.6. Application

[2] The European Commission's online platform for sanitary and phytosanitary certification required for the importation of animals, animal products, food and feed of non-animal origin and plants into the European Union, and the intra-EU trade and EU exports of animals and certain animal products.

EU level

The existing EU legislation imposes a protective framework with standards for all water bodies in EU countries and addresses specific pollution sources, including agricultural pollution. The three main directives involved are the **Water Framework Directive (2000/60/EC)** (on water resources management), the **Nitrates Directive (91/676/EEC)** and the **Floods Directive (2007/60/EC)**.

The **Emissions Directive (Directive (EU) 2016/2284)** regulates national emission ceilings for certain atmospheric pollutants.

The Nitrates Directive aims at protecting water from diffuse pollution (nitrates and eutrophication) from agricultural activity, and by extension to control the environmental problems because of nitrogen (N) losses arising from intensive livestock production. To this end, the use of manure, including processed manure, is restricted up to a maximum of 170 kg of N per hectare per year (annexe III, article 2 of the Nitrates Directive) in areas where the NAP applies.

When using the microalgae biomass as feed or food, the following regulations apply:

- Regulation (EC) 258/97 on novel foods and ingredients;
- Regulation (EC) 767/2009 the marketing of feed materials and compound feed;
- Directive 89/107/EEC food additives;
- Regulation (EC) 1831/2003 on the authorization, supervision and labelling of feed additives;
- Regulation (EC) No 852/2004 food hygiene;
- Regulation 183/2005 feed hygiene regulation;
- Regulation 1829/2003 on genetically modified organisms (GMOs) for food and feed.

To market a novel food or ingredient, companies must apply to an EU country authority for authorization, presenting the scientific information and safety assessment report. The competent authority decides if additional assessment is necessary. A novel food or ingredient may be marketed through a simplified procedure called notification. The company notifies the Commission about their marketing of a novel food or ingredient based on the opinion of a food assessment body that has established "substantial equivalence".

Catalonia, Spain

Decree 153/2019 on the management of soil fertilisation and livestock manure prohibits the application of slurries and other liquid livestock manure in vain or fan. The main objective is to reduce ammonia emissions. Thus, allowed application systems include hanging hoses or tubes (applied on the surface) and injectors or burials (applied in depth).

Another decree related to the reduction of groundwater pollution is Decree 153/2019 stating the obligation to have a conductivity meter (or similar equipment) permanently installed in all cisterns. The variable concentration of nitrates in the slurry requires a conductivity meter to estimate this concentration. It also allows adjusting the amount of nitrate allowed per agricultural area (170 kg N/ha) as limited by the EU Nitrates Directive (Council Directive 91/676/EEC).

Emilia-Romagna, Italy

The Italian NAP, **Ministerial Decree February 25, 2016**, and the regional regulations of the Emilia-Romagna Region No. 3 of December 15, 2017, regulate manure and digestate applications from the perspective of impacts on soil and water.

In addition to this, the MASAF (Ministry of Agriculture, food sovereignty and forestry) promotes the **National Code of Good Agricultural Practices** for the control of ammonia emissions that took into account the Directive 2010/75/EU (IED) and the "Framework Code of Good Agricultural Practices for the Reduction of Ammonia Emissions" published in 2015 by the United Nations Economic Commission for Europe.

Limits for N doses applied in NVZ are 170kg N /ha and in non-NVZ are 340 kg N /ha (farm average).

However, the maximum efficient doses of nitrogen to be applied to crops by fertilisation to achieve a specified average yield should not be exceeded.

For phosphorus, copper and zinc, there are no limits in applications but their content in soil (on a dry weight basis) must be less than 100 mg/kg for Cu, 300 mg/kg for Zn, 200 mg/kg for P as Olsen-P, otherwise the soil is restricted to spreading.

