Ref. Ares(2024)4682145 - 28/06/2024

NUTRI • KNOW

Practice Abstracts - batch I

D3.4

June 2024

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Technical References

Project acronym	NUTRI-KNOW
Project full title	NUTRI-KNOW - BROADENING THE IMPACT OF EIP-AGRI OPERATIONAL GROUPS IN THE FIELD OF NUTRIENT MANAGEMENT: KNOWLEDGE EXPLOITATION AND EASY-TO-UNDERSTAND MATERIAL FOR FARMERS AND PRACTITIONERS
Call	HORIZON-CL6-2022-GOVERNANCE-01
Grant number	101086524
Project website	https://www.nutri-know.eu/
Coordinator	UVIC-UCC

Deliverable No.	3.4
Deliverable nature	DEC —Websites, patent filings, videos, etc
Workpackage (WP)	WP3
Task	Task 3.3 – Creation of common 'practice abstract'
Dissemination level [1]	PU
Due date	Status completion
Number of pages	17
Keywords	Practice Abstracts, EIP-AGRI common format for interactive innovation projects, practical recommendations
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Due date of deliverable	30/06/2024
Actual submission date	28/06/2024

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

SEN = Sensitive, limited under the conditions of the Grant Agreement

EU-R = EU Restricted under the Commission Decision No2015/444

EU-C = EU Confidential under the Commission Decision No2015/444

EU-S = EU Secret under the Commission Decision No2015/444

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Document History

V	Date	Beneficiary	Author
V0.1	25/06/2024	CRPA	Martina Zecchetti, Giuseppe Moscatelli
V0.2	25/06/2024	UVIC-UCC	Anna Bagó
V0.3	26/06/2024	CRPA	Martina Zecchetti, Giuseppe Moscatelli
V1	28/06/2024	UVIC-UCC	Anna Bagó

Summary of Deliverable

Deliverable 3.4 (D3.4) *Practice Abstracts – batch 1* is part of the NUTRI-KNOW work package (WP) 3. The objectives of WP3 *Practice oriented material creation* are to translate, format, and conceptualise the collected outcomes from relevant EIP-AGRI OGs, develop outreach materials that aim at making farmers, advisors, technology providers, and policy makers use the information actively in promoting changes in nutrient management processes that fulfil societal demands toward circularity with the aim of reducing climate impacts and overall sustainability.

Subsequently, D3.4 consists of a partial package of practice abstracts for EIP-AGRI use. The package of practice abstracts has been following the EIP-AGRI common format for interactive innovation projects, outlining the most relevant practical recommendations for practitioners arising from the knowledge assimilation and facilitating the connection with other EIP-AGRI OGs. This deliver contains 15 practice abstracts.

D3.4 is divided into 5 chapters: Introduction, Methodology, Results, Conclusions and future perspectives. A first introduction of the Nutri-Know project, Work Package (WP) 3 and Task 3.3 objectives, then the methodological approach used to partially complete the task. The first results of the task are then showcased. Finally, conclusions have been made and future perspectives have been mentioned.

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1. Introduction

In recent years, EU-funded projects have played a pivotal role in advancing knowledge on agricultural practices, technologies, and products. Despite significant progress, a notable gap exists between the generation of such knowledge and its practical adoption by practitioners in the farming sector. The lack of awareness, accessibility issues, and resistance to change contribute to challenges in knowledge uptake, hindering the potential benefits of the innovation stemming from EU projects.

The EIP-AGRI Operational Groups (OGs) are addressing this gap by fostering collaboration among diverse stakeholders. The key to unlocking the full potential of innovative practices lies in developing effective knowledge transfer mechanisms and enhancing collaboration to align the generated knowledge with the practical needs of the agricultural sector.

The NUTRI-KNOW project actively contributes to bridging this gap by expanding the outcomes of EIP-AGRI OGs beyond borders. This project focuses on collecting, translating, and sharing user-friendly knowledge to support the adoption of innovative practices. Notably, the NUTRI-KNOW project addresses urgent needs, challenges, and opportunities in the agri-food sector. It promotes trust and connections between stakeholders while intensifying cooperation and the implementation of innovative solutions. Specifically, NUTRI-KNOW focuses on nutrient management, addressing the various steps of the nutrient management value chain, including livestock farming, storage systems, fertiliser production, processing technologies, transport, and application. The overarching goal is to modernise the agri-food sector and promote nutrient management best practices among farmers, practitioners, and end-users.

