NUTRI•KNOW

Report on needs and barriers for user acceptance

D2.3

30th June 2024

WE&B

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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.	2.3
Deliverable nature	[R]
Workpackage (WP)	2
Task	2.3. Report on needs and barriers for user acceptance
Dissemination level [1]	[PU]
Due date	M18
Number of pages	90
Keywords	Fuzzy Cognitive Mapping, stakeholders, barriers, nutrient management, OG outcomes
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Due date of deliverable	30/06/24
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

Document History

V	Date	Beneficiary	Author
V01	07/06/2024	WE&B	Beatriz Medina, Maria Pascual
V0.2	17/06/2024	IOA	Stephen Meredith
V0.3	21/06/2024	UVIC-UCC	Anna Bagó
V0.4	27/06/2024	WE&B	Beatriz Medina, Maria Pascual
V1.0	28/06/2024	UVIC-UCC	Anna Bagó

Summary of Deliverable

Deliverable 2.3 (D2.3) *Report on needs and barriers for user acceptance* is part of the NUTRI-KNOW work package (WP) 2. The objectives of WP2 are to detect the alignment of the 12 engaged EIP-AGRI Operational Groups (OGs) outcomes with the current market and legislative situation; to identify the target-audience and the urgent needs, challenges, and opportunities of the agricultural sector; and to adapt the knowledge gathered to the current territorial needs. Subsequently, D2.3 consists of the matchmaking of the knowledge needs and barriers for the acceptance of farmers and practitioners towards the practices and outcomes addressed in the OGs. D2.3 is divided into 5 chapters: Introduction, Methodology, Results, Conclusions and Next steps.

Based on the risks identified in Task 1.3 on cost-benefit analysis and the results from the questionnaire developed in Task 2.2, a set of barriers for the uptake of the OGs outcomes have been identified. Through workshops following a fuzzy cognitive mapping (FCM) process, these barriers have been validated and expanded. During the FCM workshops, the stakeholders have identified connections between the barriers and the stakeholder target groups relevant to the NUTRI-KNOW project.

The results presented here synthesize the data gathered during the workshops, encapsulating the rich discussions and insights generated by participants. This comprehensive analysis has been transformed into a systems map, available online as a dynamic map, which visually represents the connections between identified barriers and stakeholder target groups. Furthermore, this deliverable provides a cross-country analysis of the most prominent barriers, alongside a summary of the main contributions and findings identified in the discussion on the roles of the various stakeholder groups in addressing and reducing barriers.

The findings show that Task 2.3 has allowed the identification and matchmaking of barriers to the acceptance of the OGs outcomes among farmers and practitioners. However, obtaining specific data on target groups was difficult, indicating a need for more focused discussions. Furthermore, this task suggests associating specifically the identified barriers with each OG to enhance the integrity of the analysis. Despite these challenges, participants were highly engaged in the workshop discussions and recognized the importance of these debates, expressing a strong willingness to receive detailed project materials, which will be developed in WP3 and WP4.

Disclaimer

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Table of Abbreviations

CAP	Common Agricultural Policy
EIP-AGRI	Agricultural European Innovation Partnership
FCM	Fuzzy Cognitive Mapping
GenA	General Assembly
GDPR	General Data Protection Regulation
IP	Intellectual Property
OG	Operational Group
SNA	Social Network Analysis
SH	Stakeholder
WS	Workshop

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.

Work Package (WP) 2 aims to explore how the engaged OGs are aligned with current EU policies (top-down approach) and the challenges and needs of the farmers and the agri-food sector (bottom-up approach). This WP focuses on analysing the connections among the OGs participants and relevant actors and networks in the nutrient management field. It also aims to assess previous work in this domain to avoid redundancy. The specific objectives of WP2 entail to (i) Detect the alignment of OGs results with current market and legislative situation; (ii) Identify the target-audience and the urgent needs, challenges, and opportunities of the sector; (iii) Adapt the knowledge gathered to the current territorial needs by developing a thematic-analysis methodology; and (iv) Avoid duplication with ongoing or completed projects and networks.

Task 2.3 within WP2 consists of the identification and matchmaking of the knowledge needs and barriers for the acceptance of farmers and practitioners towards the practices and outcomes addressed in the OGs. This task brings together Task 2.1 and Task 2.2 through a fuzzy cognitive mapping (FCM) exercise done in a collaborative manner with the stakeholders in the course of workshops. In these workshops, fuzzy cognitive maps are co-designed, where the common themes related to the OGs are included and where the interconnections between barriers and stakeholder target groups are shown. The data gathered in Task 2.3 is to be used to develop the practice-oriented material for capacity building and have contents for discussion in the knowledge exchange tools such as the Community or Practice.

Deliverable 2.3 is divided into 5 chapters: Introduction, Methodology, Results, Discussion, and Conclusions and Next steps. First, it is presented an overview of the main challenges and barriers in innovation in nutrient management, related to the context of the NUTRI-KNOW project. Then, the process of FCM is described in the methodology section, which includes the elaboration of the first FCM workshop with the consortium at the General Assembly (GenA) in Ireland, and four local FCM workshops in the countries of the OGs (Spain, Belgium, Italy and Ireland). The results section presents the FCM produced for each of the countries. Further uses of the maps are discussed in the section about next steps, which ends with a comprehensive overview of the matchmaking exercise.

2. Methodology

2.1. Overall approach: Fuzzy Cognitive Mapping to matchmake knowledge needs and barriers to farmers and practitioners

The methodological approach of this report aims to achieve the objective of matchmaking knowledge needs and barriers to farmers' and practitioners' acceptance of the practices addressed in the Operational Groups as outlined in Task 2.3. Innovative approaches and collaborative efforts are essential for advancing sustainable agricultural practices. Fuzzy cognitive mapping helps identify and match knowledge needs with barriers faced by farmers and practitioners, fostering a better understanding of nutrient management current dynamics. The OGs bring together diverse actors to develop and implement practical, sustainable innovations. Nutri-Know brings the in-depth knowledge of the 12 EIP-OGs that are involved to perform this complex matchmaking analysis.

EIP-AGRI Operational Groups

The Operational Groups are designed to foster innovation in the agricultural and forestry sectors by bringing together a diverse range of actors, including farmers, researchers, advisors, businesses, environmental groups, consumer interest groups, and other NGOs. These groups collaborate to develop and implement innovative practices and technologies, targeting practical problems or opportunities in farming. OGs are flexible and formed based on the initiative of involved actors, promoting a bottom-up approach to innovation. This participatory structure ensures that projects are tailored to specific needs and can range from developing new products and practices to adapting existing technologies to new contexts. The projects undertaken by OGs must align with the EIP-AGRI objective of promoting sustainable agricultural innovation that is resource-efficient, productive, low-emission, and climate-friendly[1].

About the Operational Groups in NUTRI-KNOW

The NUTRI-KNOW project actively engages 12 EIP-AGRI OGs distributed across four member states: Belgium, Ireland, Italy, and Spain, with three OGs in each country. These OGs tackle diverse aspects of nutrient management, including livestock farming, storage systems, fertiliser production, processing technologies, transport and application. Nutrient management is a critical focus for farmers in Europe, and these OGs have generated various outputs, including technologies, tools, fertiliser products, and recommendations across the nutrient value chain. Eight of these OGs were finalised between 2017 and 2022, while the remaining four are ongoing and are expected to conclude their activities before the end of the project. This dynamic approach allows for the continuous evolution and adaptation of strategies to promote sustainable nutrient management practices across Europe.

The need for matchmaking concepts

Previous project tasks have started identifying stakeholder knowledge needs and barriers to adopting new innovations in the nutrient management sector. Task 1.3 involved a cost-benefit and sustainability analysis to assess the tangible and potential impact of the 12 EIP-Ogs in NUTRI-KNOW, identifying several barriers to innovation in the sector. This was detailed in Deliverable 1.3. In Task 2.2, a stakeholder consultation process was implemented to map relevant stakeholders and target audiences. The data extracted from this process complements the identification of barriers and needs, following a bottom-up approach, as described in Deliverable 2.2. Furthermore, we have been identifying, categorising and analysing relevant stakeholders in the sector through

[1] https://eu-cap-network.ec.europa.eu/operational-groups_en

project Task 2.2. All these different results needed to be integrated in a complexity analysis to try to offer a systematic view of the problems and needs of the sector.

Continuing in this vein, Figure 1 illustrates a participatory approach to achieving effective nutrient management by bridging stakeholders' knowledge needs and barriers (Inputs from Tasks 2.1 and 1.3) with practices and objective data. This is achieved in a collaborative manner by harnessing the collective intelligence of the community and key stakeholders through conducting workshops with these stakeholders. The first step involves identifying stakeholder needs and barriers, followed by the second step, which focuses on utilising data to inform and optimise practices. This integrative method ensures comprehensive and practical solutions for nutrient management challenges.

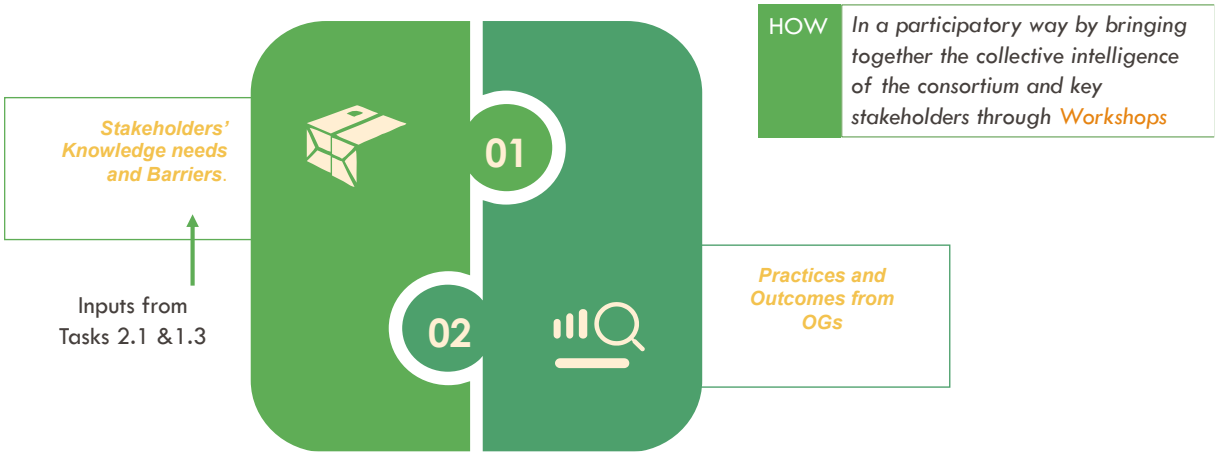

Figure 1: Schematic diagram of the participatory approach to achieving effective nutrient management

To effectively address the knowledge needs and barriers to farmers' and practitioners' acceptance of practices in OGs, complex conceptual analysis is required. This involves understanding these needs and barriers and co-designing solutions with stakeholder input.

Fuzzy Cognitive Mapping (FCM) has been the methodological approach employed which involves a mental modelling technique that creates cognitive maps representing individual thought processes related to a problem. FCM helps describe the behaviour of complex systems through interconnected concepts, reflecting the dynamics and cognitive representations stakeholders use in decision-making[2].

This approach ensures a comprehensive understanding of the system's intricacies and supports informed, collaborative decision-making.

By engaging stakeholders through workshops, the NUTRI-KNOW project leverages collective intelligence bridging knowledge gaps and optimising practices using objective data. With this bottom-up approach informed by tasks such as cost-benefit and sustainability analysis, and stakeholder mapping, we aim to ensure that the developed solutions are practical, sustainable, and tailored to regional needs.

The NUTRI-KNOW FCM Model

The FCM model in NUTRI-KNOW maps how the 12 OGs addressed real barriers or problems in the nutrient value chain. The NUTRI-KNOW FCM model (see Figure 2) is built on nodes and

[2] Gray et al., 'Are Coastal Managers Detecting the Problem?'; Papageorgiou and Kontogianni, 'Using Fuzzy Cognitive Mapping in Environmental Decision Making and Management'.

connections, where nodes represent concepts such as stakeholder types, barriers to innovation, and OGs' outcomes related to nutrient management, while connections indicate the relationships between these nodes. The red connections indicate negative influences or barriers, while the blue connections indicate stakeholders that can help overcome these barriers. This model provides a structured visual representation, facilitating the identification and resolution of challenges in nutrient management. Detailed methodological steps for this analysis are described in the next section.

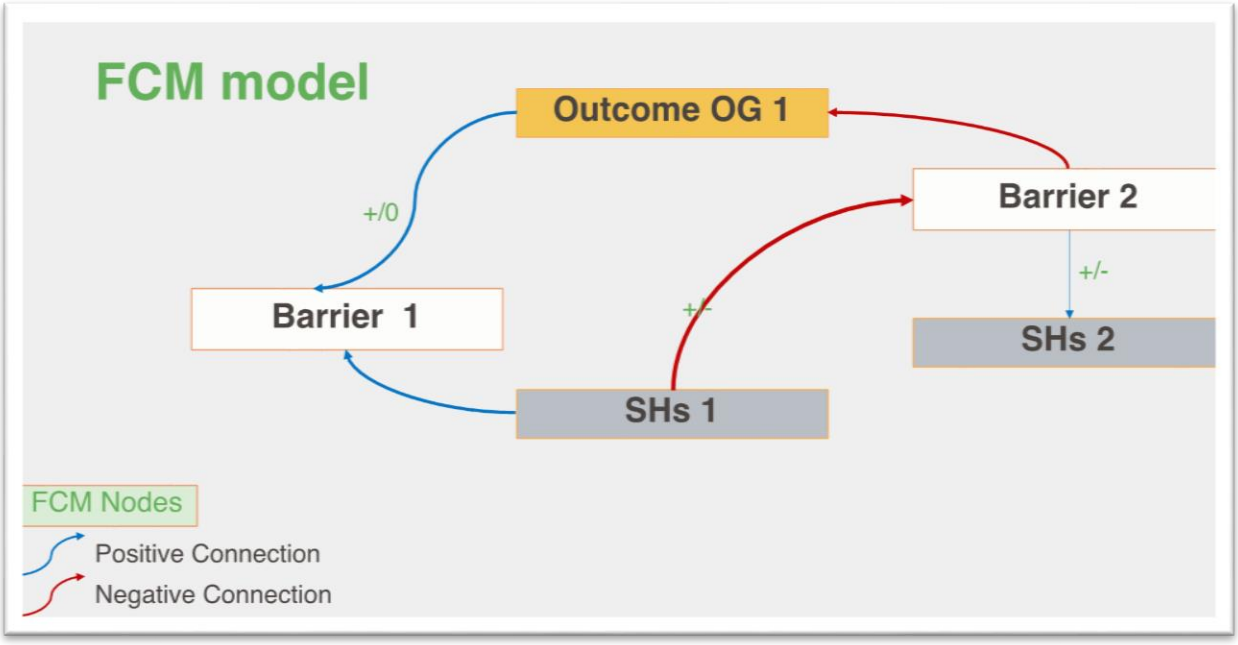

Figure 2: Schematic diagram representing the FCM model in NUTRI-KNOW

The following section details the methodological steps employed in the NUTRI-KNOW project to create the FCM model and map the relationships between stakeholders, barriers, and solutions in nutrient management.

2.2. Methodological steps – Data gathering and analysis

In this section, we detail the methodological steps carried out in the data collection and analysis to create the NUTRI-KNOW FCM, as detailed in Figure 3. The data gathering steps are based on two types of workshops and the data analysis: (1) FCM Workshop 1 in the third project General Assembly (GenA), (2) FCM Workshop 2 in each country, and (3) Data analysis.

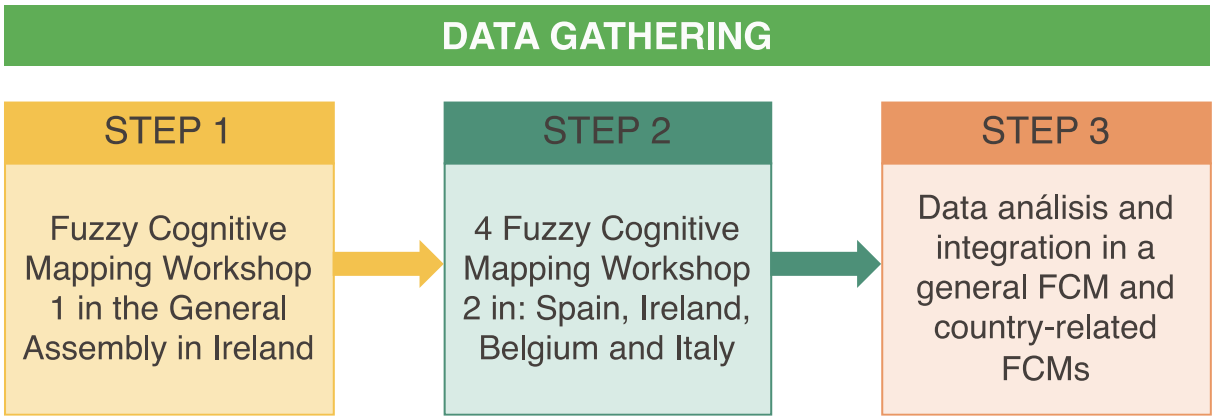

Figure 3: Methodological overview to generate the FCMs (matchmaking exercises)

2.2.1. Step 1: FCM Workshop 1 in the GenA

The data gathering starts with the collection of the identified barriers for the implementation of outcomes of the OGs. The barriers were identified based on the relevant risks outlined in the cost-benefit analysis of Task 1.3. Additionally, the challenges highlighted in the stakeholder questionnaire from Task 2.2, contributed to the identification of these barriers. The barriers were then organised into five categories: 1) Communication and Knowledge, 2) Economic, 3) Environmental, 4) Legislative, and 5) Social. The complete list of initial barriers is shown in Table 1 below.

Table 1: List of barriers identified from Task 1.3 and integrated with the new findings of the stakeholders' questionnaires in Task 2.2

Thematic categories of barriers	List of Barriers
Communication and Knowledge	Insufficient training and capacity building (risks Task 1.3)
	Lack of technical expertise (risks Task 1.3)
	Data and information gaps (risks Task 1.3)
	Scalability and replicability (risks Task 1.3)
	Lack of monitoring and evaluation (risks Task 1.3)
	Technology limitations (risks Task 1.3)
	Public perception and communication (risks Task 1.3)
	Limited transferability to other contexts (risks Task 1.3)
	Lack of technical expertise, skills (questionnaire Task 2.2)
Economic	Inadequate resources (risks Task 1.3)
	Economic viability (risks Task 1.3)
	Market constraints (risks Task 1.3)

	Insufficient financial support from governments (questionnaire Task 2.2)
	Lack of information on the cost structure of implementing the OGs outcomes (questionnaire Task 2.2)
	Additional investment is needed in infrastructure or to adopt new methods (questionnaire Task 2.2)
Environmental	Unforeseen environmental impact (risks Task 1.3)
	Climate sensitivity (risks Task 1.3)
	Long-term sustainability (risks Task 1.3)
	Compatibility with ecological systems (risks Task 1.3)
	Environmental sustainability (risks Task 1.3)
Legislative	Regulatory and policy constraints (risks Task 1.3)
	Policy alignment (risks Task 1.3)
	Policy integration (risks Task 1.3)
	It is difficult to obtain permit according to current legislation (questionnaire Task 2.2)
	Trade barriers or protectionist measures to access markets in other regions (questionnaire Task 2.2)
Social	Limited adoption (risks Task 1.3)
	Resistance to change (risks Task 1.3)
	Incompatibility with local practices (risks Task 1.3)
	Social acceptance and equity (risks Task 1.3)
	Behavioural change challenges (risks Task 1.3)
	Lack of confirmed results/successful cases from historical implementation (questionnaire Task 2.2)

After identifying and categorising all the barriers, the related OGs for each barrier were extracted from Deliverable 1.3 Results of the cost-benefit and sustainability analysis. Then, a list of stakeholder target groups was created from the groups identified in Task 2.2 (Stakeholder Database). The list of target groups for the FCM exercise was slightly adapted to fit the format of the workshop. The target groups are presented in Annex 1.

After completing the list of barriers with their related OGs and the list of stakeholder target groups, a FCM workshop was conducted to implement the matchmaking exercise. The workshop aimed at exploring the role of stakeholders in addressing or exacerbating the barriers for the acceptance of farmers and practitioners towards the OGs outcomes. Acting as the starting point for further regional workshops, this first workshop also achieved the objective of being a training and validation exercise for the NUTRI-KNOW consortium.

The first FCM workshop was organised and facilitated by WE&B, with the inputs from UVIC-UCC and UGENT as leaders of Task 1.3 and Tasks 2.1. The workshop was held during the NUTRI-KNOW General Assembly (GenA) on the 20th and 21st February 2024, in Johnstown Castle,

Wexford, Ireland, and hosted by Teagasc. The participants were the NUTRI-KNOW project partners, namely: UVIC-UCC, DACC, FCAC, CRPA, AU, UGent, Biogas-E, ESCI, IOA, and Teagasc. The complete slides used in the workshop are found in Annex 2.