Table A2 Restrictions in the application time of manure and manure-derived products in NVZ and non-NVZ.*

Regions	Application Time	Restrictions
NVZ	1/11 to 28/2	Ban slurry and digestate on bare soil
		Ban slurry and digestate with grassland or crops for at least 90 continuous days
		Possibility of spreading for the remaining 30 days depending on weather, regulated by nitrate bulletin
	15/12 to 15/01	Strict ban on manure on grassland
	1/12 to 31/1	Strict ban on manure on bare ground
Non-NVZ	1/12 to 31/1	60-day ban on slurry and digestate if grassland or crop is in place
	1/11 to 31/1	Ban slurry and digestate on bare soil for 60 continuous days
		Ban slurry and digestate on bare soil in November depending on weather, regulated by nitrate bulletin
		Manure on grassland always allowed
	1/12 to 31/1	Ban on manure on bare ground
Both NVZ & non-NVZ	Throughout	Mandatory use of low-pressure (< 6 atm) slurry distribution media
		Incorporation of slurry within 24 hours in NVZ, promoted and incentivized the use of low-emission techniques
		Respect distances from waterways

* NVZs: Nitrate vulnerable zones

Limits for sloping land

- NVZ: solid manure on slopes > 10% only with vegetation cover; NO slurry on slopes > 10%;
- non-NVZ: slurry and manure up to 20% only with vegetative cover and appropriate techniques.

It is necessary to distribute in the doses, timing and ways that allow at least nitrogen efficiency to crops as listed in Table A3

Table A3 Application requirement for the nitrogen efficiency assimilated from different manure types.

Manure type		Nitrogen Efficiency	
Category	Origin	non-NVZ*	NVZ
Slurry	fractions of digestates and poultry slurry	>48%	>60%
	Pig slurry		>55%
	cattle slurry and raw digestates		>50%
Solid manure	/	/	>40%

* NVZs: Nitrate-vulnerable zones

Note that there is a distinction between agro-livestock digestate and agro-industrial digestate concerning the matrices loaded to the biogas plant. The first is practically regulated as the manure apart from analysis on *E.Coli* and *Salmonellae*, the second has to comply with specific tabular limits and for several parameters.

Flanders, Belgium

In Flanders, manure use and management are strictly regulated by the Manure Decree and the manure action plans. This is to comply with the obligations of the Nitrates Directive. **The 6th manure action plan for the period 2019-2022 (MAP 6)** must ensure that fewer nitrates and phosphates from fertilizers end up in the water. All farmers with a production of at least 300 kg P_2O_5 have to submit a manure declaration. By 1 January 2024, the 7th manure action plan will come into force. Furthermore, various documents have been created for obtaining high-quality digestate and for the sustainable use of it ("Code Goede Praktijk").

Ireland

Statutory Instruments No. 113 of 2022 regulations on holdings with grassland stocking rates of 170 kg nitrogen per hectare from grazing livestock manure or above prior to export of livestock manure from the holding, a liming programme shall be prepared and must establish the following:- (a) A calculation of liming requirements for each parcel to achieve optimum pH; (b) A lime application programme for the farm. An occupier of a holding shall take as far as is practicable all such steps to prevent the application to land of fertilisers excessing the crop requirement on the holding) Livestock manure, other organic fertilisers, effluents, soiled water and chemical fertilisers shall be applied to land in as accurate and uniform a manner as is practically possible. (b) Low-emission slurry spreading equipment must be used for the application of slurry on holdings with grassland with specific stocking rates. These Regulations, which give effect to Ireland's 5th NAP, provide statutory support for good agricultural practices to protect waters against pollution from agricultural sources and include measures such as periods when land application of fertilisers is prohibited which limits the land application of fertilisers.

Similar to organic livestock production all organic crop production must comply the **Organic Food and Farming Standards in Ireland**. This includes the maintenance and enhancement of fertility and biological activity of the soil through cultural practices such as crop rotation, the use of green manures, and the application of farmyard manure and other organic materials appropriate for use in organic farming. The import of supplementary organic materials and other approved sources of fertiliser must have agronomic justification.

Farmyard manure or slurry of a factory-farming origin cannot be used in organic farming. Under the he Organic Food and Farming Standards in Ireland any nutrients from zero-grazing and/or permanently housed systems e.g., farmyard manure and digestate are prohibited. Where plant wastes or animal manure from non-organic sources are used, they must be justified and demonstrated that they do not derive from genetically modified crops or substrates.