In particular, Work Package (WP) 3 *Practice-oriented material creation* will translate, format, and conceptualise the collected outcomes from relevant EIP-AGRI OGs. It will also develop outreach materials that aim at making farmers, advisors, technology providers, and policy makers use the information actively in promoting changes in nutrient management processes that fulfil societal demands toward circularity with the aim of reducing climate impacts and overall sustainability. The specific objectives include: (i) develop a storytelling on the topic of nutrient management including the solutions developed by the OGs; (ii) translate, structure and homogenise collected information for regional use; and (iii) Create ready-to-use, useful, accessible and extractable material for end-users and stakeholders for educational and training purposes.

Task 3.3 within WP3 consists of the creation of a full package of Practice Abstracts following the EIP-AGRI common format for interactive innovation projects, outlining the most relevant practical recommendations for practitioners arising from the knowledge assimilation and facilitating the connection with other EIP-AGRI OGs. The format serves two main objectives, namely enabling contact between stakeholders and incentivise efficient knowledge exchange, and to disseminate the results of the project in a concise and easy understandable way to practitioners. This activity has been organised in form of a review of the material collected, with the aim to give an in-depth overview of similarities, differences and common practices of nutrient management. The practice abstracts point out entrepreneurial elements which are particularly relevant for end-users (e.g., related to cost, productivity, environmental benefits, etc).

Deliverable 3.4 is divided into 4 chapters: Introduction, Methodology, Results, Conclusions and future perspectives. A first introduction of the Nutri-Know project, Work Package (WP) 3 and Task 3.3 objectives, then the methodological approach used to partially complete the task. The first results of the task are then showcased. Finally, conclusions have been made and future perspectives have been mentioned.

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2. Methodology

The methodological approach of this report aims to achieve the objective of producing practice-oriented material for farmers and practitioners and in particular the full package of Practice Abstracts outlined in Task 3.3.

Each partner involved in the task proposed several Practice Abstracts related to their Operational Groups (OGs). These suggestions were compiled into an Excel document, including titles, short descriptions, related nutrient value chain steps, and associated OGs. Then, partners started working on the EIP-AGRI common format document to include all the necessary information related to the Practice Abstracts.

The EIP-AGRI common format excel file is structured in several tabs. Each tab refers to a different Practice Abstract and include the following information: Short title in English, Short summary for practitioners on the outcomes in English, including main results/outcomes of the activity and main practical recommendations, Short title in native language and Short summary for practitioners in native language.

The partners first provided the contents in English; then, after a revision of the WP leader, they translated it into their native languages.

This excel has been finally sent to the following email: AGRI-EIP-PRACTICE-ABSTRACTS@ec.europa.eu, including our Project Officer (REA) and Policy Officer (DG AGRI) in the CC of the email.

3. Results

This section presents the first results of the work carried out for Task 3.3.

A first batch of 15 Practice Abstracts has been realized, written in the EIP-AGRI common format.

Table 1 below provides a summary of the 15 Practice Abstracts, including their titles, related nutrient value chain step considered by Nutri-Know project, related Operational Group (OG), and the partners involved.

Table 1. First batch of 15 Practice Abstracts

PA nr.	Title	Value chain step	Related OG	Partner
PA1	OG POCKETBOER II: More performant operation of pocket digesters	3: Processing technologies	OG8: Pocketboer II	BE
PA2	Slurry Concentrator to enhance the efficiency of soil nutrient application	3: Processing technologies	OG1: Manure Concentrator	UVIC-UCC
PA3	Slurry Concentrator to reduce transport costs	5: Transport	OG1: Manure Concentrator	UVIC-UCC
PA4	Duncannon Blue Flag Farming and Communities Scheme: Sustainably Restoring, Protecting and Enhancing Water Quality	6: Application	OG12: Duncannon Blue flag and Community Scheme	Teagasc
PA5	Livestock manure and digestate treatment to produce struvite	3: Processing technologies	OG4: Struvite	CRPA