The FCM workshop was structured in the following way to allow for an efficient matchmaking exercise and to foster collaborative insights from participants:

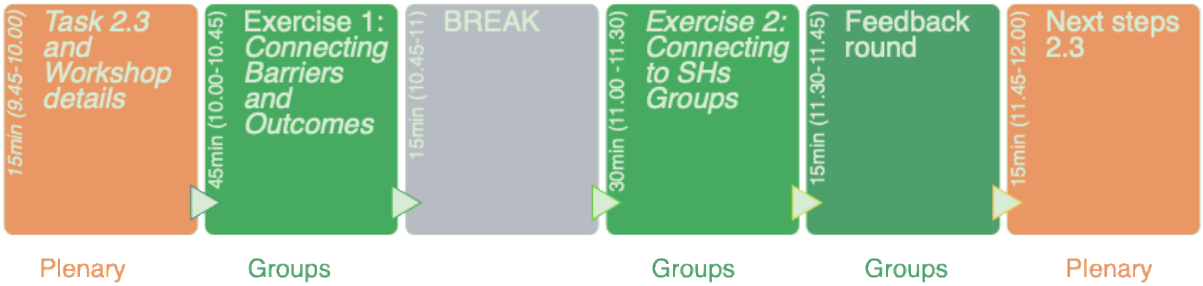

Figure 4: Structure of the FCM Workshop 1

The FCM workshop was structured in the following way to allow an efficient matchmaking exercise and foster collaborative insights from participants. First, in plenary, the workshop was introduced providing the objective of Task 2.3 together with the overall guidelines of the exercise. The participants were split into four different groups, according to the different categories (Economic and Legislative were merged into 1 group for practical reasons). In each group, there was a moderator, who was responsible for ensuring a smooth flow of the discussions and collecting the insights

This dynamic followed the World Café Workshop method (see Figure 5). The first exercise (Exercise 1) consisted in validating the barriers, identifying new ones and highlighting the OGs that are related to each barrier. The participants discussed the barriers from their own group to start with and after a first round of discussions they proceeded to go around the tables adding new insights to the rest of the barriers. The moderator stayed at their group table while the rest of the participants went around the other tables validating and expanding the results. WE&B acted as main moderator of the session

After a short break, the second exercise (Exercise 2) was carried out, which consisted of connecting the stakeholder target groups that may have a role in each specific barrier. Finally, the workshop ended with a round of general feedback and a discussion on the next steps for the second workshop design and implementation. It was agreed that a total of four FCM Workshops 2 would be held, one in each country of the OGs (Belgium, Spain, Italy and Ireland), to expand the results of the FCM Workshop 1 in a country-specific view. This way, the general data was to be validated and refined in each country's context, allowing for a deeper analysis of the local challenges and barriers for the implementation of the OGs outcomes.

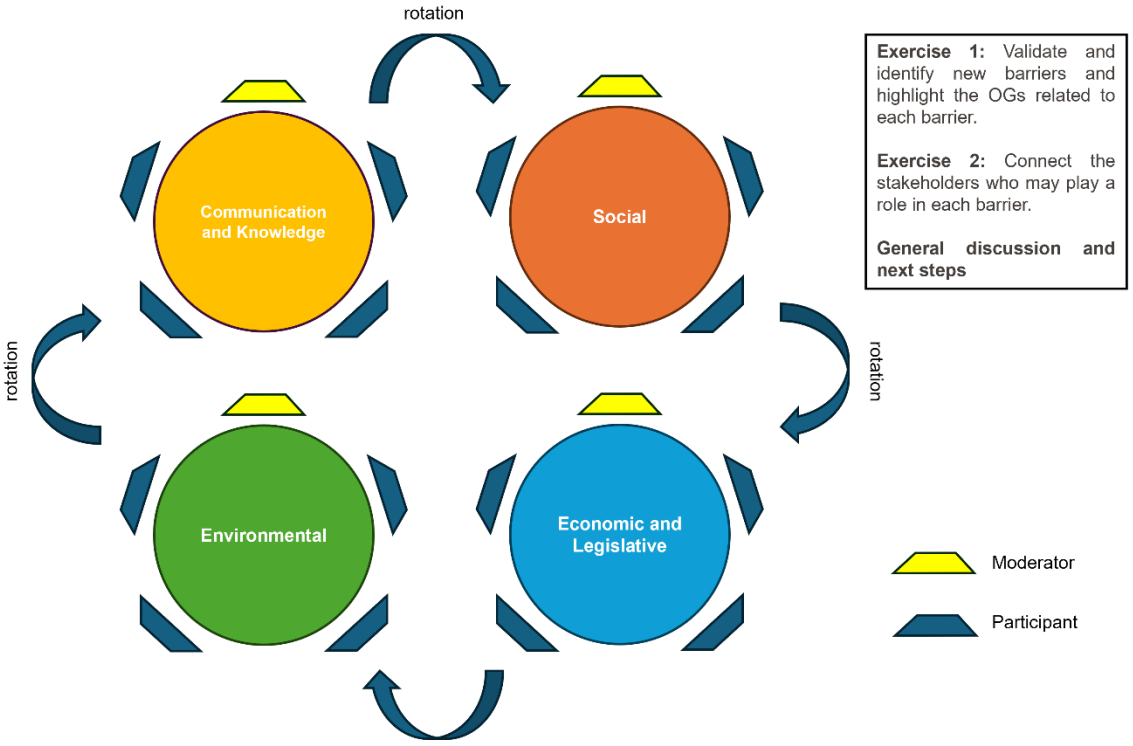

Figure 5: Structure of the FCM Workshop 1 in the GenA

The material for the workshop was prepared in advance using the list of barriers and stakeholders previously identified, together with the list of OGs and outcomes of the OGs. Posters and flash cards with the barriers, the OGs and the stakeholder categories were used as the basis for indicating the connections, and post-it notes were used by the stakeholders to add any new barriers, stakeholders, or additional information.

Post-Workshop

All the new inputs discussed during the workshop were gathered on the posters (see Figure 7). These results were then digitalised into an Excel document that was imported to Kumu[3], an online software for creating systems maps (further elaborated in Section 2.2.3).

In the map of the FCM Workshop 1 it was portrayed the connections between the barriers and the stakeholder target groups. Additionally, five separate views that correspond to the five barrier categories were created. The results of this exercise served as a basis for the FCM workshops in the four countries of the project. The resulting FCM exercise is presented and further detailed in the results section 3.1.

[3] https://kumu.io

Figure 6: Pictures of the FCM Workshop 1 in the GenA in Wexford, Ireland (21st February 2024)

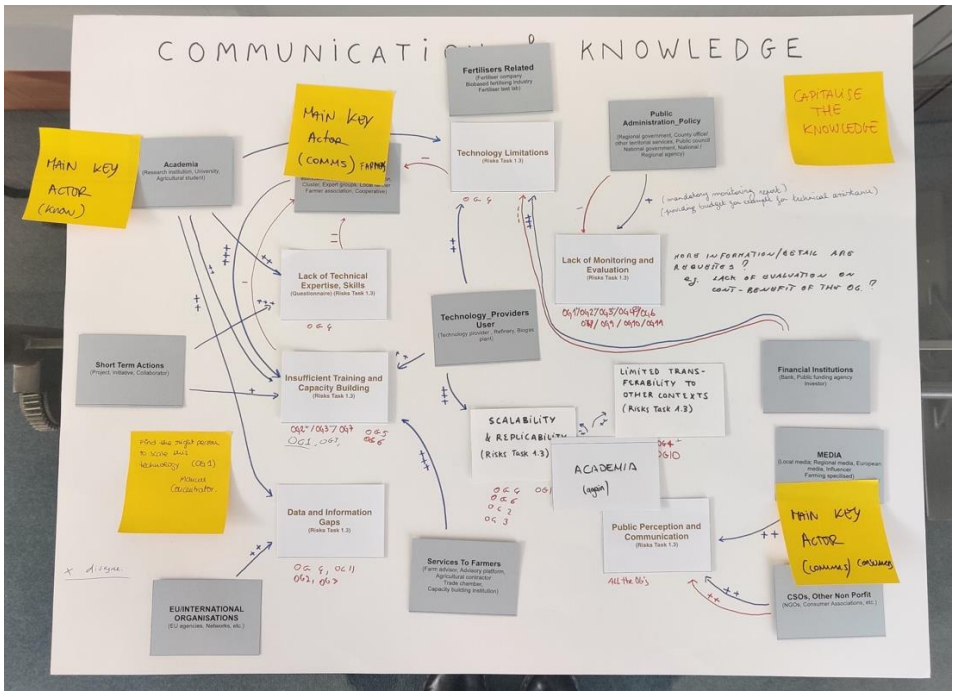

Figure 7: Picture of the Communication and Knowledge poster co-created in the FCM Workshop 1

2.2.2. Step 2: FCM Workshop 2 in each country

The second step of Task 2.3 consisted in the organisation of the four local FCM workshops: in Spain, Belgium, Italy, and Ireland. The workshops were organised by the NUTRI-KNOW partners of each country with the guidance from WE&B. Most workshops were arranged during pre-existing conferences and events to benefit from the attendance of relevant stakeholders.

To organise the workshops, the partners followed the FCM workshop protocol, produced and further refined after the first workshop during the GA (see Annex 3). The protocol provided the detailed plan of the workshop, the supporting material, the reporting template, and the consent letter for participants. Consent must be gathered from the workshop participants according to the GDPR regulation and NUTRI-KNOW Ethics Plan (D6.2). The local FCM workshops took place as described in Table 2 below.

Table 2: Date and location of each in-country FCM Workshop 2

Place of the workshop	Date of the workshop	Partners involved
During the ManuREsource conference in Antwerp, Belgium	20th and 21st March 2024	UGENT, BE
Online and at the PROFEM event in Vic, Spain	14th and 16th May 2024	UVIC, DACC, FCAC, WE&B
Tecnopolo di Reggio Emilia, Italy	13th May 2024	CRPA
During the BBioNets and Novafert workshop in Wexford, Ireland	23rd April 2024	Teagasc, IOA

For the local workshops, digital and printed versions of the map generated in Kumu were created and a handout for each category was provided. For the Italian and Spanish workshops, the documents were translated into the local language of Italian and Catalan. (See the example of the Catalan document presented in Figure 8).

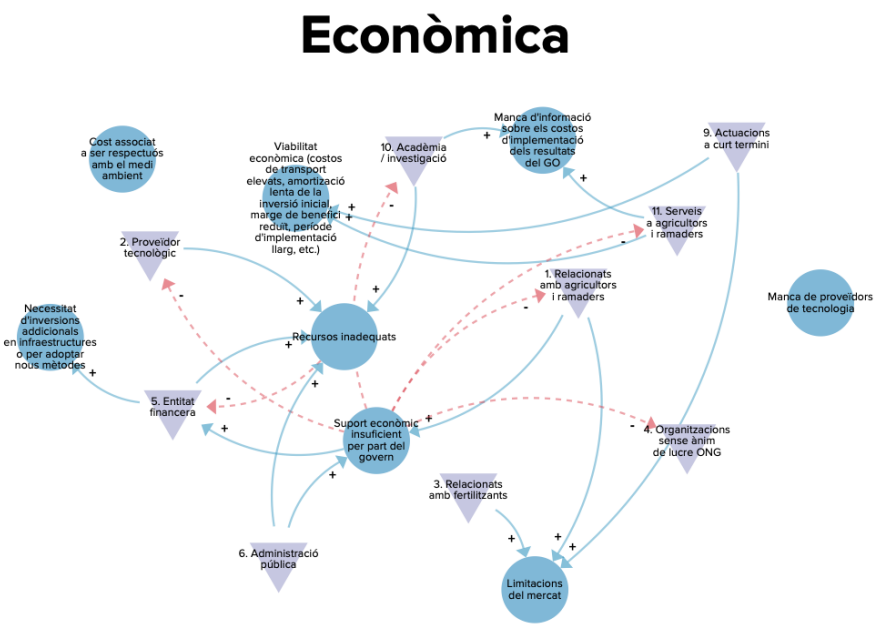

Figure 8: Translated version of the economic barriers map

During the local workshops, previously identified barriers were validated and expanded on with local insights. Furthermore, new connections and stakeholders were identified, together with extra inputs on some of the challenges presented. Incorporating a local perspective enriched the data from our initial workshop, broadening our understanding of the challenges in implementing outcomes in the different contexts.

Following the local workshops, the partners in charge of each workshop prepared the workshop reports (see Annex 4) to assist in the analysis and integration of the results. The reports encapsulated the details, attendance and insights from the workshops, providing a comprehensive overview of the sessions, participant engagement, and the key takeaways.

The following sections provide detailed explanations of how each FCM Workshop 2 was organized in each country.

FCM Workshop 2 in Belgium

The Belgian FCM workshop was co-organized with the 6th ManuREsource conference, held from March 20-22, 2024, in Antwerp. The workshop was held on the 21st March 2024 from 11:10 to13:10 and was titled "*Translating Agricultural Knowledge into Action: Unveiling the Barriers and Needs with Stakeholders' Insights*". It was formatted as a round-table discussion. An invitation to the conference's digital program included the workshop's objectives, moderator information, and a brief agenda. UGent and Biogas-E facilitated the workshop.

Figure 9: Photos from the Belgium FCM Workshop 2

The interactive round-table discussion was split into two one-hour sessions, each with distinct programming. The first session had seven external participants, while the second had five, totalling twelve participants. These individuals represented six countries—Belgium, the Netherlands, Finland, Spain, Austria, and Canada—and represented five of the NUTRI-KNOW stakeholder target groups: (i) academia, (ii) public administration and policy, (iii) farmers-related, (iv) service to farmers, and (v) media.

FCM Workshop 2 in Spain

This workshop was divided into two sessions: an online session held on the 14th of May from 10:00 to 11:30, and an in-person session on the 16th of May from 14:00 to 15:30 during the PROFEM Conference in Vic, Catalonia. PROFEM is a biennial event focused on organic production and sustainable fertilisation, providing a platform for knowledge dissemination, technological innovation, and experience exchange among agricultural professionals. The conference includes lectures, roundtable discussions, and practical demonstrations to promote sustainable agricultural practices. Utilising the PROFEM event, UVIC-UCC organised a space to hold the NUTRI-KNOW FCM Workshop.

Key stakeholders in the Catalan agricultural sector, including public administrators, farmers, businesses, and NGOs, were contacted through UVIC-UCC, FCAC, and DACC to align with the workshop's objectives. These stakeholders were selected for their significant influence and trusted relationships with the NUTRI-KNOW consortium entities to ensure high-quality responses. Personalised emails, based on a template from the WP2 leaders, were sent to each stakeholder, outlining the workshop's objectives, duration, their importance as participants, and how they and their institutions could contribute. Both workshops were facilitated by UVIC-UCC, DACC, FCAC and WE&B.


Figure 10: Photos from the Spanish FCM Workshop 2

FCM Workshop 2 in in Italy

The Italian workshop was held by CRPA on the 13th of May 2024, at 10:00 -12.30 at Tecnopolo di Reggio Emilia. The workshop provided a platform for farmers and stakeholders to discuss best practices and challenges in nutrient management. The agenda included registration, opening remarks, project presentations, participant introductions, and two workshop sessions focusing on the barriers to applying project results and identifying key stakeholders. The event concluded with a summary of the discussions. Participants were invited via phone and email by CRPA, and the event was promoted on LinkedIn and with a poster at the venue. The participants included stakeholders from the public administration, research, media and farmers-related NUTRI-KNOW target groups.


Figure 11: Photos from the Italian FCM Workshop 2

FCM Workshop 2 in Ireland

The NUTRI-KNOW IOA and Teagasc partners participated in a workshop hosted by the European-funded projects BBioNets and Novafert on April 23, 2024, at the Teagasc Research Centre in Wexford, Ireland. The workshop focused on the Irish bioeconomy, biobased fertilisers, and barriers in the nutrient value chain. Key objectives included understanding knowledge needs, research and technical development, barriers within the legal and political framework, and the acceptance by farmers and environmental protection.

The workshop was held from 11:15 to 13:00 and was integrated with the BBioNets workshop due to shared themes. Each theme was discussed during 15 minutes for barrier validation, followed by 10-12 minutes to identify relevant stakeholders. A general discussion then took place, with important topics recorded. Participants were encouraged to move around and engage in discussions throughout the session. Key stakeholders in the agricultural and forestry sectors were identified and contacted by email by IOA and Teagasc to align with each project's intended stakeholders for the workshop. A follow-up email with the agenda and event details was sent two weeks before the event. On the day of the workshop, 13 participants from academia, the public sector, the private sector, and society attended.

Figure 12: Photos from the Irish FCM Workshop 2

2.2.3. Step 3: Data analysis

The integration of the results from Step 1(FCM Workshop 1) were collected and integrated into Kumu as a systems map.

The resulting map is structured in elements or nodes and connections based on the model presented in section 2.1. The elements are represented as circles if they are a barrier or as an inverted triangle if they are a stakeholder target group. The barriers are coloured according to the category to which they belong: Environmental (green), Social (orange), Communication & Knowledge (yellow), Economic (blue), and Legislative (grey). A general view with all elements was created, and a separate view of the map for each of the categories of barriers as also developed, which provides a more detailed perspective of the stakeholders' connection to each barrier.

The map was further updated including all the data collected during the four FCM Workshop 2. Data has been reported by the partners in the workshop reports (Annex 4). The reports present the insights of the participants for each category and the modified maps that were used during the workshops. The data was logged into Kumu in order to create the final maps. There is a map for each category which is further detailed in section 3.

To be able to import the data into Kumu, which works in terms of elements and connections, an excel spreadsheet was created. This database contains one sheet for elements and one sheet for connections. The fields that were collected are the following: barriers, stakeholder, category of barrier, description or notes about the barrier or stakeholder, related OGs, country specificity, connection (positive or negative), and weight of connection (1-3). This document contains all the information from the posters from each in-country workshop (see Annex 5). Once the Excel document was complete, the data was uploaded into Kumu, which creatds a systems map that links the elements, which are the barriers and stakeholders.

3. Results

This section presents the results of the workshops, which is organised according to the results from the FCM Workshop 1 (section 3.1), and with the results from the four in-country FCM Workshops (Section 3.2). The final section (section 3.3) provides the final map with all the data collected from the workshops.

3.1. Results from the FCM Workshop 1

The FCM workshop 1 aimed to explore the role of stakeholders in either addressing or emphasising the importance of the barriers in the acceptance of the outcomes of the OGs from farmers and practitioners. Serving as starting point for the in-country local workshops, it was also intended to be a training and validation exercise with the NUTRI-KNOW consortium. The full list of participants is presented in Annex 5.

During the workshop the barriers were validated, as well as the OGs related to these barriers, together with connections with the stakeholder target groups. Furthermore, new barriers and connections were identified from the Table 1: List of barriers identified from Task 1.3 and integrated with the new findings of the stakeholders' questionnaires in Task 2.2), together with additional insights and reflections. The new identified barriers following this workshop include:

- "Different timings" – Communication & Knowledge category.
- "Lack of technology providers" – Economic category
- "Cost associated to be environmentally friendly" – Economic category

The general view of the system map, including all five themes of barriers is presented in Figure 13. A dynamic view of the map is available on the Kumu website. The details from each barrier, such as its associated OG, are shown on the description panel of each element in the Kumu website (see Figure 14).

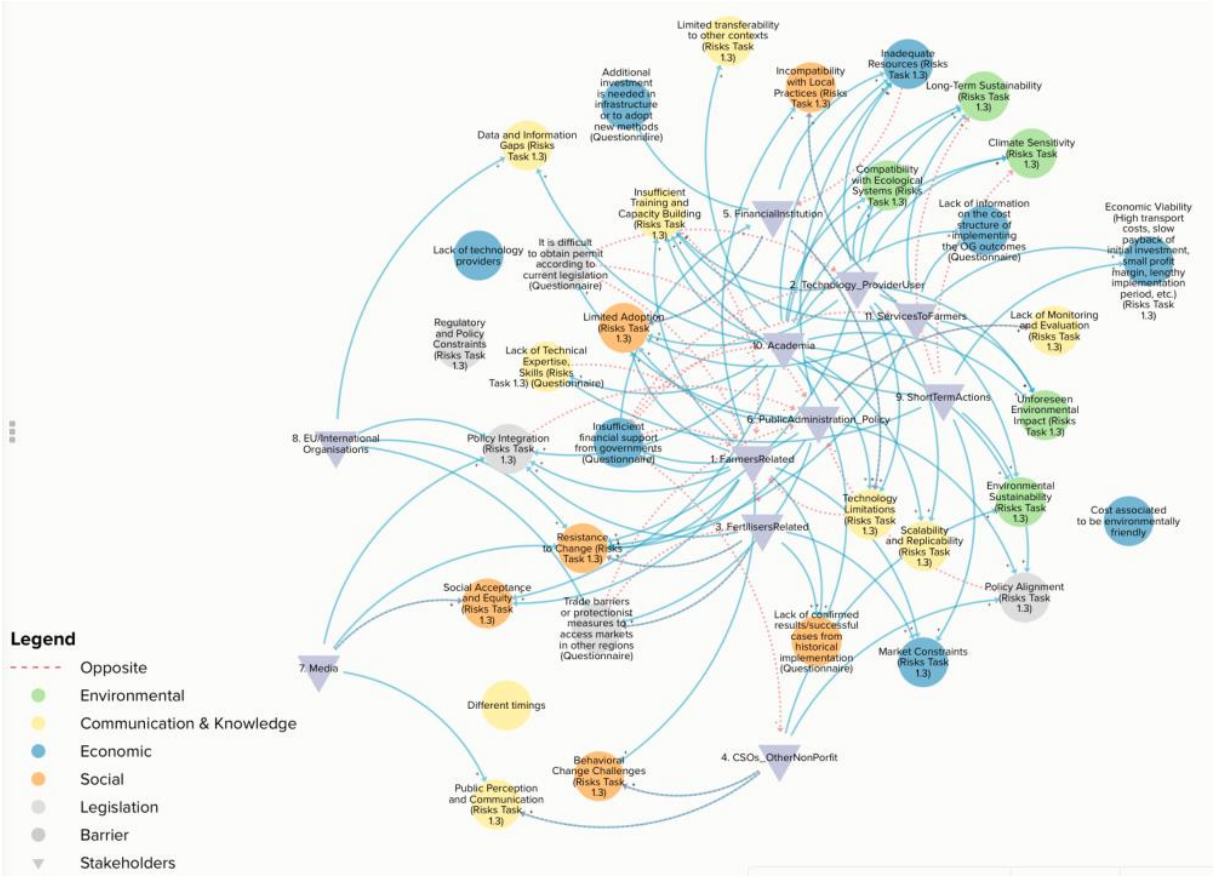

Figure 13: General view of the barriers map of the FCM workshop 1 available through this link.