PA6	Recovering nutrients from the digestate, emissions from storage and soil application are reduced	2/6: Storage systems/Application	OG4: Struvite	CRPA
PA7	SOS AQUAE: Microfiltered Digestate treatment to Fertigation, an integrated system to improve nutrient upcycling	3: Processing technologies	OG5: SOS AQUAE	CRPA
PA8	SOS_AQUAE: Sustainable farming techniques and renewable fertilisers to combine agriculture, water and environment	6: Application	OG5: SOS AQUAE	CRPA
PA9	Gas Loop: Ammonia emissions capture for a virtuous nitrogen cycle in pig livestock	1: Livestock farming	OG6: Gas Loop	CRPA
PA10	Gas Loop: Ammonia emissions in pig livestock from a problem to a fertilizer resource	4: Fertilizer production	OG6: Gas Loop	CRPA
PA11	OG RENURE: Production of manure-derived ammonium salts through stripping and scrubbing process	3: Processing technologies	OG7: RENURE	UGent
PA12	OG RENURE: Agronomic performance of manure-derived ammonium salts as RENURE fertilisers	4: Fertilizer production	OG7: RENURE	UGent
PA13	OG RENURE: Field application of manure-derived ammonium salts as RENURE fertilisers	6: Application	OG7: RENURE	UGent
PA14	OG Grass2Algae: valorisation of residual grass for microalgal cultivation as novel protein source	3: Processing technologies	OG9: Grass2Algae	UGent
PA15	Biorefinery Glás: Increasing the Value of Grass through the Grass Circular Economy	3: Processing technologies	OG10: Biorefinery Glas	Teagasc

The partners created one practice abstract for OG8 Pocketboer II, OG9 Grass2Algae, OG10 Biorefinery Glas and OG12 Duncannon Blue flag and Community Scheme; two practice abstracts for OG1 Manure Concentrator, OG4 Struvite, OG5 SOS_AQUAE and OG6 Gas Loop; and three practice abstracts for OG7 RENURE.

The 15 practice abstracts refer to all the value chain steps identified by the NUTRI-KNOW project: one practice abstract (PA9) involves value chain step nr.1 Livestock farming; one practice abstract (PA6) involves value chain step nr.2 Storage systems; seven practice abstracts (PA1, PA2, PA5, PA7, PA11, PA14, PA15) involve value chain step nr.3 Processing technologies; two practice abstracts (PA10 and PA12) involve value chain step nr.4 Fertiliser production; one practice abstract (PA3) involves value chain step nr.5 Transport; four practice abstracts (PA4, PA6, PA8, PA13) involve value chain step nr.6 Application.

In the tables below, the detail of each practice abstract has been included.

Table 2. Practice Abstract 1 in English

Practice abstract 1	
Short title in English	OG POCKETBOER II: More performant operation of pocket digesters
Short summary for practitioners in English	Currently, both organic and synthetic fertilizers are used to supplement nutrients in the soil. This allows farmers to grow their crops optimally. However, improperly managed nutrients can become pollutants that harm the environment. Therefore sustainable nutrient management is essential. Pocket digestion can play an important role in this sustainable story. Through pocket digestion (farm-scale anaerobic digestion), renewable energy is produced from on-farm biomass. It mainly concerns digestion of only one type of input stream (mono-digestion), in most cases dairy manure. The produced biogas is valorised in a combined heat and power (CHP) unit (<200 kW electrical power), of which the generated electricity and heat can be used to meet the farmers' energy demand, thereby (partly) replacing fossil fuels and reducing greenhouse gas emissions. The environmental benefits of pocket digesters are not limited to the production of renewable energy. Since storage is minimized, (methane) emissions can be significantly reduced and environmental nuisance is limited. In addition, the digestate can be used as an organic fertilizer (with a higher fertilization efficiency than raw manure). The OG Pocketboer 2 aims to find solutions for persistent and common problems with pocket digesters. It encourages implementation of solutions at many existing and future plants to improve the digester performance and efficiency. By tackling these challenges, demonstrating the positive environmental impact and highlighting the sustainability aspect of pocket digestion, the technology and the interest to invest will improve. Nevertheless, ongoing efforts are needed to create more awareness on farm-scale digestion.

Table 3. Practice Abstract 2 in English

Practice abstract 2	
Short title in English	Slurry Concentrator to enhance the efficiency of soil nutrient application
Short summary for practitioners in English	The Slurry Concentrator separates livestock slurry into two phases: a semi-liquid phase rich in organic matter and nutrients and a liquid phase with low organic nutrient concentration. Outcomes: •Reduction of slurry volume by 20-30%, making transport more efficient. •Concentrated fraction retains 85-95% of total solids, 45-55% of total nitrogen, and 85-95% of phosphorus. •Low energy consumption with costs as low as € 0,0351 per m³. •Technological and economic viability confirmed in joint analysis and pilot-scale operations. Practical recommendations and opportunities for farmers: •Cost Savings: Using the same tractor and slurry tanker for both fractions cuts investment and operational costs, and reduces management time. •Enhanced Monitoring: Integrated online devices track nutrient content in real-time, facilitating precision fertilization, minimizing nutrient losses, and reducing emissions. •Efficiency: The system simplifies nutrient application by providing easy-to-handle liquid fractions, optimising soil health and productivity. •Shared use: The mobile design allows for shared use between farmers or within cooperatives, spreading the costs of investment and maintenance. •Versatility: Suitable for different farm sizes and regions, it operates effectively regardless of climate, providing a practical solution for any farm producing livestock slurry. Implementation: Place the concentrator in a slurry pond with floats. An additional pond is required to collect the diluted fraction. Use the concentrated fraction for distant fields and the diluted fraction for nearby fields, ensuring efficient nutrient distribution and reducing transport costs.

Table 4. Practice Abstract 3 in English

Practice abstract 3	
Short title in English	Slurry Concentrator to reduce transport costs
Short summary for practitioners in English	The Slurry Concentrator addresses the challenge of nutrient imbalance in high-density livestock regions by efficiently separating slurry into two phases: a nutrient-rich semi-liquid phase and a low-nutrient liquid phase. This separation directly reduces transport costs by significantly decreasing the volume of material needing transport. The concentrated phase retains the majority of nutrients, making it efficient for long-distance transport. Benefits and opportunities for farmers: • Cost Savings: By reducing the total volume of manure that needs to be transported, the Slurry Concentrator decreases transport costs. Farmers can move less material while transporting the same amount of nutrients. For breeding farms, savings start at 350 m^3 of treated slurry, while for fattening farms, benefits begin at 500 m^3. • Flexibility: The concentrated fraction is ideal for transporting to distant fields where nutrients are needed, while the diluted fraction, with its higher volume but lower nutrient concentration, can be applied to nearby fields. • Environmental Impact: Reduced transport frequency lowers fuel consumption and emissions, contributing to more sustainable farming practices. Implementation: The Slurry Concentrator is easy to set up with no major infrastructure changes. It requires a slurry pond for initial processing and an additional pond for the diluted fraction. Its mobile design allows it to be shared among multiple farms, further reducing individual costs and maximising efficiency.

Table 5. Practice Abstract 4 in English

Practice abstract 4	
Short title in English	Duncannon Blue Flag Farming and Communities Scheme: Sustainably Restoring, Protecting and Enhancing Water Quality
Short summary for practitioners in English	Elevated bacteria levels in bathing water quality at Duncannon Beach, Ireland, together with the loss of its ‘Blue Flag’ status of environmental excellence in 2007 had a major impact on tourism in the area. Overall, 35 farmers from 4 dairy, 8 tillage and 23 dry stock farms, covering a catchment area over 975 hectares, came together to contribute to the recovery and long-term retention of the Blue Flag status. With guidance from a dedicated sustainability manager, farmers developed results-based rewards scheme to assess the pollution risks on farms and formed Pollution Potential Zone (PPZ) maps. To improve their PPZ scores, participating farmers implemented water protection improvement works on their farms and the catchment area. Overall, 15.5 km of watercourses were fenced off, water troughs were moved 20m from waterways and sediment traps were installed to trap and filter run-off. Soil sampling was conducted, farm roadways were improved and nutrient management plans were developed for all farms. Participating farmers were encouraged to implement native riparian zones, plant native hedgerows and sow winter cover crops. At a farm level, the catchment farms became more efficient, the number of septic tank failures reduced and compliance above the Nitrates Directives was observed. At a local level, a reduction in bacterial pollution at Duncannon Beach was recorded and an improvement in ecological quality was observed. At a community level, the participants reported a sense of ownership and appreciation for the local water environment. A combination of implementing these water protection improvement works on farms, having access to a sustainability manager and having a nutrient management plan drawn up increased the success of this project.