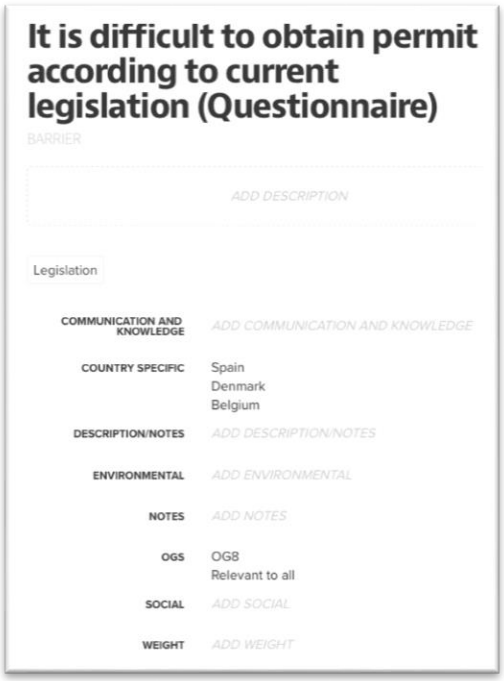

Figure 14: Example of details of a barrier as presented in Kumu

A separate view of the map for each of the themes was also created, which provides a more detailed perspective of the stakeholders' connection to each category of barriers.

The following section details the content of the FCM Workshop 1 discussions, organised by barrier category. It also shows how each view of the FCM Kumu map was developed with these results.

Legislative

Figure 15 provides the results of the view of the FCM Kumu map related to the Legislative category arising from the discussions in the FCM Workshop 1.

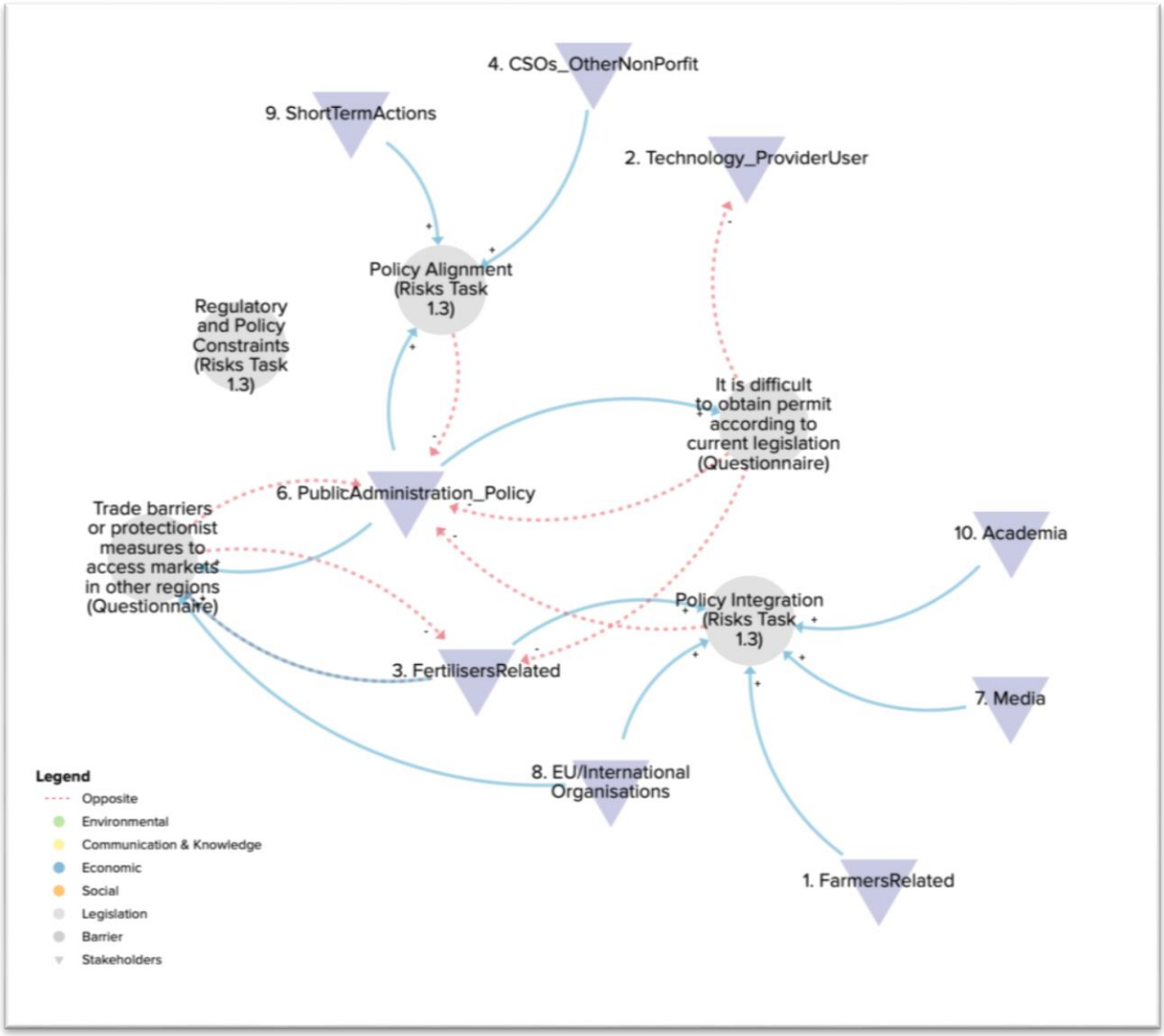

Figure 15: Legislative view of the barriers map of the first FCM workshop 1 available in Kumu.

For the category of legislative, the role of **public administration** was especially highlighted in overcoming the barriers related to the implementation of the OGs outcomes. Public administration not only has the ability to address certain legislative barriers but can also contribute to their creation or perpetuate their existence. This two-folded matter is represented as a double connection (both positive and negative) on the map.

The most prominent legislative barriers are (1) "**trade barriers or protectionist measures to access markets in other regions"** and (2) "**policy integration"**, followed closely by (3) "policy alignment" and (4) "difficulty in obtaining a permit according to the current legislation"

Organisations related to the fertiliser industry were identified as important actors in addressing the barriers, together with EU/International organisations, who can also positively influence the integration of policies and overcome trade barriers.

The target groups media, farmers-related and academia were connected only to "policy integration". CSOs and other non-profits, and short-term actions were linked to "policy alignment" as potential enablers, while technology providers were identified as playing a role in hindering the obtainment of legal permits. For conventional technologies, changes in legal status can impact provider profits or compatibility, while for innovative technologies, restrictive intellectual property (IP) or licensing terms can limit users' ability to modify the technology to meet local regulations,

complicating the permitting process if adaptations are required to comply with legal standards. Lastly, the barrier of “regulatory and policy constraints” remained unconnected to any of the stakeholder target groups.

Economic

Figure 16 provides the view of the FCM Kumu map related to the Economic category as arising from the discussions in the FCM Workshop 1.

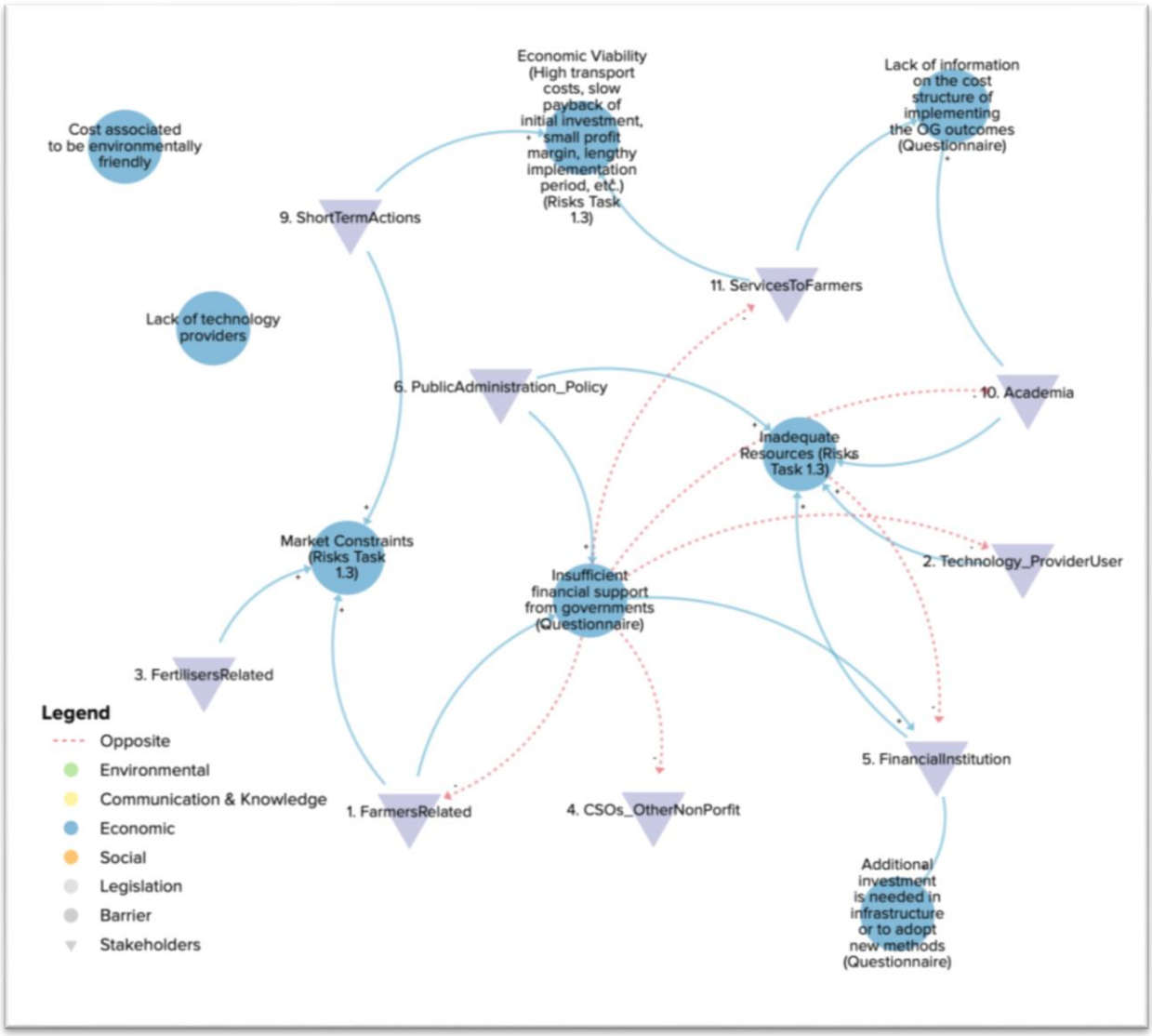

Figure 16: Economic view of the barriers map of the first FCM workshop 1 available in Kumu.

Regarding the economic category, two additional barriers were identified: the "cost associated with being environmentally friendly", and the "lack of technology providers". The most prominent barriers are (1) "**insufficient financial support from governments"** and (2) "**inadequate resources"**. To both barriers, the public administration was identified as a relevant stakeholder to overcome them. Additionally, many stakeholder target groups were marked as being negatively influenced by this barrier. These target groups are services to farmers, academia, technology providers, CSOs and other non-profit entities, and farmers-related stakeholders.

Another important barrier identified was "market constraints", which can be addressed by short-term actions, fertilisers-related stakeholders and farmer-related stakeholders. An example of a short-term action is the OGs and the NUTRI-KNOW project. Fertiliser-related and farmer-related stakeholders are crucial for the new fertiliser market. They can set up initiatives or small-scale local markets for specific types of fertilisers, serving as role models to promote adoption in different regions. Their perspectives and actions can significantly influence policymakers to address market constraints.

Financial institutions were marked as a key actor and linked to tackling the issue of “inadequate resources” and the “need for additional investment in infrastructure or to adopt new methods”. Technology providers were also identified as playing a role in solving the inadequacy of resources.

The last two barriers are (1) the “economic viability”, which can relate to the elevated transport costs, the slow payback of initial investment, or the small profit margin, among others, and (2) the “lack of information on the cost structure of implementing the OGs outcomes”. The stakeholders that can address these barriers are academia, short-term actions, and services to farmers.

Lastly, both for the Legislative and economic themes, **media** was identified as a supporting actor in overcoming the barriers.

Social

Figure 17 provides the view of the FCM Kumu map related to the Social category arising from the discussion in the FCM Workshop 1.

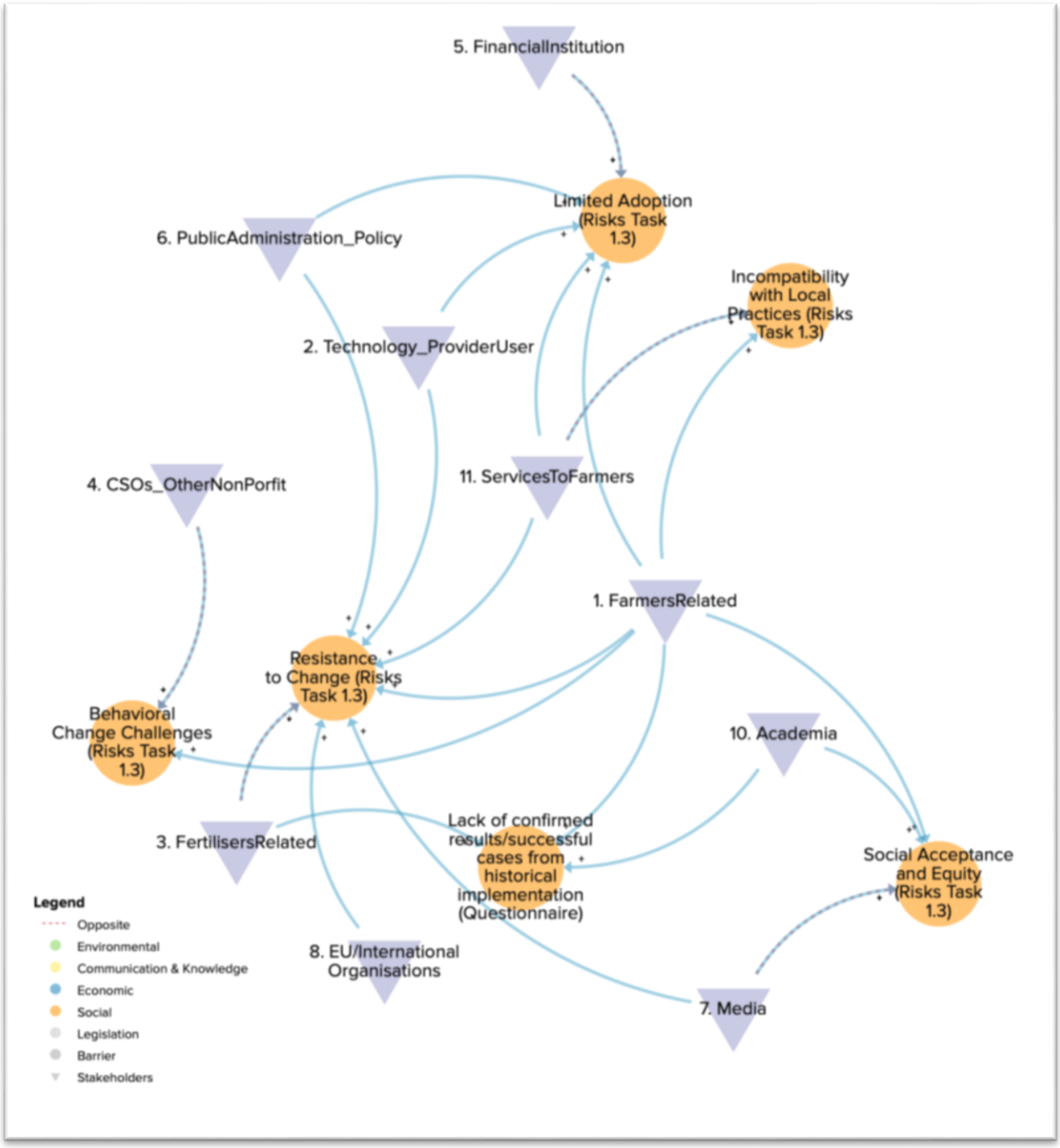

Figure 17: social view of the barriers map of the first FCM workshop 1 available in Kumu.

In the social category, the most relevant barrier is "**resistance to change"**, followed by a "**limited adoption"** of the practices. It was provided as an example that some NGOs were reluctant to implement new technologies and only use traditional farming techniques. All target groups except for academia, financial institutions and CSOs and other non-profit, were connected to "resistance to change" as potential enablers.

The **farmers-related** target group was highlighted as the main key actor in being able to overcome the social barriers. Thus, it was connected to all barriers.

Furthermore, it was discussed during the workshop that the barrier of “limited adoption” was linked to other two barriers, namely “lack of confirmed results/successful cases from historical implementation”, and “resistance to change”. It was also mentioned that to address the “limited adoption” of the practices, it was important to understand the different stages where this adoption can take place in the nutrient value chain. This barrier was connected to the following target groups that are able to address it: farmers-related, services to farmers, technology providers, public administration and financial institutions.

In addition to the farmers-related target group, other relevant stakeholders in addressing the social barriers include academia, public administration, technology providers, services to farmers, fertilisers-related and media.

Media and academia were connected to “social acceptance and equity”. Academia was also linked, together with fertiliser-related, to the “lack of confirmed results/successful cases from historical implementation”.

Lastly, the least connected barriers were “incompatibility with local practices” and “behavioural change challenges”. The first one was linked to services to farmers and the second one to CSOs and other non-profit (besides the farmers-related group that is connected to all).

Communication and Knowledge

Figure 18 provides the view of the FCM Kumu map related to the Communication and Knowledge category arising from the discussions in the FCM Workshop 1.

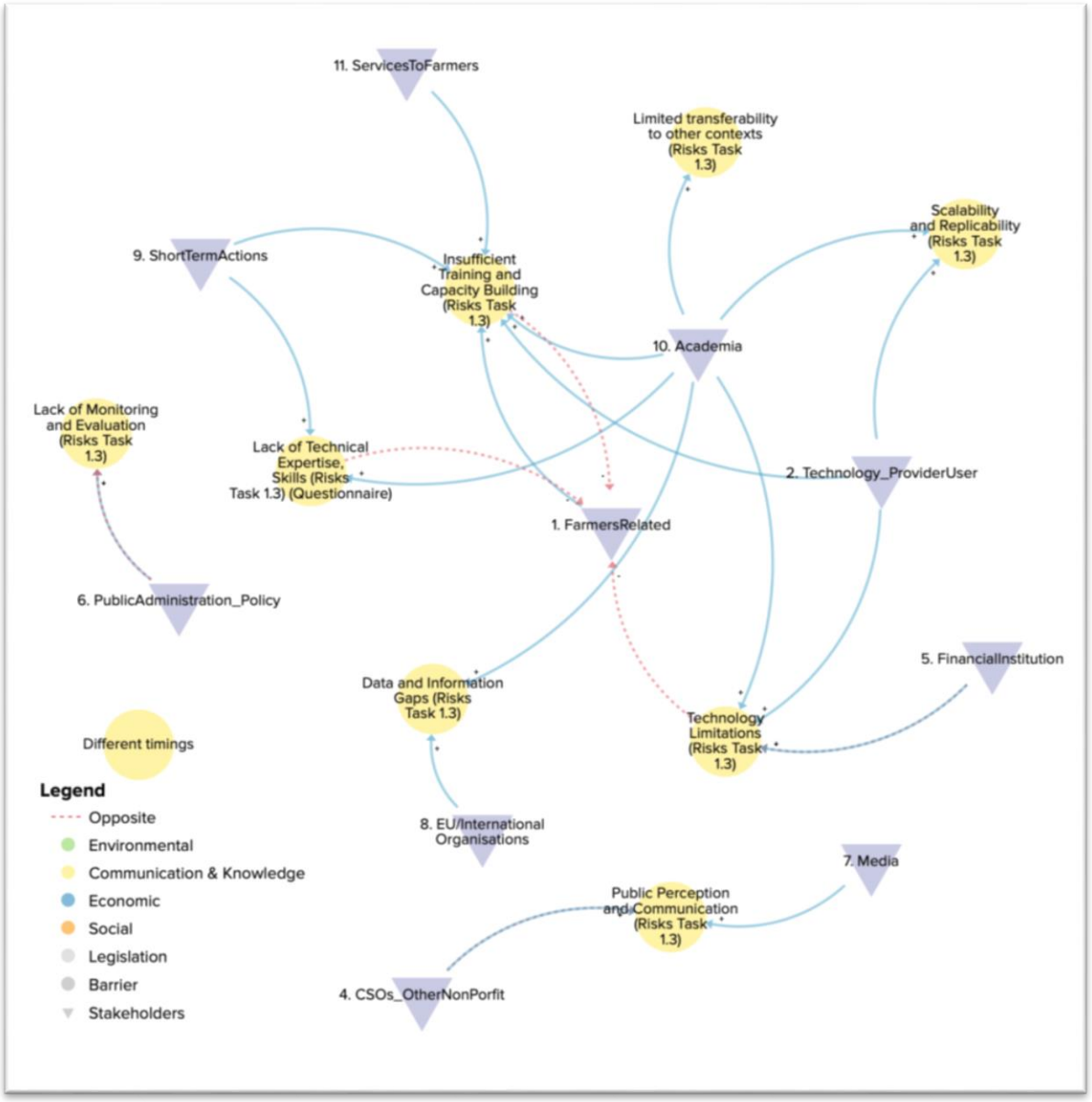

Figure 18: Communication and knowledge view of the barriers map of the first FCM workshop 1 available in Kumu

The **farmers-related** target group was highlighted as a key actor in this category. It was mentioned that farmer-to-farmer communication is essential in overcoming the communication barriers. **Media** was also identified as a key actor, particularly in relation to the communication with the consumers, so it was connected as an enabler to the barrier regarding "public perception and communication".