Table 6. Practice Abstract 5 in English

Practice abstract 5	
Short title in English	Livestock manure and digestate treatment to produce struvite
Short summary for practitioners in English	The aim of the project was decreasing nitrogen (N) and phosphorous (P) content in agricultural digestates to reduce ammonia, methane and nitrous oxide emissions from both storage and field use compared to the use of raw digestate. Therefore, a real-scale prototype has been designed, implemented and installed to recovering N and P from digestate and produce a renewable fertilizer: Struvite (Magnesium Ammonium Phosphate Hexahydrate, $MgNH_4PO_4 \cdot 6H_2O$). Digestate treatment consisted in a solid-liquid separation by screw-press, follow by acidification of the liquid fraction up to pH of 7.5 using sulfuric acid (H_2SO_4 50% v/v). The processing was carried out in order to mineralize the organic phosphorous. After the liquid is microfiltered at 40 microns to partially remove the suspended solids and the organic matter. Because the latter hinders the struvite formation. Finally, in a crystallization and precipitation reactor, magnesium chloride ($MgCl_2$ 15% v/v) and sodium hydroxide (NaOH 30% v/v) are added to promote production of struvite crystals and allows an efficient recovery of N and P from digestates. Air blowing was also provided in the crystallization reactor to support the pH increasing due to carbon dioxide stripping. Results showed a significant depletion of N (- 20%) and P (- 73%) than the input digestate. Moreover, a reduction in the percentage of orthophosphoric in the precipitate was highlighted in contrast of the raw digestate, 8% and 36% respectively. Together, an increase of total phosphorous concentration in the precipitate compared to raw digestate was also observed (2.247 mg/kg and 725 mg/kg, respectively).

Table 7. Practice Abstract 6 in English

Practice abstract 6	
Short title in English	Recovering nutrients from the digestate, emissions from storage and soil application are reduced
Short summary for practitioners in English	Management of agricultural digestates could contribute to the reduction of greenhouse gas (GHG) emissions. Digestate treatment, also aimed at nutrient recovery, could facilitate the relocation of surplus nitrogen (N) and phosphorous (P) from high livestock areas. In fact, nutrient content in digestates could meet the demand for fertilizers, thus reducing the use of chemical fertilizers. In this regard, the aim of the project is to reduce the content of N and P in livestock manure and digestates to reduce atmospheric emissions of ammonia, methane and nitrous oxide from both the storage and field use of livestock manure and digestate. N and P were recovered to produce a slow-release renewable fertilizer: Struvite (Magnesium Ammonium Phosphate Hexahydrate, $MgNH_4PO_4 \cdot 6H_2O$). About this, a real-scale prototype was designed and implemented to recover struvite from digestate. N and P were recovered from digestate in a small volume of stable product. Consequently, the remaining liquid fraction obtained had a reduced nutrient and organic matter content than the raw digestate. The study highlights how methane and ammonia emissions from the treated fraction storage were much lower than the raw digestate, 86% and 42% respectively. Field application of the treated digestate led to a reduction in N emissions of 19% compared to raw digestate. Furthermore, reduction of N, P and dry matter contents in agricultural digestates has made possible to reduce GHG emissions during storage and field application of liquid fraction. "

Table 8. Practice Abstract 7 in English

Practice abstract 7	
Short title in English	Microfiltered Digestate treatment to Fertigation, an integrated system to improve nutrient upcycling

Short summary for practitioners in English	Fertigation with digestate from biogas plants is a practice that significantly enhances nutrient use efficiency on growing crops but is not yet widespread because of chemical-physical characteristics of digestate cause problems of clogging of the nozzles of the fertigation line. SOS_Aquae Operational Group has tested and promoted an innovative integrated system to valorize the liquid fraction of digestate in fertigation, in order to maximize efficiency of the reuse of nutrients and the reduction of mineral fertilizers. Optimizing the efficiency of nutrients use allows to reduce the mineral fertilizers apply (both nitrogen and phosphorous) and at the same time avoid pollution caused by agricultural activities and therefore improve the water quality. Digestate undergoes a preliminary solid-liquid separation, resulting in a solid fraction and a clarified liquid fraction. The latter is then microfiltered at 50 µm. This process produced microfiltered digestate, which is transferred to the field and mixed with water for fertigation on growing crops and injected into a Subsurface Drip Irrigation system with drip lines buried at a depth of 25-30 cm. Project demonstrated that it is possible to use conservation tillage up to no-tillage in combination with continuous soil cover with two crops per year and innovative techniques for fertigation with renewable fertilizers (liquid fraction of digestate). All with a view to a more rational use of inputs, which are expensive, non-renewable and often have a strong environmental impact. The main effects for farms consist in the identification and application of agro-technological technics that allow to increase both productivity and environmental sustainability.