Regarding the knowledge aspect, the actor that plays a greater role in addressing the barriers is **academia**. During the workshop, academia was connected as an enabler to the following barriers: (1) "technology limitations", (2) "data and information gaps", (3) "lack of technical expertise and skills", (4) "insufficient training and capacity building", (5) "scalability and replicability", and (6) "limited transferability to other contexts". It was discussed the importance of **capitalising the knowledge** for the successful implementation of the outcomes of the OGs, where academia plays an important role.

Public administration was connected as a positive and negative stakeholder for overcoming the "lack of monitoring and evaluation" barrier.

The most connected barriers were (1) "**insufficient training and capacity building"** and (2) "**technology limitations"**. The target groups that can facilitate overcoming these barriers are the following: services to farmers, short-term actions, academia, technology providers, financial institutions and farmer-related stakeholders.

The workshop participants identified a new barrier, which they did not connect to any particular stakeholder: there are variations in the timing of communication and reception among the different stakeholders involved. For example, sometimes information about new innovations is shared while farmers are busy working in the field, making it difficult for them to receive and respond to the information promptly.

Environmental

Figure 19 provides the view of the FCM Kumu map related to the Environmental category as arising from the discussion in the FCM Workshop 1.

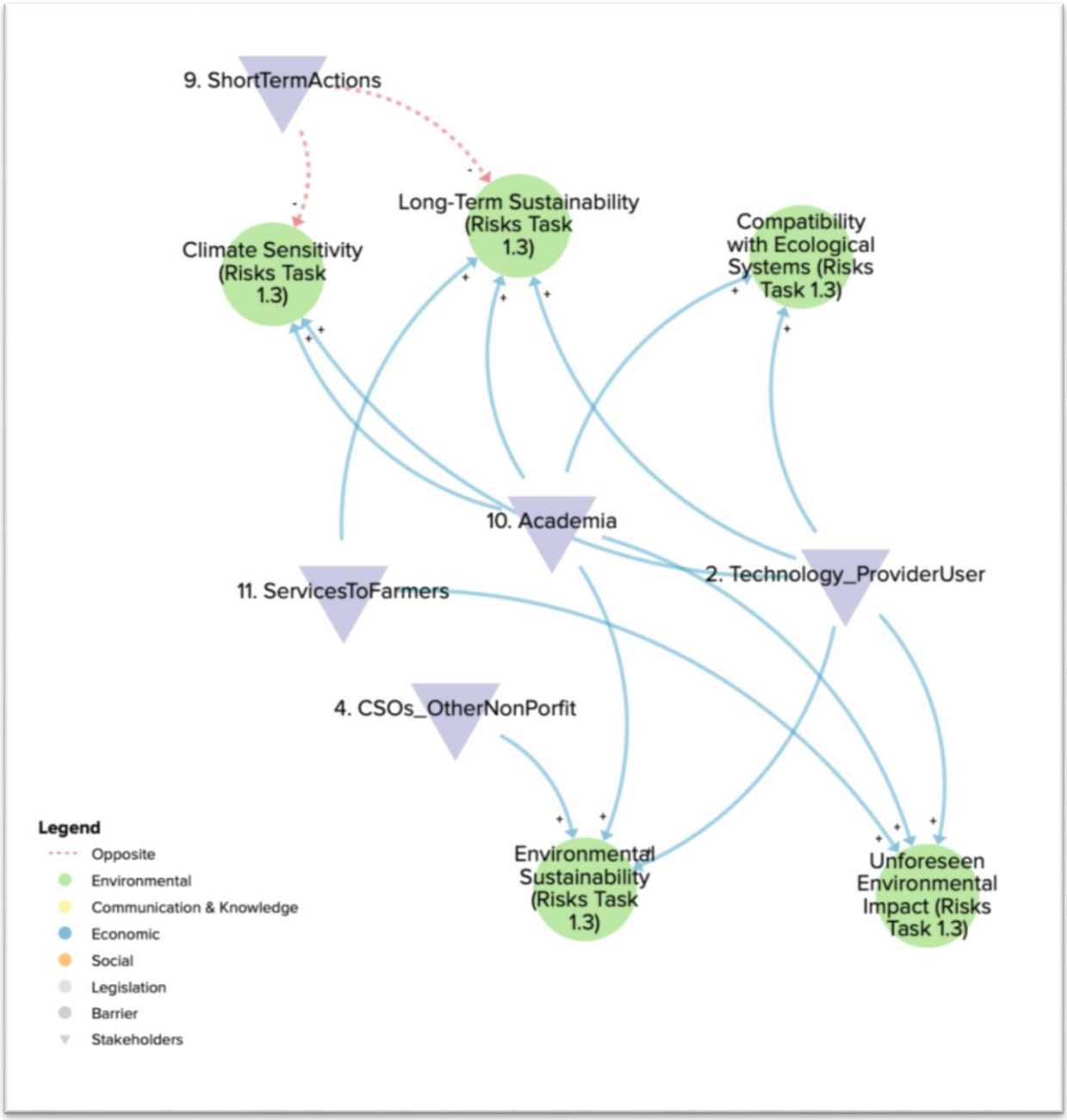

Figure 19: environmental view of the barriers map of the first FCM workshop 1 available in Kumu.

The European Union (EU) and international organisations were identified as key actors in overcoming the environmental barriers. Although they do not appear in **Error! Reference source not found.**, during the workshop they were marked as the main actor within this category. The role of **public administration** was also highlighted, particularly regarding strategies and policies such as the European Green Deal, the FARM2FORK strategy, or the common agricultural policy (CAP).

Academia was connected to all environmental barriers, as it was seen that research has a pivotal role in tackling sustainability challenges in the agricultural sector. It was discussed that academia is the first promoter of sustainable practices and that they are able to provide science-based

evidence that can help overcome the barriers for the implementation of the outcomes of the OGs and practices.

The target group fertilisers-related was not added as key stakeholders to be connected to a specific barrier or OG. In this regard, it was mentioned to have a positive effect on addressing the environmental barriers in general if the fertiliser used was organic or biobased, but to have a negative effect if it was inorganic.

Media was also generally mentioned and not connected to any barrier to have a potential bias on information, which could influence the barriers in different ways, positive or negative (however this is further detailed in the category Communication and Knowledge).

During the workshop, it was also discussed whether financial institutions had any interest in addressing the environmental barriers but decided not to include them as a relevant target group. It was mentioned that they can perpetuate some environmental barriers if they do not speed up the financing of more sustainable production schemes adapted to new innovations.

Lastly, technology providers were also connected to all barriers as having a positive influence in overcoming the barriers.

3.2. Results from the FCM Workshop 2 results

In this section we collect the evidence gathered from the discussions that took place during the FCM Workshops 2 in each country, the details of each meeting can be found in the workshop reports for each country.

Belgium

The Belgian FCM workshop was proposed to be co-organized with the 6th edition of ManuREsource conference (20-22 March 2024, Antwerp, Belgium)[4], in the format of a round-table discussion entitled "Translating Agricultural Knowledge into Action: Unveiling the Barriers and Needs with Stakeholders' insights"

Workshop participants

There were 7 external participants in the round-table Session 1, and 5 external participants in the round-table Session 2, which makes a total of 12 participants. These participants were from 6 countries (Belgium, the Netherlands, Finland, Spain, Austria and Canada) and belonged to 5 stakeholder groups: Academia, Public Administration and policy, Farmers-related, Service to farmers and Media.

Workshop settings

The workshop was organised at an international conference in two rounds of participation, allowing small group discussion. The results are presented combining insights from the two rounds.

Discussions per each category of barriers

- **Communication & Knowledge**

Communication and knowledge transfer should be timely and align with farming practices to be effective. Projects should be aligned with the farmers' practices. For example, communicate things

[4] ManuREsource is an international conference stimulating the exchange of experiences between regions on the policy measures taken for coping with manure surpluses in terms of manure management and treatment. Moreover, it aims to give an overview of the developments and innovations in manure treatment technologies and to explore various valorisation strategies for manure, such as energy production and nutrient recovery.

related to harvesting when the crop is being prepared or is taking place. Similarly, Academia should focus/align research efforts to specific farming periods, focusing on relevant topics at specific times. There is a noted disconnection between services to farmers and policy institutions, leading to barriers in effective policy information transfer. Both sessions acknowledged the risk of information overload for farmers and stressed the importance of using preferred communication channels like social media, apps, and practical on-site visits. Training and capacity building by CSOs and other non-profit organisations were highlighted as beneficial for addressing knowledge gaps and the barrier of "insufficient training and capacity building" by providing or promoting the service to society. Services to farmers were identified as key stakeholders in communication and knowledge as they are the closest related to the end users.

The participants identified via which communication channels they prefer to receive information:

- Social media was preferred.
- They also thought an app may be a good idea.
- The NUTRI-KNOW forum (CoP) was mentioned and the participants agreed that this is a good way to connect stakeholders and transfer valuable information between them.
- To reach the farmers, the participants mentioned the importance of on-site visits. Let them connect in real life, linked to something practical.

- **Economic**

Both sessions stress the crucial role of policy institutions in overcoming economic barriers. There is a clear need for better alignment between policy and short-term actions to provide adequate financial support and incentives, especially for technology providers and farmers. The lack of technology providers is more relevant to a certain scale requirement e.g. farmers may need innovations at the household scale. Still, such technologies may not be available on the market. This can negatively impact the fertiliser-related stakeholders (fertiliser company, biobased fertilising industry, fertiliser test lab).

The lack of financial backing and technology availability is a significant barrier, specifically mentioning the Spanish farmers' plight. Short-term financial gaps could be filled by financial institutions, but there is a consensus on the necessity for long-term policy to secure sustained financial support for innovation. In the case of technology providers there can be a negative influence when there are costs associated to being environmentally friendly.

- **Legislative**

Legislative barriers are addressed by emphasizing the dual impact of **policy institutions**, which can either facilitate or hinder policy integration. Disagreements between **policymakers** and conflicts between various directives present challenges. Current policies might be outdated (notably the Nitrates Directive; and e.g. between different DG's, between the CAP and Nitrates Directive) and not conducive to the adoption of new practices. Disagreements among different DGs may pertain to preferences for higher support for agricultural productivity versus environmental protection. This could result in varying directions and degrees of changes to current legislation or prolong the time needed to reach agreements.
The Nitrates Directives (91/676/EEC) for example, which was lively discussed during the ManuREsource 2024 conference, was issued more than 30 years ago. The limits may not be suitable for the current situation, or there is an **overload of regulations between the old and new ones**. It should be clear for **farmers** that the risk of doing nothing is larger than changing to systems with less risks. The fact that it is difficult to obtain a permit is also a major barrier for farmers to implement certain techniques/nutrient management practices Therefore, the participants suggested that **policy makers** should transition from past legislation and look more into the future.

The participants suggest a shift towards future-oriented legislation that is less restrictive and more supportive of innovation, reducing the negative impact on farmers.

Public administration and policy institutions are identified as key stakeholders related to legislative barriers. However, the participants also highlighted the impact of the whole society on policy direction. For example, society is supposed to set the general target (expectation), and the policy should reduce the limitations and risk in implementing the innovations.

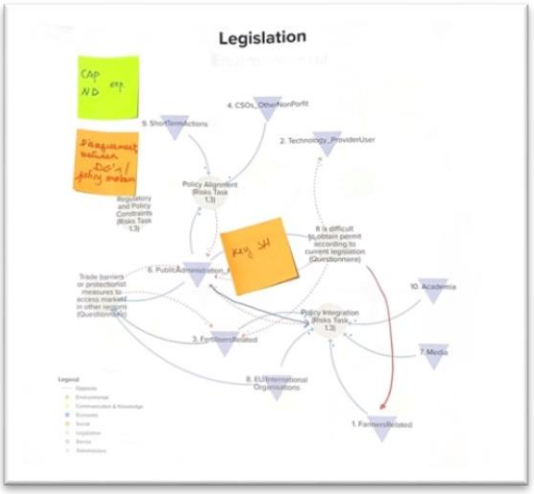

Figure 20: Results from the legislation discussion in the Belgium FCM Workshop 2.

- **Environmental**

The environmental aspect recognizes the general public's significant role in driving climate awareness and the need for farmers and academia to collaborate in addressing environmental impacts. Policy goals that aim for environmental sustainability could negatively affect farmers if they necessitate changes in practice. The dialogue in both sessions reflects on the importance of balancing environmental initiatives with stakeholder needs and aligning academic research with public engagement.

Given the impact of policy and social media on reflecting and affecting the opinions of the general public, the participants also highlighted public administration and policy institutions, as well as the media, as key stakeholders in addressing environmental barriers, while the connections could be negative or positive from case to case.

- **Social:**

Social aspects focus on the pivotal role of policymakers in driving technology adoption and the importance of public perception in social acceptance and behavioural change. The presence of technology providers and competition among them is seen as influential in the uptake of new technologies. Media's influence is significant in shaping societal views on innovation. The discussions underscore that consumer needs can prompt the adoption of innovative products, reflecting the interplay between market demand and the implementation of new technologies

Media is a key player in “social acceptance and equity”. Media can influence people’s opinion in a positive or negative way.

Italy

The workshop in Italy was not associated to any other event, and a specific session and time were dedicated to that effect. Thus, participants were selected and recruited by phone and email. As sub-objectives, special attention was devoted to explaining the project's expected outputs and the OGs unrelated to Italy in detail.

Workshop participants

The participants were from the following target groups:

- Two representatives from the regional public administration, from the agriculture department and the environmental department in the agency for prevention, environment and energy
- Two regional representatives from the public administration from the
- Two representatives from academia
- One representative from a training center for farmers, from the group service to farmers
- One representative from a technical media
- One local farmer and also member of a farmer association
- 4 Representatives from CRPA (NUTRI-KNOW -partners

Other people were invited and guaranteed their attendance but could not attend due to last-minute difficulties. Regardless, they received results and feedback after the workshop. Those were from the business sector, producers, a farmer association.

The participants were extremely interested in the issues addressed during the workshop and the discussion was very fruitful. Participants were given instructions and slides with links to the NUTRI-KNOW project website and the EU-Farm Book platform. They also showed interest in staying informed about the project's activities and developments.

Workshop settings

Participants could receive information related to the content of the workshop beforehand. The workshops were organised according to the procedure proposed in Annex 3. First, a presentation of the project and the expected results, and of the 12 GOs, was given. Subsequently, the participants were divided into two groups where they reviewed each of the FCM maps for each thematic category of barriers. The results, in the section below, are presented based on the conclusions drawn by the two groups. The two groups had the opportunity in a plenary session to share the results of the two groups.

Discussions per each category of barriers

- **Communication & Knowledge**

During the recent workshop, participants identified several key barriers impacting the agricultural sector, particularly focusing on succession planning, language, communication, and information dissemination. The discussion also highlighted potential solutions and the roles various stakeholders can play in addressing these challenges. No new stakeholders were added, but the participants created new links between stakeholders and barriers.

Another aspect highlighted by the participants is that barrier “limited transferability” to other contexts can be solved by stakeholder Academia:

- Favouring exchanges and study visits for farmers;

- Favouring knowledge and information sharing among farmers both in person and through technology.

This is because they stated farmers and agriculture in general need examples and direct testimonials.

- **Economic**

During the workshop, participants discussed several key points regarding the Common Agricultural Policy (CAP) and nutrient management. They noted that public administration policy could positively impact barriers related to the new CAP and the limited availability of nutrients.

The “lack of technology providers” was not considered a significant barrier. However, “economic viability” and the “lack of information on the cost structure of implementing OG outcomes” were identified as substantial challenges.

Within the Services to Farmers category, the role of subcontractors and control services was emphasized. These entities should focus on balancing nutrients between surplus and deficit areas and genuinely serving the farmers rather than enforcing regulations without in-depth knowledge.

Overall, participants stressed that nutrients should be viewed as an opportunity rather than a waste product.

- **Environmental**

Participants in the workshop discussed various barriers to improving environmental sustainability, focusing on the lack of environmental labels on products and the high costs of innovations to reduce environmental impact. It was highlighted that:

- **„Lack of Environmental Labels“**: The absence of clear environmental product labels limits consumer awareness. Stakeholders such as the media, research centers, and large-scale retail trade were identified as key influencers who could help address this issue.
- **„High Costs of Innovations“**: The significant expenses associated with innovations aimed at reducing environmental impact were recognized as a major barrier. Technology providers were noted as crucial stakeholders who could help mitigate these costs.

Additionally, while some participants were sceptical about the role of “unforeseen environmental impacts” as a barrier, arguing that it is not a stand-alone issue, there was a consensus on the critical responsibility and influence of research centers and university researchers in overcoming most of these barriers.

- **Legislative**

The workshop highlighted the challenging dynamics between farmers and commercial sellers of nutrients. Farmers often struggle with the technical language and marketing strategies used by sellers, which can lead to misunderstandings and mistrust. Participants emphasized the need for better communication channels and more transparent practices to foster a more cooperative relationship. The geographical and informational distance between producers (farmers) and end-users of agricultural products was identified as a significant barrier. However, using social platforms and digital communication tools was recognized as a promising solution to bridge this gap. The issue of social acceptance of agricultural waste disposal practices was also discussed here(as it belongs to the “Social” category). Participants noted that many citizens have concerns about the environmental impact of these practices. There was a consensus on the need for educational campaigns and transparent communication to inform the public about sustainable disposal methods and their benefits, thereby increasing social acceptance. The generational gap in the agricultural sector poses a challenge, particularly in terms of adopting new technologies and practices. The workshop participants agreed that this gap can be reduced through the combined efforts media and academia stakeholders. Lastly, the issue of farmers being tied to a single trade association was discussed. This exclusivity can limit farmers' access to diverse resources and opportunities. Participants suggested the need for policies and initiatives that encourage farmers to engage with multiple associations, thereby broadening their support network and access to information.

The participants also affirmed that stakeholders related to fertilisers, CSOs, and other non-profits are not only stakeholders but also barriers. The last one, in particular, is severely linked to stakeholder public administration policy and to barrier “regulatory and policy constraints” and can positively or negatively impact on them according to the actions they decide to undertake.

- **Social**

Participants highlighted ongoing challenges in the relationship between farmers and nutrient suppliers. Communication gaps and differing expectations often hinder effective collaboration.

The physical and relational distance between producers and users of agricultural products was discussed. Stakeholder media was identified as a crucial tool to bridge this gap by facilitating better communication and understanding between the two groups.

There is a need to improve the social acceptance of disposal practices among citizens. Participants recognized the importance of educating the public to enhance understanding and acceptance.

Generational gaps in the agricultural sector are a challenge. Stakeholder media and academia are seen as key players in reducing these gaps by promoting knowledge transfer and encouraging engagement from younger generations.

The limitation of farmers being tied to a single trade association was discussed. This can restrict their access to diverse resources and information, potentially hindering their growth and adaptability.

It was acknowledged that citizens have a significant role in overcoming barriers related to “social acceptance and equity”. Their active participation and support can drive positive changes in the agricultural sector.

Farmer Advisors were identified as influential in addressing the barriers of “limited adoption” and “resistance to change”. Their guidance and expertise can readily help farmers adopt new practices and technologies more readily.

The importance of fostering interactions between different educational entities (academia), particularly universities and institutions of higher education, was emphasized. Such collaborations can enhance the overall quality of education and research in agriculture, leading to more innovative and effective solutions.

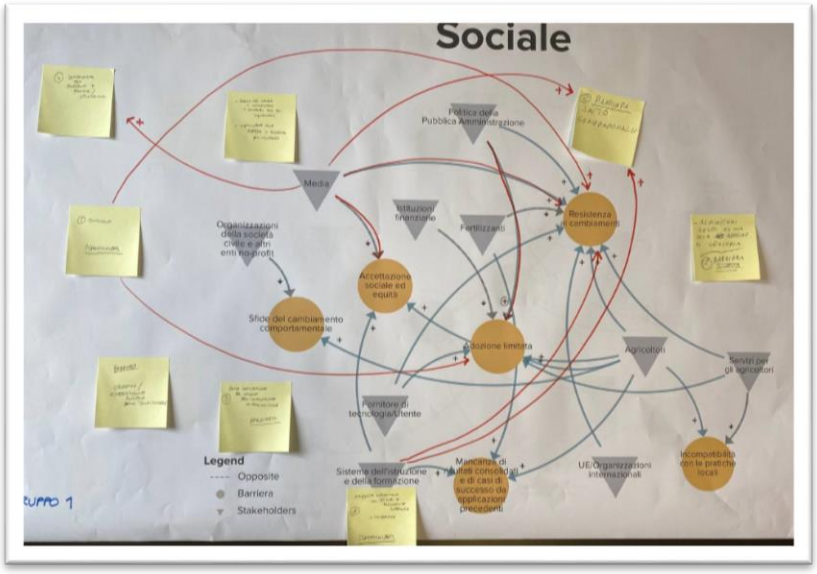

Figure 21. Results from the exercise with stakeholders in Italie about Social Category in the FCM Workshop 2.

Ireland

The Irish FCM workshop 2 joined forces with two other European projects that also needed to engage with stakeholders, BioNets and Novafert. Join discussions were organised on the Irish bioeconomy resources, needs and biobased fertilisers, including addressing barriers on the nutrient value chain.

The objectives of the meeting were to gain insights into key problem areas of the nutrient value chain with a focus on biobased fertilisers in terms of: Knowledge needs, research and technical development, barriers, legal framework and political willingness and perception of farmers and practitioners and environmental protection.

Workshop participants

Key stakeholders in the agricultural and forestry sectors participated to align with the intended stakeholders for each project involved with the workshop. A good range of participants from academia, public sector, private sector and society participated in the workshop, with 13 individuals participating. Specifically, there were participants from the following:

- Service to farmers: Agricultural sales
- Technological providers in mechanical separation tools
- Technology provider- Technological development for refining poultry manure
- Academia: Teagasc forestry specialist
- Irish Organic Association (NUTRI-KNOW partner)
- Academia: Teagasc organic specialist
- Academia: Scientific Officer Environmental Protection Agency
- Academia: Munster Technological University
- Public Administration: Technological development in waste management services
- Teagasc Research Officers(NUTRI-KNOW partner)
- Local farmers

Workshop setting

The workshop took place on 23rd April 2024, jointly with the European-funded projects BBioNet and Novafert. The FCM WS2 was included with the BBioNets workshop due to similar themes being discussed. 15 minutes per theme was given to the group to validate the barriers. 10-12 minutes were given to identify the relevant target stakeholders. After this, a general discussion took place, and any important topics were recorded. The participants were encouraged to move around, circulate the room, and participate in discussions.

Figure 22. Discussion about main barriers in the irsh sector in the FCM Workshop 2.

Discussions per each category of barriers

- **Communication & Knowledge**

Participants highlighted the inadequate support mechanisms for encouraging local production of alternative fertilisers. This lack of support extends to a limited understanding of the value of recycled organic materials. The need for policies and incentives to promote local initiatives was emphasized to foster sustainable practices and local economies.

The discussion underscored the necessity for enhanced collaboration between research institutions, companies, and the industry. Such partnerships are crucial for developing and deploying advanced nutrient management technologies.

There was a consensus on the need for more scientific research focused on nutrient management technologies. The aim is to identify and develop alternative fertilisers that can replace chemical fertilisers without compromising crop yield or quality.

The workshop identified a significant information gap for advisory and extension services that support farmers. There is a need for comprehensive information on the bioeconomy and related technologies.

- **Economic**

The discussion focused on the critical need for regional capacity-building to effectively process and valorise organic manures and other green waste. Participants stressed the importance of developing infrastructure and expertise in methods such as composting and separating solid and liquid fractions.

- **Environmental**

In the workshop, the importance of using the correct fertiliser at the right time, rate, and place to protect the environment was mentioned.

Participants highlighted that the barriers in biobased fertiliser use include having full proof that products are safe for use on crops and for human consumption, which is very important to the farmer e.g., sewage sludge.

Finally, as mentioned, using correct terminology for different categories of biobased fertiliser products is key for their acceptance and use. This barrier is more related to the "communication & knowledge" category.

- **Legislative**

Participants identified a significant lack of policy support regarding the application and use of biobased fertilisers. This issue was prominently discussed in the FCM workshop 1, where it was noted that existing policies do not sufficiently encourage or facilitate the adoption of biobased fertilisers, hindering their widespread use and potential benefits.

- **Social**

Participants suggested fostering relationships and partnerships between livestock and tillage operations to facilitate the exchange of organic materials. This collaboration can optimize nutrient flows and improve soil health, creating a more integrated and sustainable farming systems.

In terms of social themes, the FCM workshop did not address the "lack of confirmed results or successful cases from historical implementations", nor did it mention "resistance to change". These social barriers, noted in other discussions, indicate the need for demonstrating successful case studies and managing change resistance to enhance the adoption of new technologies and practices.

Spain

The workshop in Spain was divided into two sessions: an online session held on 14th May and an in-person session held on 16th May titled 'Workshop NUTRI-KNOW Project: Dialogue Between Key Actors for Better Nutrient Management in Catalonia'. The second session was organised during the PROFEM conference "Biofertilisers: Challenges for a Real and Effective Nutrient Recovery" in Vic. PROFEM is a biennial event focused on sustainable fertilisation and organic production. It offers professionals in the agri-food sector the opportunity to participate in lectures, roundtable discussions, and practical demonstrations, facilitating knowledge exchange. By using a space within the conference to conduct this workshop, a wider range of participants was reached. The two workshops aimed at collecting inputs and adapting the FCM general map created to the Catalan context.

Workshop participants

The first online session gathered participants from the stakeholder target groups farmers-related and public administration, particularly cluster, farmers' cooperatives, farmers' trade unions, and professional associations. These stakeholders were selected upon their power and influence within the agricultural sector in Catalonia and upon the needs and scope of the project.

In the second session the attendees were directly recruited from the attendance list. The attendees belonged to the farmers-related, academia, fertilisers-related, public administration and technology providers target groups.

Workshop settings

The online session started with a brief introduction to the NUTRI-KNOW project and a description of the workshop's aim. It was followed by an exercise focused on validating the existing barriers, identifying new ones, and connecting them to the stakeholder target groups.

This activity was conducted with the tool MIRO[5], an online software that allows to collaboratively create visual boards and maps. A board for each category had been previously crafted on MIRO, based on the maps created after the FCM Workshop 1, and during the workshop new items and connections were added to each one. Finally, the online session ended with a group discussion on the new inputs gathered.

The second session was less structured and more dynamic, as it was organised during the lunch break when the participants had the chance to approach the designated space, provide their feedback, and have an open discussion while looking at the different FCM maps. First, they were welcomed to the activity and offered an introduction to the NUTRI-KNOW project. After the presentation, they were asked to validate the barriers previously identified and provide new ones, as well as their connection to stakeholders. For this exercise, the MIRO boards from the first online session were printed out and new inputs were collected on the boards (see Figure 23). As during the first session, the economic and legislative categories were thoroughly discussed, the second session was focused on the social, communication and knowledge barriers.

Overall, the FCM workshop 2 in Spain was highly successful, sparking engaging and insightful discussions. Participants expressed satisfaction with the topics covered and shared their perspectives on improving nutrient management in Catalonia. Additionally, there was a consensus on the importance of promoting the implementation of solutions proposed by the operational groups.

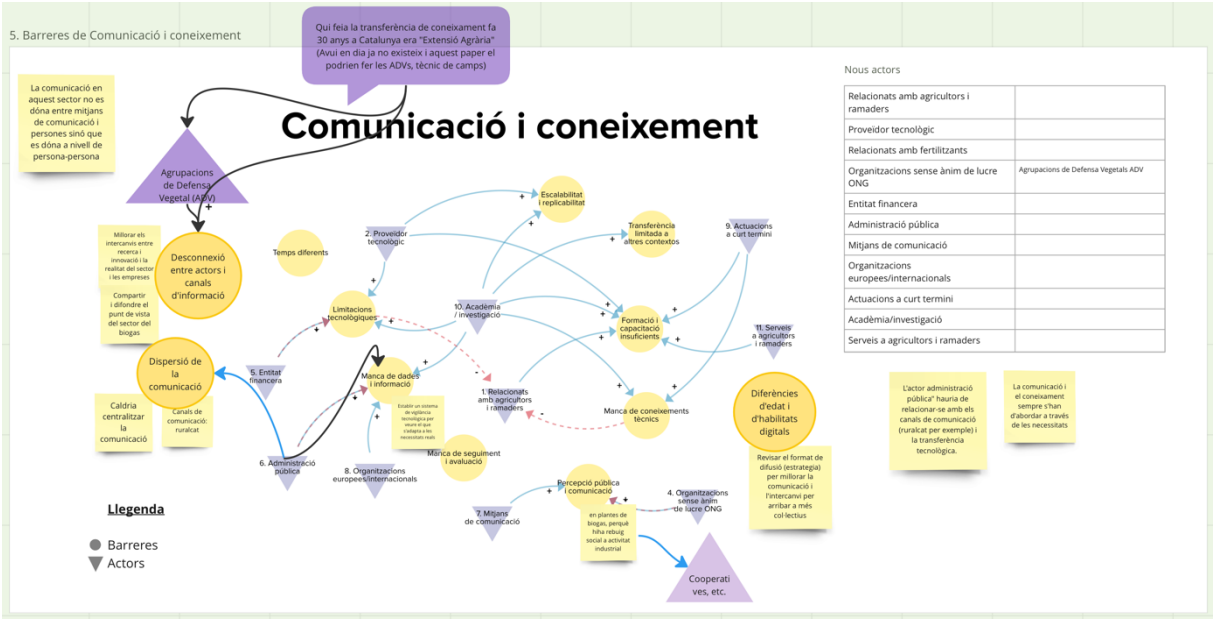

Figure 23: Communication & Knowledge MIRO board for the Spanish FCM Workshop

The results and insights of both workshops combined are presented below.

Discussions per each category of barriers

- **Communication & Knowledge**

[5] https://miro.com

The "public perception and communication" barrier was validated and linked to the social barrier of "Social rejection". Cooperatives could help to address this issue, as there is often rejection of some industrial activities that cooperatives or similar entities could help to mitigate.The barrier of "Lack of data and information" was validated and it was mentioned that establishing a way to check if the technology is adapted to the real needs of practitioners could help in this regard. This barrier was connected to the public administration, as they can have a direct influence on having better data management systems.

It was discussed that communication channels are often dispersed and that there is a need to find a way to centralise communication. Some platforms currently used in this respect are RuralCat[6] and BIOHUBCAT[7]. Another related barrier was highlighted: the disconnection between actors and information channels. In order to overcome this barrier, the exchange of knowledge between research and innovation and farmers and agricultural institutions should be promoted. Participants also discussed the role of public administration in disseminating knowledge and information. They mentioned that this actor should interact more with the communication channels and be more involved in technology transfer.

Moreover, it was commented that the communication in the agricultural sector is not between media and people, but mainly at a person-to-person level. In the past, in Catalonia, knowledge transfer was carried out by *Extensió Agrària*, which was a public service in Catalonia whose main function was to advise, train and inform farmers about the best agricultural practices, modern techniques and innovations in the agricultural sector. Nowadays it no longer exists and this role could be done by the *Agrupacions de Defensa Vegetal (ADVs)*, private non-profit organisations that bring together farmers and that aim to collaborate with the administration.

A new barrier that emerged during the workshop was the age gap in the sector and digital skills. This barrier was linked to the social barrier of an ageing agricultural sector. It was discussed that it is crucial to adapt the communication channels and format to the different digital skills of the practitioners. Developing an intelligent strategy to improve communication can help overcome this barrier and reach more stakeholders. Another point discussed was the role of stakeholders in overcoming communication barriers. Participants mentioned that technicians from co-operatives or private institutions can play an intermediary role to facilitate the transfer of information between academia and research and practitioners. Clusters and associations can also play this dissemination role. Furthermore, technical conferences and workshops can be central places for knowledge transfer and communication. Finally, it was highlighted that knowledge and communication should always be approached from the need of the sector in order to ensure that they are met.

- **Economic**

The new barrier that had appeared during the FCM Workshop 1 in the GA about the "costs associated with being environmentally friendly" was validated and expanded on by relating it to the current drought situation that Catalonia has been facing. It was mentioned that environmental costs were higher for small and medium-sized companies. Additionally, strategies following circular economy principles, such as commercialising biofertilizers sub-products, can help face those barriers.

Regarding the economic barriers, it was mentioned that a considerable barrier was the uncertainty of the energy price, coupled with the uncertain evolution of the agricultural market, which causes an increment in the fertilisation costs. A key stakeholder that can help overcome

[6] https://ruralcat.gencat.cat

[7] https://biohub.cat

this barrier is the self-consumption initiatives, which oppose the current energy model by democratising access to (renewable) energy. This barrier is also tightly linked to the barrier on "market limitations", which was connected during the workshop to the public administration target group as a stakeholder with an enabling role. This differs from the results of the first FCM workshop, in which the stakeholders that were considered to be capable of overcoming the market limitation barrier were short-term actions, fertilisers-related stakeholders and farmer-related stakeholders.

The barriers to "insufficient economic support from the government" and "inadequate resources", and their connection to the Public Administration were validated.

It was further discussed that implementing certain support mechanisms such as subsidies for biofertilizers and biofuels could help small-scale biogas plants overcome the market limitations, as currently, local biofertilizers are more expensive than imported ones. Another support mechanism could be acknowledging captured CO_2 by issuing a certification of the CO_2 equivalent that has been captured in certain processes. It was discussed that the public administration has a crucial role in implementing a model of incentives for decarbonisation.

Project developers and big companies, like the ones boosting biomethane projects, were highlighted as important actors in overcoming the economic barriers.

Furthermore, the barrier to "economic viability" was validated and linked to a new barrier: the "high risk of conducting innovations". It was mentioned that reducing costs of digestates was not feasible, as it was already a mature technology not likely to get any less expensive. Thus, innovative improvements to reduce costs are unlikely to happen.

Financial institutions and the media were not mentioned as key actors in overcoming the economic barriers, as was the case in the FCM Workshop 1.

- **Environmental**

The environmental barriers were validated and linked to the economic barriers, like the "cost of being environmentally friendly". The participants stressed the relevance of climatic sensitivity, environmental uncertainty and sustainability as challenges in implementing the OGs outcomes.

No further barriers and connections were mentioned.

- **Legislative**

The participants validated the barrier of "limitation of regulations and policies", adding the example of the limitation of nitrogen coming from organic sources that can be used to fertilise. It was discussed that promoting more support towards organic fertilisation by increasing the maximum amount of organic nitrogen allowed would be a useful measure for farmers. Furthermore, applying regulations to promote the use of fertilizers coming from dejections could help remove that barrier.

It was highlighted that the Spanish public administration is currently collapsed, and that collaborating entities with the public administration are crucial actors in overcoming that barrier, as they would help reduce the workload of the public administration.

A new barrier that was identified was the lengthy adaptation process of regulations to technological innovation.

The barrier of "policy integration" was expanded with the barrier of integration of all actors involved and complexity of the legislation.

It was mentioned that another important barrier is the bureaucratic overload of farmers, which also comes with an economic cost. The public administration could address the overload by

clarifying the requirements to facilitate the farmers' understanding. Because legislation and policies are often hard to understand, they should be "translated" into an easy-to-understand language. Actors that can help in doing so are the "Agrupacions de Defensa Vegetal (ADV)", non-profit private entities that collaborate with the public administration and that aim to collectively fight against harmful agents affecting plants.

Overall, this workshop highlighted the crucial role of public administration in addressing legislative barriers, similar to the findings of the first workshop in Ireland. However, the participants did not mention the role of media in this category, contrary to what was expressed during the first workshop.

- **Social**

The participants validated the barriers about "social acceptance and equity", "resistance to change", and "lack of successful implementation cases". They added the barrier of the agricultural sector's aging, which is a key factor when it comes to changing practices and implementing new techniques and technology.

Related to the "social acceptance and equity" barrier, it was discussed that there is rejection to industrial processes by the farmers and practitioners, which could be solved through communication. This rejection is further addressed in the communication & knowledge section.

A crucial strategy in overcoming the "resistance to change" barrier is the word-of-mouth among farmers and a leader figure, someone who can serve as a successful example of the adoption of new farming practices. This was connected to the barrier of the "lack of successful implementation cases", as having one local successful case can help overcome resistance to change. The word-of-mouth matches what was discussed in the communication barriers of the FCM Workshop 1.

Furthermore, regarding the "lack of successful implementation cases" barrier, it was discussed that ways to solve it could be having exchanges among different countries or contexts and carry out field visits to successful implementation areas.

Lastly, it was mentioned that technicians from cooperatives or other entities could advise farmers, which would help overcome the social barriers.

3.3. Final FCM Kumu map integrating all results

Overall, the workshop was highly successful, sparking engaging and insightful discussions. Participants expressed satisfaction with the topics covered and shared their perspectives on improving nutrient management in Catalonia. Additionally, there was a consensus on the importance of promoting the implementation of solutions proposed by the operational groups.

The results gathered in section 3.1 and 3.2, including the data from the FCM Workshop 1 and the four regional FCM Workshop 2 have been integrated into a comprehensive final map (see Figure 24). The map illustrates all the identified barriers and their connections to stakeholder target groups, and it can be filtered according to the five different barrier categories. It incorporates inputs from the four NUTRI-KNOW countries, and it is available as a dynamic map on Kumu.

The FCM Workshops 2 highlighted several key stakeholders, including *self-consumption initiatives, policy institutions, research centers, project developers, large-scale companies, cooperatives, technicians, certification bodies, and counselors and advisors*. These stakeholders, while relevant, are incorporated into the general stakeholder target groups and do not appear individually in the connections of the barrier map. The map also shows

connections between various barriers across different categories, illustrating their interrelated nature. However, some newly identified barriers remain unconnected to any specific stakeholders, appearing isolated on the map. Additionally, the map does not indicate the strength of these connections, as this information has not been provided during the workshops.

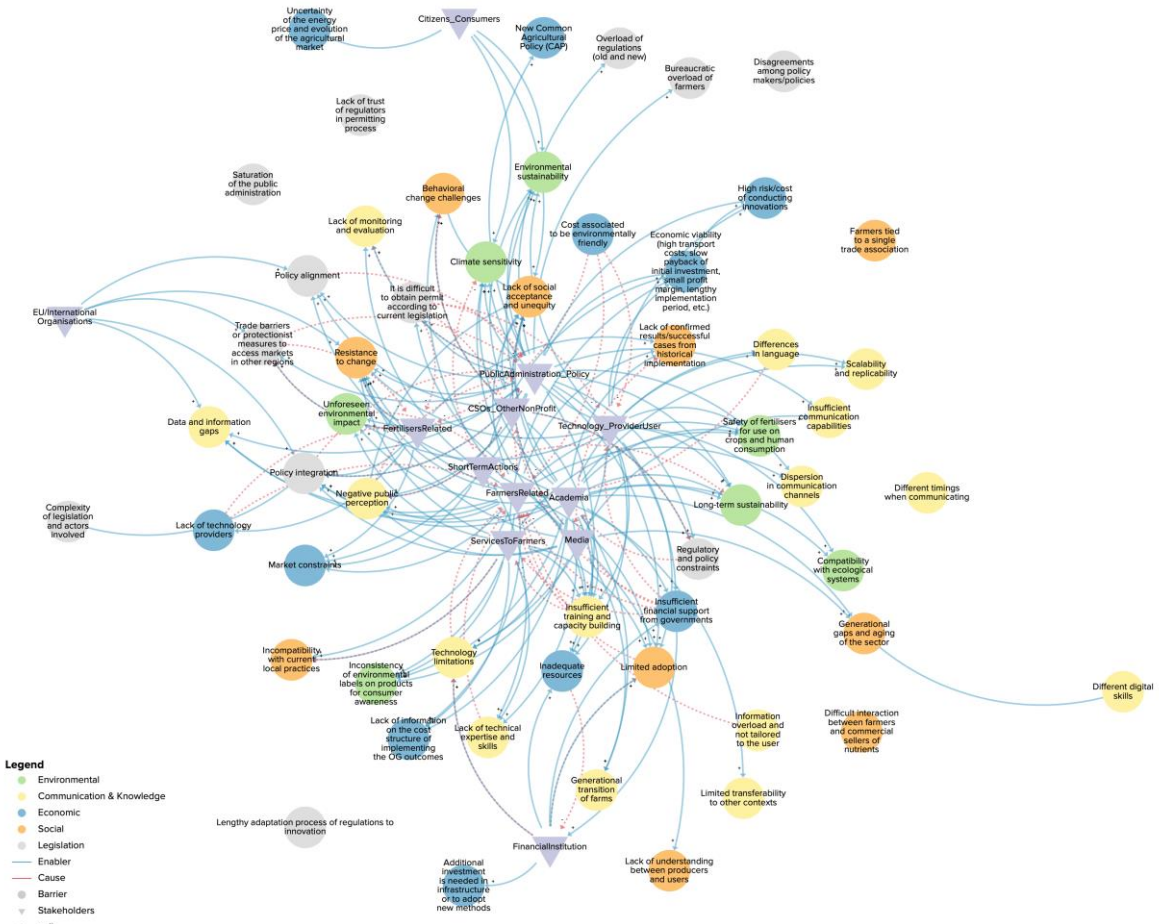

Figure 24: Final barrier map including the results from FCM WS 1 and 2

4. Discussion

4.1. Cross-country analysis of barriers

In the following section, we explore the findings across the different country contexts, highlighting both similarities and differences. We present an overview of the most prominent economic, legislative, social, environmental, communication, and knowledge barriers that farmers and practitioners must overcome to implement the outcomes of the OGs.