Table 9. Practice Abstract 8 in English

Practice abstract 8	
Short title in English	Sustainable farming techniques and renewable fertilisers to combine agriculture, water and environment
Short summary for practitioners in English	During the project SOS_Aquae an innovative system was developed to increase the use of liquid fraction of digestate by mixing with water in fertigation. This practice offers an interesting option in regions where crops require water. During the project, three innovative agrosystems were investigated. In particular, the agronomic techniques stand out from the comparison with traditional practices, including soil management, chemical fertilizers input, conventional application and sprinkler irrigation: - no-tillage, based on spring-summer crops (i.e., sorghum and maize) alternating with autumn-winter cover crops, fertigated with ammonium sulphate derived from stripping treatment of digestate, injected through sub-surface drip irrigation; - minimum tillage, based on double crops, the first for food and the second for biogas. Both of them fertigated with microfiltered digestate injected through subsurface drip irrigation; - agricultural system based on conventional, for food and no-food but fertigated with microfiltered digestate spread through a Rainger. Distributing the nutrients mixed with the irrigation water on growing crops reduces nitrogen leaching and ammonia emissions to almost zero. The efficient distribution of water in sub-irrigation avoids water saturation of the soil and the emission of nitrous oxide. These innovative techniques for applying digestate extend its spreading periods and avoids soil compaction due to the passage of the slurry tanker. The sub fertigation avoids ammonia and odor emissions compared to conventional digestate application.

Table 10. Practice Abstract 9 in English

Practice abstract 9	
Short title in English	Ammonia emissions capture for a virtuous nitrogen cycle in pig livestock
Short summary for practitioners in English	Gas Loop Operational Group has made a prototype system with a Technology Readiness Level (TRL) of 8-9, that is a real system, complete and ready for applicability.

	This device, made during the project, allowed ammonia-rich air to draw from the pig housing through suction ducts located below the slated floor. After, the collected air was purified by treatment based on chemical ammonia adsorption. The latter consisted of backwashing the air with an acid reagent sprayed from the top of a tower scrubbing with packing bodies. The process was carried out at pH of 4.5 and a sulfuric acid (H_2SO_4) solution is used. This reacts chemically with ammonia to form a stable solution of ammonium sulphate ($(NH_4)_2SO_4$), collected in a tank at the base of the washing tower. This treatment cannot replace the existing ventilation system but complements it. Air scrubbing effectively removed ammonia from the airflow of pig housing was on average 86%. Moreover, air treatment improved indoor air quality, reducing the ammonia average percentage within the treatment (range 57-67%) compared to the untreated control.

Table 11. Practice Abstract 10 in English

Practice abstract 10	
Short title in English	Ammonia emissions in pig livestock from a problem to a fertilizer resource
Short summary for practitioners in English	During the project, an innovative technology was developed to remove ammonia from the air of pig housing. The EIP-AGRI Gas Loop Operational Group implemented and monitored for 2 years an air washing system which able to remove ammonia from pig housing and recover the nutrient in form of ammonium sulphate solution. In this way, the nitrogen (N) cycle ends, limiting the emissions into the atmosphere. Nitrogen is an essential nutrient which is often emitted into the atmosphere in the form of harmful ammonia. The proposed technology captures and reuses ammonia in the form of fertilizer. Air treatment is based on a chemical adsorption of ammonia by backwashing with an acid reagent in a tower. Usually, the acid reagent is sulfuric acid (H_2SO_4) which reacts with ammonia (NH_3) to form a stable suspension of ammonium sulphate ($(NH_4)_2SO_4$), accumulates in a tank at the base of the washing tower. Treatment was tested for 2 years in fattening cycles of pigs for the PDO Prosciutto di Parma supply chain. During this period, the process produced ammonium sulphate fertilizer which reduced GHG emissions by replacing N-based chemical fertilizers. In fact, the production of ammonium sulphate solution was 230 liters per ton of live weight in 1 year. The characterization of the liquid demonstrated a pH value of 4, a Total Kjeldahl Nitrogen of 64 kg per tons (99% as $N\text{-}NH_4^+$), and a Total Organic Carbon of 1% in weight. Ammonium sulphate solution produced nutrients N category PFC 1(C)(I)(b)(i). This allows a GHG reduction of 66 kg CO_2eq per tons live weight in 1 year. This, linked to replacement of N-based chemical fertilizers.