Table 3: cross-country analysis of the identified barriers in the FCM workshops

Category of barrier	Barrier	Country perspective
Communication & Knowledge; Social	**Public perception and communication; social acceptance and equity; resistance to change**	*General*: Media as a key actor, especially in the communication with consumers. Also, farmer-to-farmer communication is essential to enhance acceptance and adoption of new practices and technologies.

		Spain: Cooperatives can address this issue by easing social rejection to some industrial activities. Clusters and farming associations can help disseminate knowledge in a way that it is well-received. For the acceptance of the farmers, it is crucial that communication and knowledge should always be approached from the actual necessities of the sector. Lastly, word-of-mouth is a highly effective strategy to overcome resistance to change. *Italy*: Farmer Advisors can address resistance to change through guidance and expertise that help farmers adopt new practices and technologies.
Communication & Knowledge	**Data and information gaps**	*General*: Academia is a key actor in addressing them and capitalising knowledge *Belgium*: there is a disconnection between services to farmers and policy institutions that lead to barriers in policy information transfer. CSOs and other non-profit entities can address the knowledge gaps by providing training and capacity building *Ireland*: there is an information gap for advisory and extension services that support farmers. Also, collaboration between research institutions, companies and the industry is needed *Spain*: knowledge exchange between research and innovation, and the farmers and agricultural entities should be promoted. Establishing a way to check if the technology is being adapted to the real necessities of practitioners can also help overcome the barrier. The public administration should be more involved in technological transfer.
Communication & Knowledge	**Age gap and digital skills; Information overload for farmers; disconnection between actors and information channels**	*Spain*: adapt the communication channels and format to the diverse skills of the practitioners. There is a dispersion in communication channels, so communication should be centralised somehow. The public administration should interact more with the communication channels. Technicians from cooperatives or private entities can serve as intermediaries for information transfer between academia and practitioners. *Belgium*: use the preferred communication channels of practitioners. *Italy*: the generational gap in the agricultural sector poses a challenge in adopting new technologies and practices. This gap can be reduced through the combined efforts of Media and Academia stakeholder groups, by promoting knowledge transfer and by encouraging engagement from younger generations.
Communication & Knowledge; Social	**Limited transferability; lack of successful implementation cases**	*Italy*: Academia can promote exchanges and field visits for farmers. *Spain*: having exchanges among different countries or contexts and carry out field visits to successful implementation cases. *Belgium*: on-site visits are important to reach the farmers and share knowledge
Economic	**Insufficient financial support from governments; market limitations; inadequate resources**	*General*: the Public Administration was highlighted as a relevant stakeholder to address the barrier of inadequate resources and insufficient financial support from governments. *Belgium:* there is a need to have better alignment between policy and short-term actions to provide adequate financial support and incentives for technology providers and farmers. Short-term financial gaps could be addressed by financial institutions, but long-term policies should be developed to secure sustained financial support for innovation.

		Spain: implementing support mechanisms such as subsidies for biofertilisers and biofuels and implementing a model of incentives for decarbonisation would help address these barriers. The Public Administration has a key role in this matter.
Economic	**Economic viability; Additional investment is needed in infrastructure or to adopt new methods**	*Italy:* subcontractors and control services (Services to Farmers) should focus on balancing nutrients between surplus and deficit areas so that farmers benefit. Spain: this barrier is linked to the high risk of conducting innovations, which can reduce the overall cost of implementing new technologies. *General:* Financial institutions were marked as a key actor in addressing the additional investment barrier.
Economic	**Cost associated to be environmentally friendly**	*General:* this barrier was identified during the first FCM Workshop *Belgium*: Technology Providers could be negatively affected by this barrier. *Ireland*: there is a critical need for capacity building at the regional level to effectively process and valorise organic manure and other green waste. *Italy*: there are significant expenses associated with innovations aimed at reducing environmental impact. Technology Providers were identified as crucial stakeholders that could help mitigate these costs. *Spain*: environmental costs are higher for small and medium-sized companies. Strategies that follow circular economy principles, such as commercialising biofertilisers subproducts, can help address this barrier.
Environmental; Social	**Environmental sustainability; incompatibility with local practices; social acceptance and equity**	*Belgium:* some environmental policy goals could negatively affect farmers if they necessitate changes in practice. It is crucial to balance environmental initiatives with stakeholder needs and to align academic research with public engagement. Farmers and academia need to collaborate in addressing environmental impacts. *Italy*: the absence of clear environmental labels on products limits consumer awareness. There is a need for environmental campaigns and transparent communication to inform the public about sustainable disposal methods and their benefits, thus increasing social acceptance. *Ireland*: the farmers need to have full proof that the products they use are safe for crops and for human consumption.
Legislative	**Overload of regulations; bureaucratic overload of farmers**	*Belgium:* this new barrier was identified. It should be clear for farmers that the risk of doing nothing is larger than changing systems with less risk. Policy makers should make the transition from past legislation towards future-proof policies that are less restrictive on farmers and that support innovation more. *Spain*: the bureaucratic overload of farmers has an associated economic cost. This overload could be addressed by the Public Administration by being clearer about what they require from the farmers. Policies should be “translated” into an easy-to-understand language for farmers. *Italy*: farmers struggle with the technical language and marketing strategies used by sellers, so there is a need for more transparent practices to foster a more cooperative relationship

Legislative	**Regulatory and policy constraints**	*Spain*: it was discussed that supporting organic fertilisation by increasing the maximum amount of organic nitrogen allowed would be a useful measure for farmers. Furthermore, the Spanish Public Administration is currently collapsed. Collaborating entities are crucial actors that can provide support to the administration and reduce their workload, thus helping overcome this barrier. *Ireland*: there is a lack of policy support regarding the application and use of biobased fertilisers. *Belgium*: the whole society has an impact on the direction of policies. It was mentioned that society should set the general target and policy institutions should reduce the limitations and risk in implementing the innovations.
Social	**Social acceptance and equity**	*Belgium:* a key stakeholder that has the power to influence society in both a positive and a negative way is Media. *Italy:* there is a need to improve the social acceptance of disposal practices among citizens by educating society on the matter. Also, there is a physical and relational distance between producers and users of agricultural products. Media is crucial in bridging this gap by facilitating better communication and understanding between the two groups.

4.2. Target group roles and responsibilities

Below we propose a summary table of the main contributions and findings identified in the discourse on the role that the different target groups of the project have in solving and minimising the barriers according to the results from section 3.

Table 4: main findings on overcoming the barriers for OGs outcomes implementation per target group

Target groups	Main insights from the results
1. Farmers	• Enablers for policy integration and adoption • Enablers of having a market more agile • Needers of resources: financial instruments, etc. • Central role for solving social barriers • Active role in communication to the sector • Reachable in their communication channels, cannot really be forced to use others • In the need of simpler permitting and bureaucracy process to acquire new innovations • Reinforce collaboration with Academia group • In the need of more dynamic market practices • In the need of proofs about safety products from ne innovation.
2. Technology Providers	• Target group very much needed, especially innovators (not seen as an issue in Italy) • Blocking the process of obtaining permits to new innovations by imposing restrictive IP or licensing terms • Role in balancing the use of resources and financial mechanisms (inadequacy of resources) • Capacity building to farmers directly on the field • Need of incentives and motivators to adopt new innovations • Cannot afford extra costs for products being environmentally friendly

3. Fertilisers Related	• Key role in addressing social barriers as they have an active role in communicating about them • Dual effect depending on the environmental condition of the product provided. • Active role in requesting for acceleration in the new regulations needed • inadequate support mechanisms in terms of communication for encouraging local production of alternative fertilisers • Experiencing lack of policy support and market limitations in the application and use of biobased fertilisers
4. CSOs and Other Non Profit	• Active support for new policy integration • Lacking financial support and having inadequate resources to support nutrient management practices • Influencing public opinion in agricultural practices and creating behavioural changes in some cases favouring and some other cases hindering sustainable agricultural practices. • Training and capacity building role
5. Financial Institutions	• tackling the issue of inadequate resources and the need for additional investment in infrastructure or to adopt new methods. • Unblocking limitation from technology exploitation with incentives • Showing more proactivity in short term action to generate quicker swift to sustainable practices
6. Public Administration and Policy	• Key role in policy changing and solving legislative barriers • Key role to provide support from governments as financial mechanisms and have balance resources in terms of economic viability • Key role for prioritizing in policy agenda the need of addressing specific environmental barriers • Building trust with sustainable farming practices • overcoming the lack of monitoring and evaluation barrier as well as the lack of data and information • Disseminating knowledge and information a, by being more active in communication channels and getting more involved in technological transfer. • Facing also collapses from tasks that cannot go beyond with innovation in the sector • Reducing and simplifying bureaucracy, especially for new regulations needed to adopt sustainable practices
7. Media	• Key actor, particularly in relation to the communication with the consumers and general public • Facilitating the speed up of policy integration and adoption of new policies if they spread the message • Influencing social acceptance and shaping public opinion

	• Showcasing widely key case studies that is needed to build trust on new innovations • Influence in bias information • Social media being the first step of communication for quick and short messages • Specific media channels that can better transfer knowledge from different target group in a simpler terminology
8. EU	• Overcoming environmental barriers by adapting European legislation and key strategies (European Green Deal, the FARM2FORK strategy, or the Common Agricultural Policy (CAP) • Role of European research project in building trust and generating science-based knowledge (as short-term actions)
9. Short Term Actions	• Supporting policy alignment • Overcoming training and capacity building specific needs • Creating specific actions to address specific technology limitations
10. Academia	• Key role in Trust building and influencing social acceptance • Creating partnerships with other actors to foster policy changes and integration through scienc-based decision • Showcasing more often new innovations and successful pilot test • Capitalising the knowledge for the successful implementation of the OGs outcomes • Research is having a pivotal role in tackling sustainability challenges in the agricultural sector • Adequate timings for research to specific farming periods • Reducing these gaps by promoting knowledge transfer and encouraging engagement from younger generations
11. Services to Farmers	• Key stakeholders in communication and knowledge as they are the closest related to the end users • Needing more capacity building and keeping them updated with innovations • Increasing understanding of the different stages where this adoption can take place in the nutrient value chain • Focusing on balancing nutrients between surplus and deficit areas and genuinely serving the farmers, rather than merely enforcing regulations without in-depth knowledge.

5. Conclusion and next steps

With the results of Task 2.3, content for the rest of the project activities dealing with developing communication material can be generated, as well as implementing further communication actions. The development of practice-oriented material should be oriented to address the barriers outlined here as well as the role that OGs can play in this.

During the workshops it was easy to lead the discussions to a more general scope of the nutrient management innovation sector, its barriers and the actors (target groups) that are responsible for overcoming them. These connections were established and detailed with a rich level of debate since the first workshop took place.

Still, this complex analysis was challenging, as there were three ingredients of our first model in the discourse, in addition to having the OGs and their outcomes. In the maps, it was possible to associate the OGs with the barriers, however, the discussion could not be deepened, as this complicated the discourse.

We therefore propose that the next steps should be to link the identified barriers specifically to each of the OGs and to address them in the following actions of the project, in order to give more integrity to the analysis proposed here.

Another general limitation we had in the process was obtaining more specific data on the target groups. It is difficult for the participant to decide on specific stakeholders in each case, the tendency was to go back to talking in generalities. We feel that it is necessary to have more specific and focused discussions on very concrete aspects in order to get more specific details.

In general, there was a very favorable predisposition on the part of the participants, who understood the need for this debate and for this type of meeting to deal with innovation in the sector. Having clear ideas and guidelines for each of the barriers is seen as a great necessity, and there is a great willingness to receive the informative and specific material of the project.

6. Annex 1: Stakeholder target groups

Table 5: Stakeholder target groups for the FCM workshops

Stakeholder Target groups	Stakeholder sub-groups
Farmers Related	Farming trade union, Farmers association, Professional association, Cluster, Expert groups, Local farmer Farmer association, Cooperative
Technology Provider User	Technology provider , Refinery, Biogas plant
Fertilisers Related	Fertiliser company Biobased fertilising industry Fertiliser test lab
CSOs, Other Non-Profit	NGOs, Consumer Associations, etc.
Financial Institution	Bank, Public funding agency Investor
Public Administration and Policy	Regional government, County office/ other territorial services, Public council National government, National / Regional agency
Media	Local media; Regional media, European media, Influencer Farming specilised
EU/International organisations	EU agencies, Networks, etc.
Short-term Actions	Project, Initiative, Collaborator
Academia	Research institution, University, Agricultural student
Services to Farmers	Farm advisor, Advisory platform, Agricultural contractor Trade chamber, Capacity building institution

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7. Annex 2: Slides from the FCM Workshop 1

TASK 2.3 Identification of knowledge needs and barriers for user acceptance [M6 – M18]

Task leader:	**WE&B**
Task contributor(s):	WE&B; FCAC, BE, IOA
Deliverable (s)	D2.3 Report on need and barriers for user acceptance [M18, (June 2024)] *Report on need and barriers for user acceptance, which will be based on an analysis to understand what are the knowledge needs and barriers for the acceptance of farmers and practitioners towards the practices addressed in the OGs*
Objective	*To matchmake practice for complexity analysis to understand what are the knowledge needs and barriers for the acceptance of farmers and practitioners towards the practices addressed in the OGs*
M6-M12 PLAN	Consultation, organise first engagement workshop

2

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11.06.24

What is Fuzzy Cognitive Mapping (FCM)?

- A method of 'mental modelling' that creates a 'map of cognition', which represents individual's thought processes in relation to a given problem space (Gray et al, 2014; Papageorgiou & Kontogianni, 2012).
- FCM describe different aspects of the behaviour of a **complex system** in terms of **concepts**. Each concept represents a state or a characteristic of the system and interacts with each other showing the **dynamics** of the system.
- A mental model is a cognitive representation of an external reality that is held by a stakeholder which is used to aid in the structure of their reasoning with regards to a decision-making process.

Tools: FCM Expert, FCMappers, MentalModeler

3

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Objective of the FCM Workshops
What are we going to Map?

- What is the principal outcome or topic you would like to place at the centre of the map?

How the 12 OGs addressed real barriers or problems in the nutrient value chain through their outcomes and which stakeholders are or should be involved

- What information do we want to build in the map? Next slide

4
4

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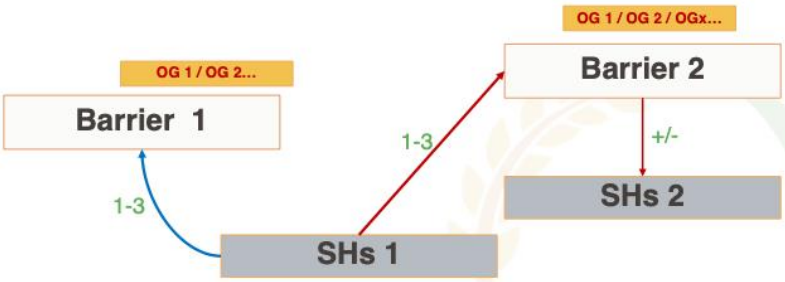
11.06.24

FCM model



Nodes

1-3 Connection weight

Connection (neutral – positive – negative)

- Spain
- Italy
- Belgium
- Ireland

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5

11.06.24

OGs Outcomes

OG1. Slurry concentrator: 1TH_concentrator
OG2. Optimized management tool:
2TL_conductivitymeters; 2TL_computerApp;
2TL_economicreduction
OG3. FERTICOOP-GO: 3R_BAT; 3TL_rapidtesting
OG4. Struvite: 4TH_manuretreatment; 4P_struvite
OG5. SOS- AQUAE: 5R_packages
OG6. GAS LOOP: 6TH_airwashing; 6P_ammoniumsulphate
OG7. RENURE: 7P_ammoniumsulphate; 7R_evaluation
OG8. POKETBOER 2: 8R_pocketdigesters
OG9. Grass2Algae: 9P_grassjuice
OG10. Biorefinery Glas: 10TH_mobilegrass;
10P_presscake; 10P_monogastrics; 10P_prebioticsugars;
10P_recoveredfertilisers
OG11. MOPS: 11R_organiccropping; 11TL_greenmanures
OG12. Duncannon Blue Flag Farming & Communities:
12TL_PPZmaps; 12R_waterquality; 12TL_rewardscheme

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SHs Target Groups

1. FarmersRelated
2. Technology_ProviderUser
3. FertilisersRelated
4. CSOs_OtherNonPorfit
5. FinancialInstitution
6. PublicAdministration_Policy
7. Media
8. EU
9. ShortTermActions
10. Academia
11. ServicesToFarmers

7

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BARRIERS

SOCIAL	ECONOMIC	LEGISLATION	COMMUNICATION & KNOWLEDGE	ENVIRONMENT
Limited adoption	Inadequate resources	Regulatory and policy constraints	Lack of technical expertise	Unforeseen environmental impact
Resistance to change	Economic Viability	Policy alignment	Data and information gaps	Climate sensitivity
...	...	...	...	...

Source:
- Task 1.3
- Questionnaires in WP2

9

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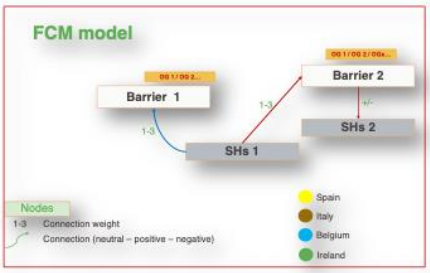
Structure of the workshop

15min (9.45-10.00)	45min (10.00-10.45)	15min (10.45-11)	30min (11.00 -11.30)	15min (11.30-11.45)	15min (11.45-12.00)
Task 2.3 and Workshop details	Exercise 1: *Connecting Barriers and Outcomes*	BREAK	*Exercise 2: Connecting to SHs Groups*	Feedback round	Next steps 2.3
Plenary	Groups		Groups	Groups	Plenary



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10

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Groups

GROUP 1: SOCIAL	GROUP 2: ECONOMIC & LEGISLATION	GROUP 3: COMMUNICATION & KNOWLEDGE	GROUP 4: ENVIRONMENTAL
Allan Leck Jensen	**Hongzhen Luo**	**Daniel Hölle**	**Claus Grøn Sørensen**
Giuseppe Moscatelli	Andrea Poluzzi	Anna Bagó	Víctor Carbajal
Clara Fullana	Gemma Rocadembosch	Céline Wyffels	Sergio Ponsá
Paula Jimeno	Marta Daví Pous	Patrick Forrestal	Aoife Egan
Stephen Meredith	Derek Kelly		

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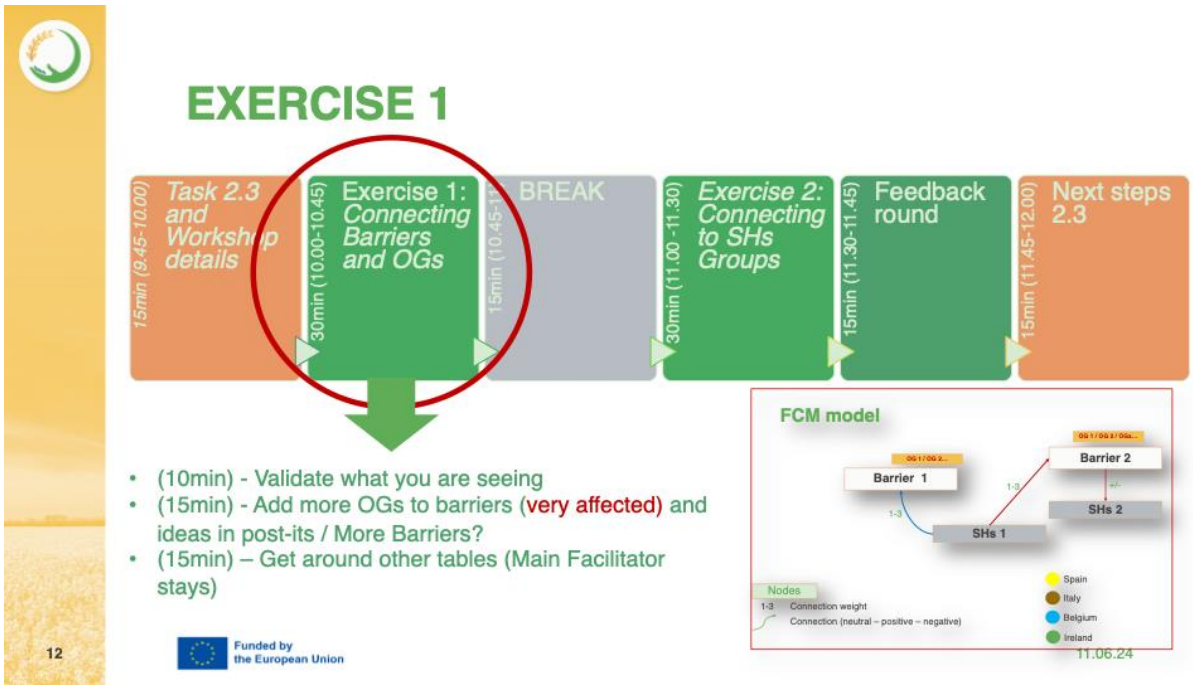
*** Group facilitators**