Table 12. Practice Abstract 11 in English

Practice abstract 11	
Short title in English	OG RENURE: Production of manure-derived ammonium salts through stripping and scrubbing process
Short summary for practitioners in English	The Flemish agricultural sector finds itself in the paradoxical situation with an animal nutrient surplus and additional nutrients demand from synthetic fertilizers. To this end, the RENURE criteria have been introduced by the EU Joint Research Center to ensure the safe application of nitrogen recovered from manure as substitutes for synthetic fertilisers. Stripping-scrubbing is a technology that makes it possible to upgrade manure to RENURE fertilisers such as ammonium salts. A stripping-scrubbing installation consists of two compartments: firstly, air is blown into the stripping compartment to remove the gaseous ammonia that is released from the thin fraction of manure or digestate due to increased pH and/or temperature; in the successive compartment, the ammonia-rich air is sprayed with a strongly acidic solution, such as sulfuric acid or nitric acid, to form ammonium sulphate or nitrate, respectively. Since the

	process depends on temperature increase, it is usually coupled with an anaerobic digester to make use of the excess heat. The pH is increased by adding slaked lime ($Ca(OH)_2$) or sodium hydroxide (NaOH). However, mixing CO_2 from the input stream with $Ca(OH)_2$ can also increase the pH and promote the formation of CaCO3 prevent precipitates in the stripper. The economic viability of implementing an ammonia stripper is highly dependent on the business type under study. The estimated price of the operational installation for pig farms is approximately €100-150/m^3 (in June 2023). It requires an annual manure processing capacity of at least approximately 20,000 tons to achieve a desired economic viability.

Table 13. Practice Abstract 12 in English

Practice abstract 12	
Short title in English	OG RENURE: Agronomic performance of manure-derived ammonium salts as RENURE fertilisers
Short summary for practitioners in English	In 2020, the EU Joint Research Centre proposed the RENURE criteria to allow the safe use of recovered nitrogen from manure as replacement for synthetic nitrogen fertilisers. Ammonium salts recovered from manure through stripping and scrubbing process are proposed as a priority of RENURE products. Depending on the counter acid (nitric acid or sulfuric acid), ammonium nitrate or ammonium sulphate is produced, respectively. The obtained ammonium salts are slightly acidic, containing 100% mineral N without organic particles. Ammonium nitrate only contains nitrogen (7.5-12% N) and at a higher concentration than ammonium sulphate which also contains a high concentration of sulphur. The storage of ammonium salts often has a higher price tag, because these are liquid products are with a lower nitrogen content compared to chemical fertilizers. The ammonium salts can be stored in a polyester tank or intermediate bulk container which makes it easily stackable. Field tests in 2022 indicated a comparable performance of the recovered ammonium nitrate as compared to synthetic fertilizers in terms of effectiveness and fertilising value. In some cases, the crops treated with ammonium nitrate resulted in higher yields than the synthetic reference (calcium ammonium nitrate), although this was partly due to the heterogeneity of growth induced by the dry growing season. Fertilizing with ammonium nitrate in winter wheat or similar crops does offer possibilities, as the animal manure in those crops is often not filled in or is filled incompletely. However the current status of animal manure remain as a main bottleneck for applying ammonium nitrate in-field practice.

Table 14. Practice Abstract 13 in English

Practice abstract 13	
Short title in English	OG RENURE: Field application of manure-derived ammonium salts as RENURE fertilisers
Short summary for practitioners in English	The EU Joint Research Center proposed the RENURE criteria to allow the safe use of recovered nitrogen from manure as fertiliser substitutes, among the priority RENURE products are ammonium salts recovered through stripping and scrubbing process. The RENURE operational group aims to prepare the Flemish agriculture and horticulture sector for the practical use of recovered ammonium salts. Five field trials were set up in 2022 and one in 2023 to evaluate the ammonium nitrate recovered from animal manure through the stripping and scrubbing process. The results showed that ammonium nitrate recovered from animal manure performs as well as artificial fertilisers in terms of effectiveness and fertilising value. Applying ammonium nitrate with a row tiller or with injection is preferred as a low-emission method over application with a spray boom. The main bottlenecks when using ammonium nitrate in practice are the lower nitrogen content as compared to synthetic fertilizer, and the legal status that it was still considered as animal manure. The lower nitrogen content (9-12%) means that larger volumes are

	required as compared to synthetic fertilizer, therefore the fertilizer machine has to be replenished more often and is especially an inconvenience if the storage is located far from the plot. Mixing ammonium salts with synthetic fertilizer can meet farmers' demand for a higher nitrogen content. Moreover, this can provide a bridge in a transition phase from fertiliser to recovered fertilizers, where the mixture combines the security of the known fertiliser with the cost savings of the ammonium salts. However, the status of animal manure in current legislation provides limited options for both the sole and mixed application of ammonium salts.