EXERCISE 1
Task 2.3 and Workshop details
15min (9.45-10.00)
Exercise 1: Connecting Barriers and OGs
30min (10.00-10.45)
BREAK
15min (10.45-11)
Exercise 2: Connecting to SHs Groups
30min (11.00 -11.30)
Feedback round
15min (11.30-11.45)
Next steps 2.3
15min (11.45-12.00)
(10min) - Validate what you are seeing
(15min) - Add more OGs to barriers (very affected) and ideas in post-its / More Barriers?
(15min) – Get around other tables (Main Facilitator stays)
FCM model
Barrier 1
Barrier 2
SHs 1
SHs 2
Nodes
Connection weight
Connection (neutral – positive – negative)
Spain
Italy
Belgium
Ireland
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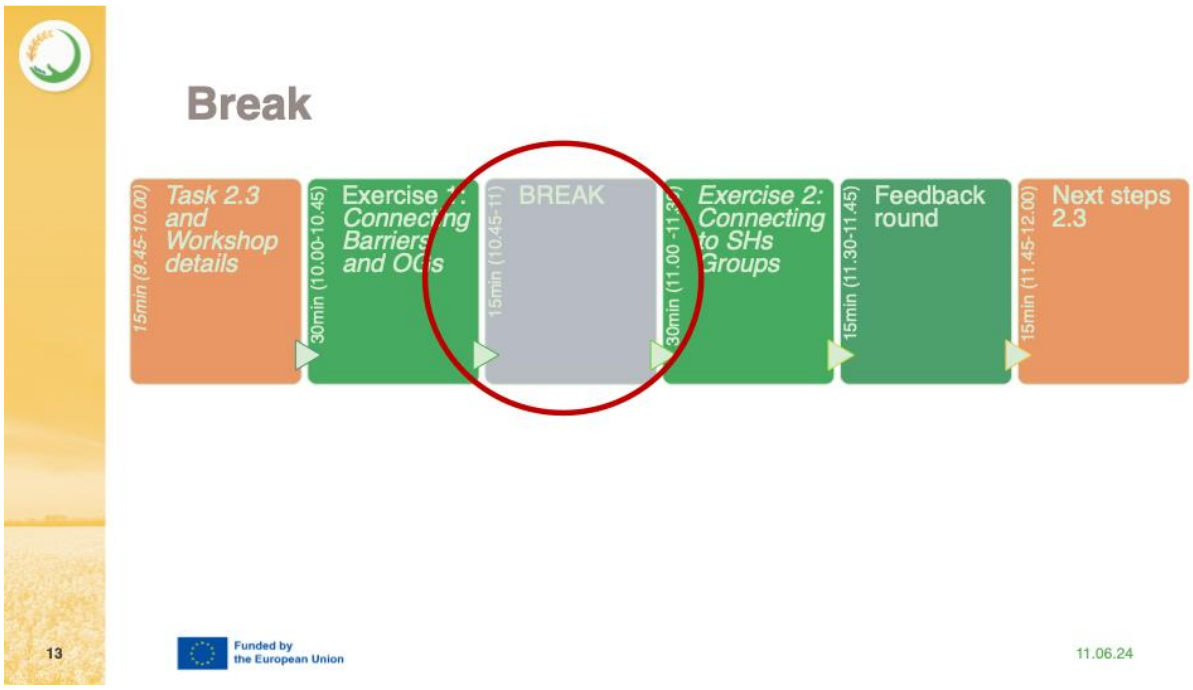
Break
Task 2.3 and Workshop details
15min (9.45-10.00)
Exercise 1: Connecting Barriers and OGs
30min (10.00-10.45)
BREAK
15min (10.45-11)
Exercise 2: Connecting to SHs Groups
Feedback round
15min (11.30-11.45)
Next steps 2.3
15min (11.45-12.00)
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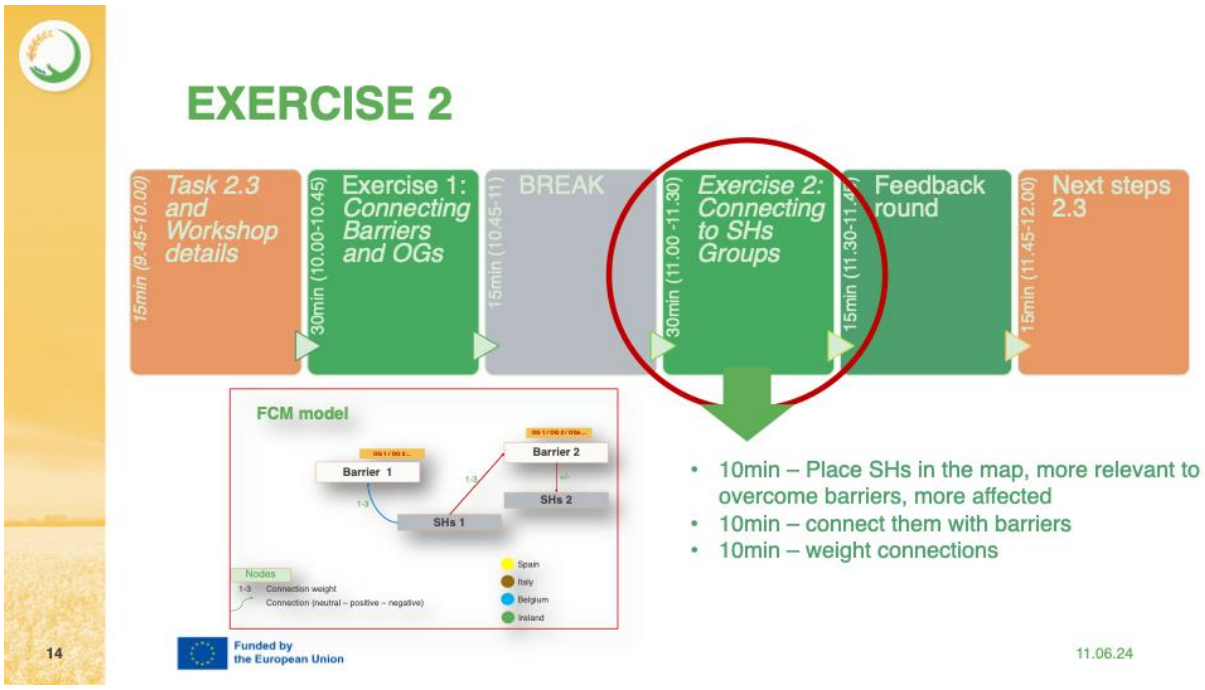
EXERCISE 2
Task 2.3 and Workshop details
15min (9.45-10.00)
Exercise 1: Connecting Barriers and OGs
30min (10.00-10.45)
BREAK
15min (10.45-11)
Exercise 2: Connecting to SHs Groups
30min (11.00 -11.30)
Feedback round
15min (11.30-11.45)
Next steps 2.3
15min (11.45-12.00)
FCM model
Barrier 1
Barrier 2
SHs 1
SHs 2
Nodes
Connection weight
Connection (neutral – positive – negative)
Spain
Italy
Belgium
Ireland
• 10min – Place SHs in the map, more relevant to overcome barriers, more affected
• 10min – connect them with barriers
• 10min – weight connections
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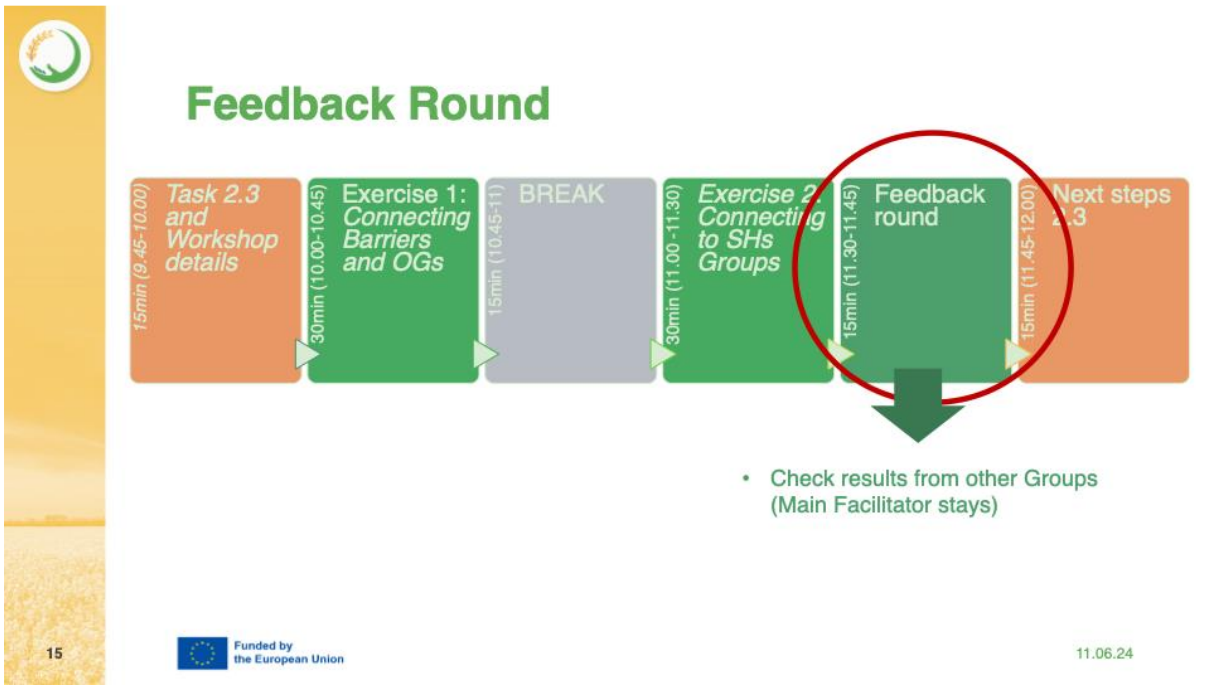
Feedback Round
Task 2.3 and Workshop details
15min (9.45-10.00)
Exercise 1: Connecting Barriers and OGs
30min (10.00-10.45)
BREAK
15min (10.45-11)
Exercise 2: Connecting to SHs Groups
30min (11.00 -11.30)
Feedback round
15min (11.30-11.45)
Next steps 2.3
15min (11.45-12.00)
• Check results from other Groups (Main Facilitator stays)
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TASK 2.3 Roadmap of FCM WSs

Step 1. Preparatory actions Done — Dec 2023- Jan 2024

- Results from tasks 1.3, 2.1 and 2.2 will feed the contents of the FCM Workshops

Step 2- 1st FCM WS Internally (Face to Face, English) — General Assembly, Ireland, Feb 2024

- 1st FCM WS to initiate the exercise and to, partners, get trained for Step 4.
- FCM modeler – input results from Step 2

Step 3 – Online FCM WS 2 with European stakeholders (Online, in English) — TBD - March 2024

- Max. 2h duration. It will be based on the results from the Step2 – JUST TO VALIDATE THEM,
- With an international audience focusing at European level. AB will be invited

Step 4 – FCM Workshop 3 in the 4 EIP-OGs Countries (Face to Face, local languages) — April 2024

- 4 FCM WS3 (max10 local participants), we can invite at least one AB if Step 3 is not conducted
- Similar replication of the FCM WS1 but addressing only each geographical context.
- Launching the CoP and other communication materials

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Who will contribute in the mapping session

- FCM WS1 – NK consortium, General Assembly –first draft
- FCM WS2 – International SHs, Online – validating scope
- FCM WS3 – Ogs partners - zoom per country

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NUTRI•KNOW
Thank you!
WE&B

8. Annex 3: FCM Workshop 2 protocol

Workshop context in NUTRI-KNOW

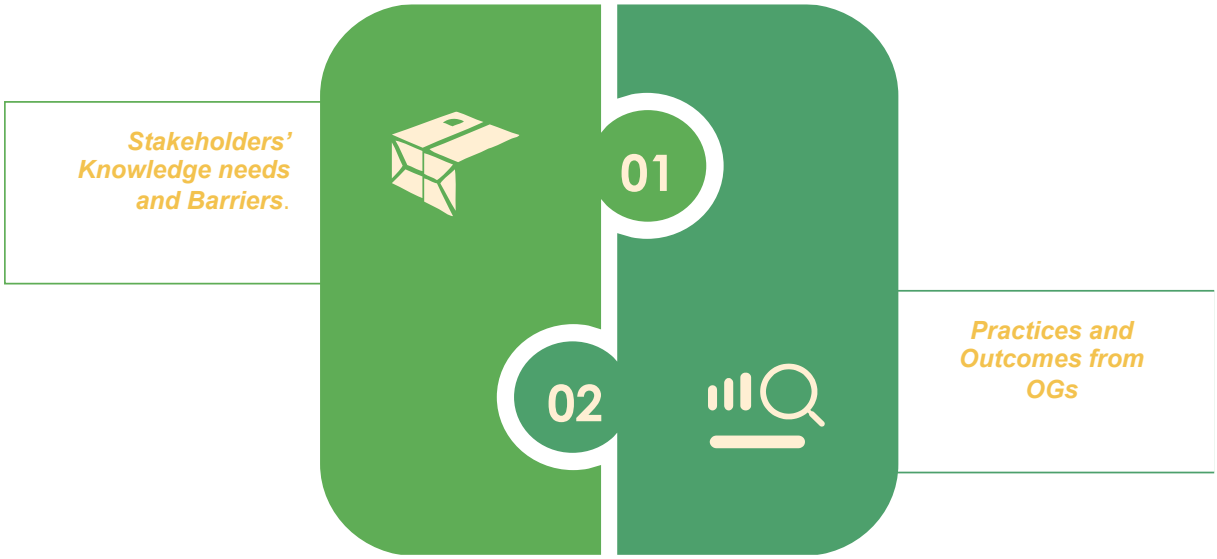
This activity is framed in Task 2.3. to increase understanding of **what are the knowledge needs and barriers for the acceptance of farmers and practitioners towards the practices addressed in the OGs.**

What is Fuzzy Cognitive Mapping?

- Fuzzy Cognitive Mapping (FCM) is a method of 'mental modelling' (Gray et al., 2014) that creates a 'map of cognition', which represents an individual's thought processes in relation to a given problem space (Papageorgiou & Kontogianni, 2012). Fuzzy Cognitive Maps (FCMs) describe different aspects of the behaviour of a complex system in terms of concepts. Each concept represents a state or a characteristic of the system and interacts with each other showing the dynamics of the system.
- A mental model is a cognitive representation of an external reality that is held by a stakeholder which is used to aid in the structure of their reasoning with regards to a decision-making process.

Objective of the FCM in Task 2.3

Matchmake knowledge needs and barriers for the acceptance of farmers and practitioners towards the practices addressed in the OGs.



We aim to answer this question:

*How did the 12 OGs address real **barriers** or problems in the nutrient value chain through their **outcomes** and which **stakeholders** are or should be involved?*

Sub-objectives of the FCM Workshop in each country

The workshop will be based on the results obtained in the first FCM Workshop held with Nutri-know project partners during the General Assembly in Ireland in February 2024. Workshop materials are created on that basis. The sub-objectives of the workshops to be held in each country are as follows:

- To understand what are the **knowledge needs and barriers** for the acceptance of farmers and practitioners towards the practices addressed in the OGs and more specifically addressing the country specificities.
- To co-design, relying on the input from the stakeholders, where the **common themes** related to the OGs projects will be included.
- To identify key stakeholders with roles to overcome barriers identified and/or main influential organisations.
- To communicate about products and activities developed in WP3 and WP4:
    - Practice Oriented Materials (practice abstracts, fliers, booklets, etc.)
    - Upcoming webinars
    - CoP
    - MOOC
    - Farmbook
    - Others

Workshop procedure

Before the workshop

- Review the planning and check list (see Section **Check list**) and have periodic meetings with the organising team (WE&B, NUTRI-KNOW partner in the region)
- Prepare print outs of the NUTRI-KNOW informed consent sheet (see Annex 1), tailored to the workshop setting (date and data manager)
- Prepare print outs of the handouts 'FCM maps' (one per thematic barrier) (see Annex 2)
- Have post its, markers and other supporting material ready
- Look for a 'dynamic' room (if possible, chairs and tables that can be moved)
- Ensure the room has a projector
- Pack the NUTRI-KNOW communication material
- Set up the room with 5 tables, one per thematic
- Distribute project flyers on the tables
- Clarify main facilitator/support roles to implement the workshop
- Post in X/LinkedIn about the forthcoming workshop
- **Note that all workshop material can be found in this Folder of the NUTRI-KNOW SharePoint, as well as in Annex 2 of this document**

Communication with participants

- Decide on a suitable title for the event according to your audience. Here is just a suggestions „**Needs and roles for farming innovation in [your region]**"
- Carefully recruit the participants in communication with WE&B- Share the list of potential participants (we are not looking for a high number of participants but only for a maximum of 10 people representing the 4-helix: academia, public sector, private sector and society)
- Contact each of them with the strategy each case study finds more adequate: phone call, individual email, etc. After this send a „Save the date" email (translated in your local language if needed):

Example of a Save the Date email

> In the framework of the European-funded NUTRI-KNOW project, you have been selected as a key stakeholder to take part on an open discussion table about the **future of innovation in the nutrient management value chain in [your region].** Your inputs are highly valued, as they contribute to understanding the current challenges and needs within the agri-food sector.
>
> The open discussion will be held the [add date] 2024 in [add location] and it will have 2 hour duration. We will send you more details close to the date, but please confirm that you have received this invitation.
>
> Kind regards,
> The NUTRI-KNOW team

- Closer to the date of the workshop, send a reminder and a more extended invitation email that includes the agenda, more details about the event and the project flyer.

During the workshop

- Introductory section where to explain the context and procedure of the workshop
- Allow participants to introduce themselves while signing consent sheet form (Annex 1)
- Start the participation process, according to section 4.
- At the end wrap up with conclusions and explain how the data gathered will be used
- Take pictures (if possible not picturing peoples‘ faces)
- Timing control over the process

After the workshop

- Take photos of all the materials produced during the workshop (post-its, compass posters, etc.) and upload it to the NUTRI-KNOW SharePoint in the relevant country folder
- Safe and scanned the signed list of participants
- Gather all physical workshop material post-its, compass posters, etc. and keep it safe (sometimes they are needed to check the non-legible written inputs)
- Hold a de-briefing meeting with the NUTRI-KNOW team to capture lessons learned
- Send WE&B the workshop report (see Section **Reporting the Workshop**)

Check list

Please check all these items are considered in the organisation of the workshop:

- The list of all **barriers**, **target groups** and related **outcomes** to be printed and sent in advance (optional) (see Annex 2)
- 5 large posters and handouts of the previous NUTRI-KNOW exercise (see Annex 2)
- Coloured stickers to differentiate the countries
- Black markers to highlight neutral connections
- Blue/Green markers to highlight positive connections
- Red markers to highlight negative connections
- Post its to add further inputs
- Supporting ppt: good to visualise in the screen if possible the whole dynamic of the session, so participants can know where they are in the scene
- Informed sheets (see annex 1)

- List of participants where they can check their Consent given
- NUTRI-KNOW communication material: leaflets, etc.
- Camera/phone to digitalise the co-created material
- Some refreshments available if considered appropriate

Workshop Detailed Plan

This is tentative planning similar to what was used for the first FCM Workshop in the GA. Feel free to modify it according to your needs.

Session item	Purpose	Targeted outputs	Materials, support
Welcome and Workshop details ***15min***	*This section is to welcome participants, explain the NUTRI-KNOW project and the related OG outcomes Also it should be explained the aim and structure of the session.*	*Creating awareness about NUTRI-KNOW materials*	*Slides about the project and the workshop process and groups* *Check Annex 2 for more*
Validating Barriers and introducing OGs Outcomes ***60min***	*The aim is to validate first the barriers they see* ***per each theme*** *in order to implement the OG outcomes.* *This session can be divided into some groups if the group is big (max 5 people in each group). Anyway, the aim is to ensure that each Thematic of the barriers are introduced in consecutive rounds.*	*Barriers validated per each of the themes*	*FCM handout Annex 2.1* *Black Pens* *Post-its to add new inputs* *Print out of the OGs outcomes list* *…*
Identifying and connecting to key SHs Groups ***30min***	*Now it is time to look again at each map with attention on identifying who is a relevant stakeholder.* ***SH Target group*** *should be connected to the Barriers based on their potential role:* - *one direction would mean that they can help overcome barriers* - *other direction means that they are affected by the barriers*	*Stakeholders nominated and connections*	*FCM handout Annex 2.1 used in previous round* *Stakeholder map print out per each country* *Black Pens* *Post-its* *Print out of the Target Groups* *…*
Feedback round ***10min***	*Everyone to comment in general on the FCM maps generated and modified allowing free time to give more opinions*	*Finishing FCM Maps*	*Post its* *Pens*
Next steps ***5min***	*The facilitator explains about next actions in the project and how generated data in the workshop will be used*	*Identification of next steps*	*Slide*

Roles

- Overall Facilitators: NUTRI-KNOW Partners involved.
- Participants: freely moved from one table to another.