Table 15. Practice Abstract 14 in English

Practice abstract 14	
Short title in English	OG Grass2Algae: valorisation of residual grass for microalgae cultivation as novel protein source
Short summary for practitioners in English	Flemish Farmers have access to an abundance of roadside grass or low- quality grass that cannot be used as animal feed. Grass juice accounts for 40-60% of the total grass weight and research results have shown that it can be used for microalgae cultivation. Therefore, farmers can grow microalgae themselves to use as animal feed or supply the grass juice to algae growers who want to produce organic-certified algae, since grass juice can be considered an organic growing medium. The grass juice was separated from the fibre fractions by a sequence of sedimentation, coarse filtration and pH adjustments. The obtained grass juice has an intense green color and a high concentration of suspended solids, which means that light cannot penetrate efficiently. Therefore the grass juice was pretreated through a sequence of dilution to 10% and overnight sedimentation which resulted in a nutrient-rich clear supernatant with good light penetration properties. Further pH adjustment from the initial acidic pH of 4 to 8 was necessary to inhibit contaminants and ensure good algae growth. After proper treatment of the grass juice, green microalgae (Chlorella sorokiniana) and cyanobacteria (Arthorspira platensis) were successfully grown in this organic medium. The produced biomass had a 41% protein content, and most microorganisms complied with safety norms for feed production These findings offer new perspectives to sustainably manage plant waste and convert it to a protein source in a Green Biorefinery. Future studies are needed to further explore the potential of grass juice for microalgae cultivation at larger scales (e.g. pilot-scale).

Table 16. Practice Abstract 15 in English

Practice abstract 15	
Short title in English	Biorefinery Glás: Increasing the Value of Grass through the Grass Circular Economy
Short summary for practitioners in English	Biorefinery Glás focuses on the demonstration of a small-scale grass biorefinery with farmers to diversify farmer produce while resolving significant challenges in traditional agriculture. In the biorefinery, grass is crushed and separated into two fractions, a solid presscake and a liquid protein rich fraction. Presscake feed trial results with dairy cows indicated that the dry matter intake was lower in the presscake fed group compared to grass silage. Milk quality and protein did not differ between the two groups, but milk fat and milk solids content were lower in presscake fed cows. Rumen ammonia concentration in presscake fed cows decreased compared to grass silage. Nitrogen excreted in the milk increased but N & P excretion decreased in presscake fed compared to grass silage. The NUE increased in presscake compared to grass silage. Pigs fed the protein rich dried feed were slow to adapt at first but adjusted within a week. They had a higher-than-average daily intake and higher than average daily gain compared to the control group after 30 days. Including dry protein concentrate in the pig's diet replaced up to 50% of the usual soya levels from the diet. Using this locally produced pig feed reduces transport distances and import cost associated with

	soya. Currently, these types of small-scale biorefineries are being developed with built in automation, making this type of technology more accessible to farmers. It also allows farmers to increase resource efficiency while addressing key emissions challenges. The biorefinery model could allow farmers to continue to feed their cattle, with reduced emissions, while producing three co-products which can increase their overall farm efficiency and income.

4. Conclusions and future perspectives

The first batch of 15 practice abstracts has been made available to be published at the EIP-AGRI website to enable the easy flow of knowledge and exchange between farmers, researchers and other stakeholders.

A total target number of 30 practice abstracts is foreseen for the project.

Therefore, Practice Abstracts will be delivered in two batches. The second batch of 15 Practice Abstracts will be delivered in month 24, that is, December 2025.

To make them further usable and understandable for farmers, the content of the 30 Practice Abstracts will also be translated into a more appealing graphic layout (Figure 1). The layout was developed in-house and requires the following information: link to project page on EIP-AGRI OG, link to project website, short project name, project title, objectives, activities, project photos and diagrams, further details, context and results.

Figure 1. Graphic layout for Practice Abstracts

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The coordinator will finally contact the project team of the EU-FarmBook (101060382) and assess the possibilities of uploading the practice abstracts in EU-FarmBook platform in the requested formats.

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