Reporting the Workshop

Each workshop will lead to a document output drafted by its organiser shortly after its completion (within 1 month after the workshop). In particular, every aspect of the co-creation workshops will be documented into a comprehensive report that will follow the following format and include the following aspects:

Introduction: A part that will state the time and place of the workshop's implementation, its objectives and a brief summary of its structure, proceedings and overall success.

The workshop's agenda according to which the event unfolded.

Description of the participant groups: A description of the participant profile, invitation criteria and a full list with participants' information.

Description of workshop's sessions, discussions, outcomes: A detailed description of the overall structure of each workshop phase including the process followed, methods used, people in charge of the phase, main remarks, and main outcomes of each session.

Description of each FCM map per thematic and describing new inputs along with their evaluation (self-reflection).

Results from the evaluation of the workshop: you can create a quick survey in case you think it would be useful

Conclusions and next steps

Annexes (Background material, etc.)

Annex 1 – NUTRI-KNOW Research Information Letter

DATE, LOCATION

Dear Participant,

NUTRI-KNOW is a project funded by the European Commission Horizon Europe research program (Grant agreement No 101086524) that aims to contribute to a safe and cost-efficient nutrient management, which is a strategic element for the EU agricultural sector (http://nutri-know.eu). NUTRI-KNOW aims to support the modernisation and dynamisation of the agrifood sector by broadening EIP-AGRI Operational Groups (OGs) outcomes across borders. NUTRI-KNOW will contribute to foster and share knowledge and innovation aiming to address the most urgent needs, challenges, and opportunities for farmers.

What does it mean for you to participate in the NUTRI-KNOW Project?

- **Participation is voluntary**

Your participation in the NUTRI-KNOW project is voluntary and you can choose to stop participating at any time. You can withdraw your consent at any time without giving any reason. It shall be as easy to withdraw as to give consent. Withdrawing consent shall not impact the legality of processing done before the withdrawal. There will be no negative consequences for you if you decide to withdraw your consent. Data and information that has been collected up to the point of withdrawal will continue to be used by the NUTRI-KNOW Consortium, unless the participant requests that their data is removed from the dataset.

If you should decide to withdraw your consent, please contact the research contact person and let them know of your intention of leaving the research project. You can contact the research contact person at the address given below (Ms. Beatriz Medina). Please keep in mind that if you do not provide us with your authorization now or if you cancel it in the future, you will not be able to participate in this study.

We hope that most participants will find the discussion interesting and thought-provoking. If, however, you feel uncomfortable in any way during the session, you can decline to answer any question or to end the session.

- **How do we store and handle the information you provide?**

The provided information will be treated anonymously, which means it will be aggregated with other data and not used as individual data. This is in accordance with the data protection regulation from the European Commission: art. 5.1, “b”, of the Regulation (EU) 2016/679 of the European Parliament and of the Council, of 27th April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC. The results from the study will be stored in the NUTRI-KNOW database which will be archived by WE&B and will be deleted one year after the project ends. The results will be made available to other collaborating researchers within the NUTRI-KNOW project.

Results from this study will be used for the NUTRI-KNOW project and for scientific purposes only. Personal data will be processed in a manner that ensures appropriate security and confidentiality of personal data, which includes preventing unauthorized access to or use of personal data and the equipment used for processing. Recorded information will be processed during the phase of data analysis and will be included in project internal reports or later in scientific publications. Your recorded information will only be processed for the purposes of the project (‘purpose limitation’) and limited to what is necessary in relation to the purposes for which they are processed (‘data minimisation’). The results of this study may be published in scientific magazines, conference proceedings or books.

- **Contact person**

If you want to receive a copy of the results of this study, if you would like to request any further information about your rights as a participant in the testing phases, if you are not satisfied with

the way this study is being carried out, or if you have any question or complaint during the testing phase, please contact the leading researcher:

Beatriz Medina,

WE&B

beatriz.medina@weandb.org

Thank you on behalf of NUTRI-KNOW team, we are looking forward to speaking to you soon!

CONSENT SHEET FORM

LINK ACCESS

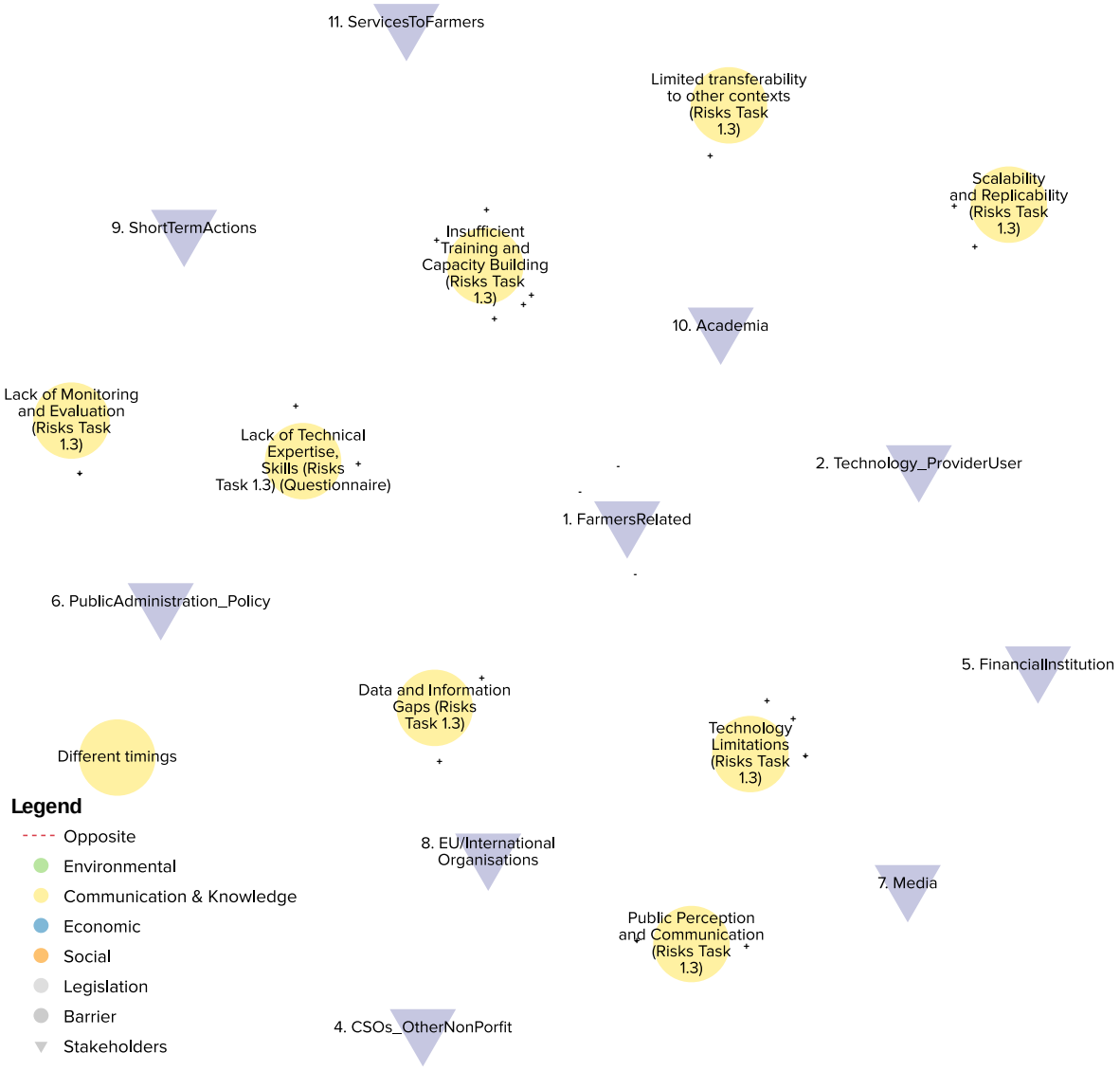
General		
I confirm I have read and understood **the Information Letter and Consent Sheet** (attached) for the above project. The information has been fully explained to me and I have been able to ask questions, all of which have been answered to my satisfaction.	Yes ☐	No ☐
I **give my consent** to participate in the interview of the research project entitled NUTRI-KNOW	Yes ☐	No ☐
I **give my consent** to record this interview.	Yes ☐	No ☐
I understand that this project **is entirely voluntary and if I decide that I do not want to take part, I can stop taking part in this project at any time without giving a reason.** I understand that deciding not to take part will have no negative consequences for me.	Yes ☐	No ☐
I understand that participation may involve being interviewed and tested by researchers, members of the NUTRI-KNOW.	Yes ☐	No ☐
I understand that I **will not be paid or receive any materialistic reward for taking part in this project.**	Yes ☐	No ☐
I know who to contact if I have any question about the NUTRI-KNOW, my participation thereto or my privacy.	Yes ☐	No ☐
I consent to take part in this project having been fully informed of the **risks, inconveniences and benefits** which are described in full in the Information Letter which I have been provided with.	Yes ☐	No ☐
I agree to being contacted by researchers by email and phone as part of this project.	Yes ☐	No ☐

I agree that my data is collected in a central database. In order to facilitate scientific discoveries, **my non-identifiable data** will be made available to the public (in absolutely anonymous form) for the use permitted by research.	Yes ☐	No ☐
Data processing		
I consent to the **collection of personal data** such as my **name, email address** in accordance with the purposes of this research project.	Yes ☐	No ☐
I understand that personal information about me, including the transfer of this personal information about me outside of the EU, will be protected in accordance with the General Data Protection Regulation.	Yes ☐	No ☐

Annex 2 – Supporting Material for Facilitators

FCM Handouts

Communication & Knowledge



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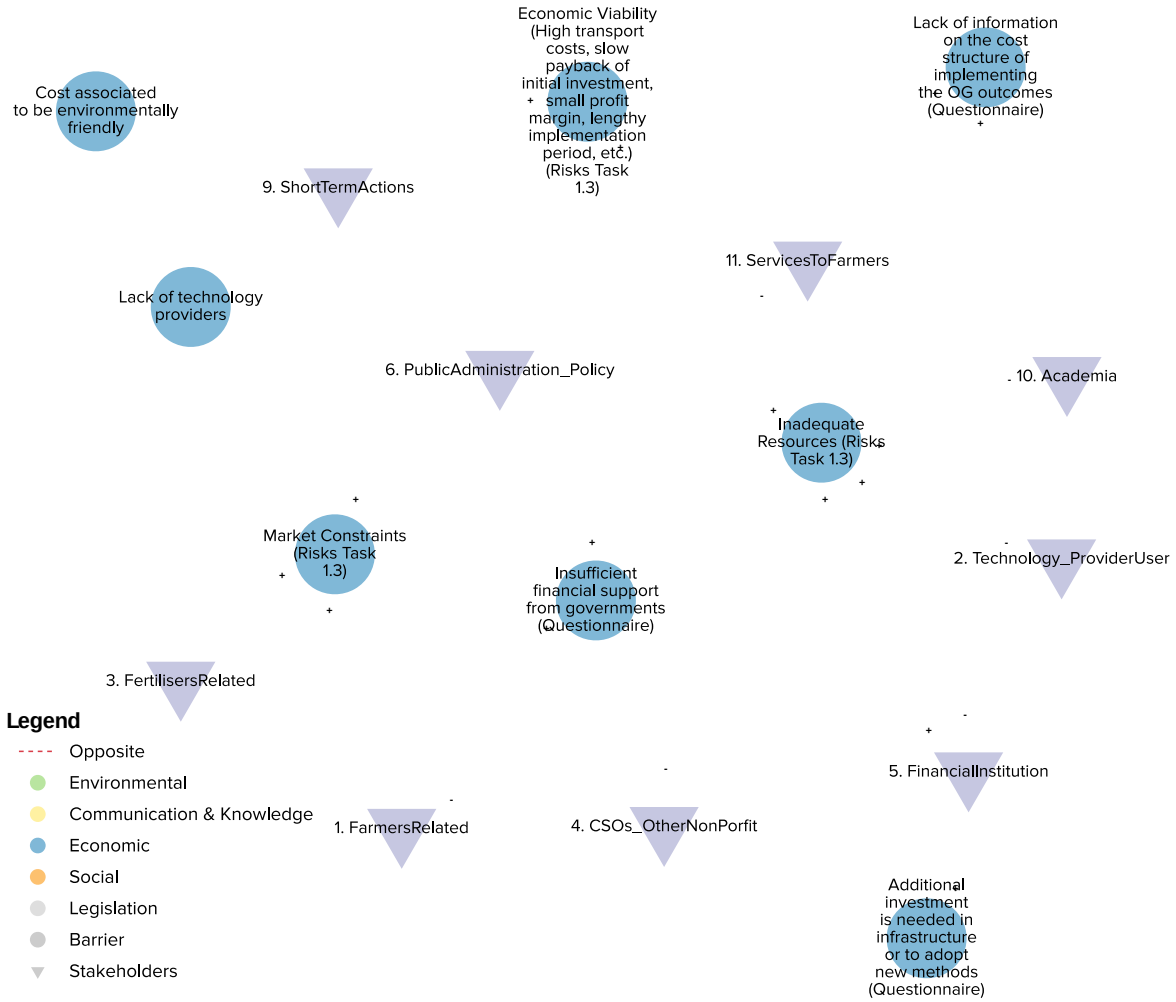
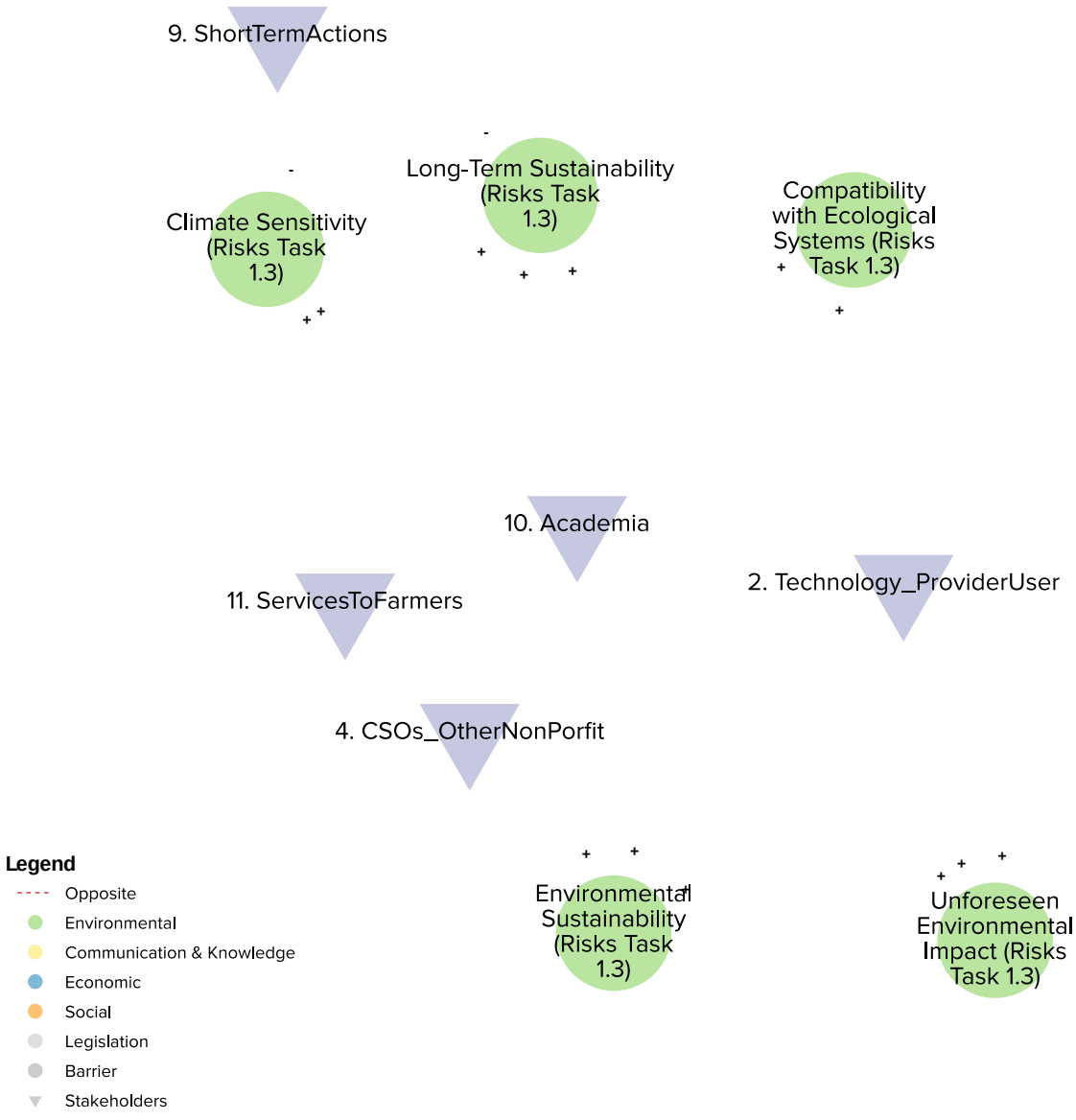
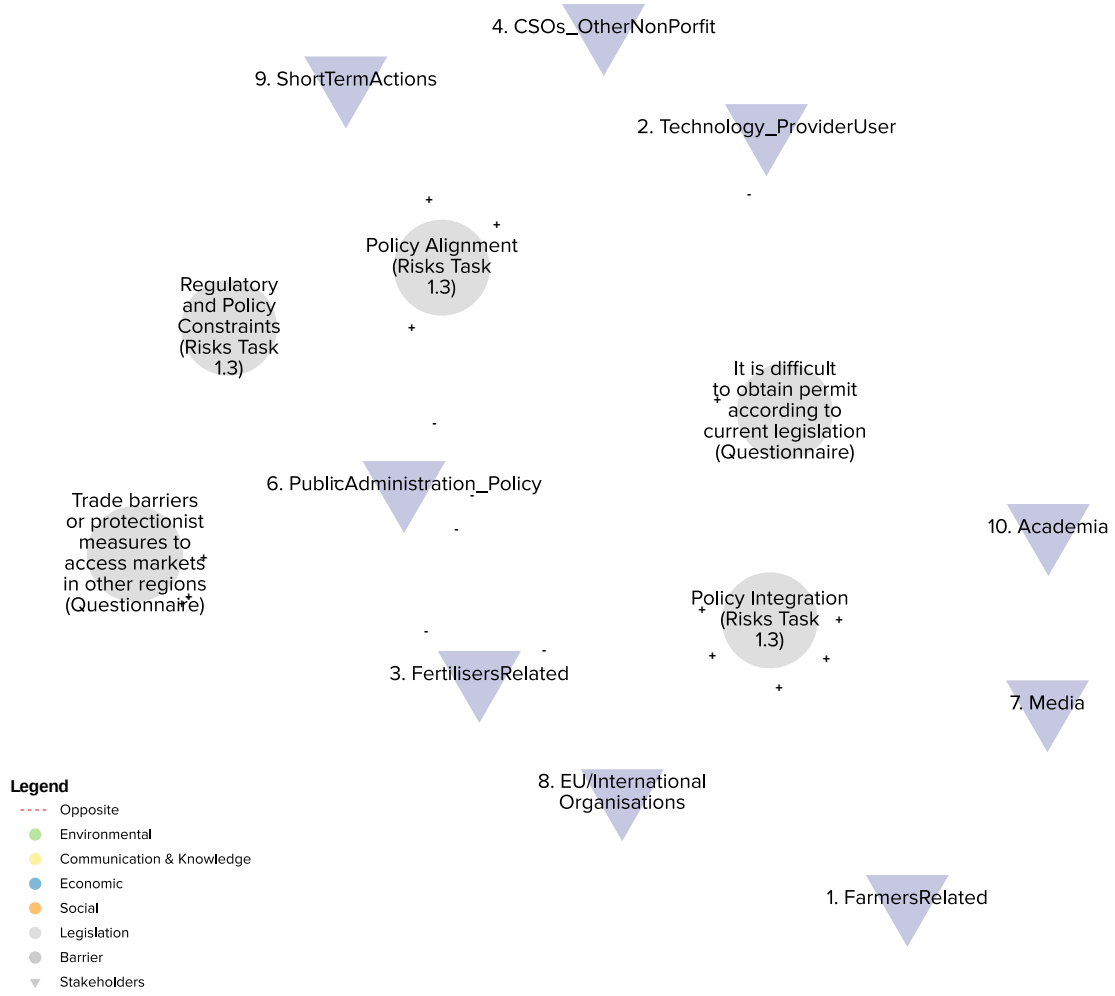
Economic


Cost associated to be environmentally friendly
Economic Viability (High transport costs, slow payback of initial investment, small profit margin, lengthy implementation period, etc.) (Risks Task 1.3)
Lack of information on the cost structure of implementing the OG outcomes (Questionnaire)
9. ShortTermActions
11. ServicesToFarmers
Lack of technology providers
6. PublicAdministration_Policy
10. Academia
Inadequate Resources (Risks Task 1.3)
Market Constraints (Risks Task 1.3)
Insufficient financial support from governments (Questionnaire)
2. Technology_ProviderUser
3. FertilisersRelated
Legend
Opposite
Environmental
Communication & Knowledge
Economic
Social
Legislation
Barrier
Stakeholders
1. FarmersRelated
4. CSOs_OtherNonPorfit
5. FinancialInstitution
Additional investment is needed in infrastructure or to adopt new methods (Questionnaire)

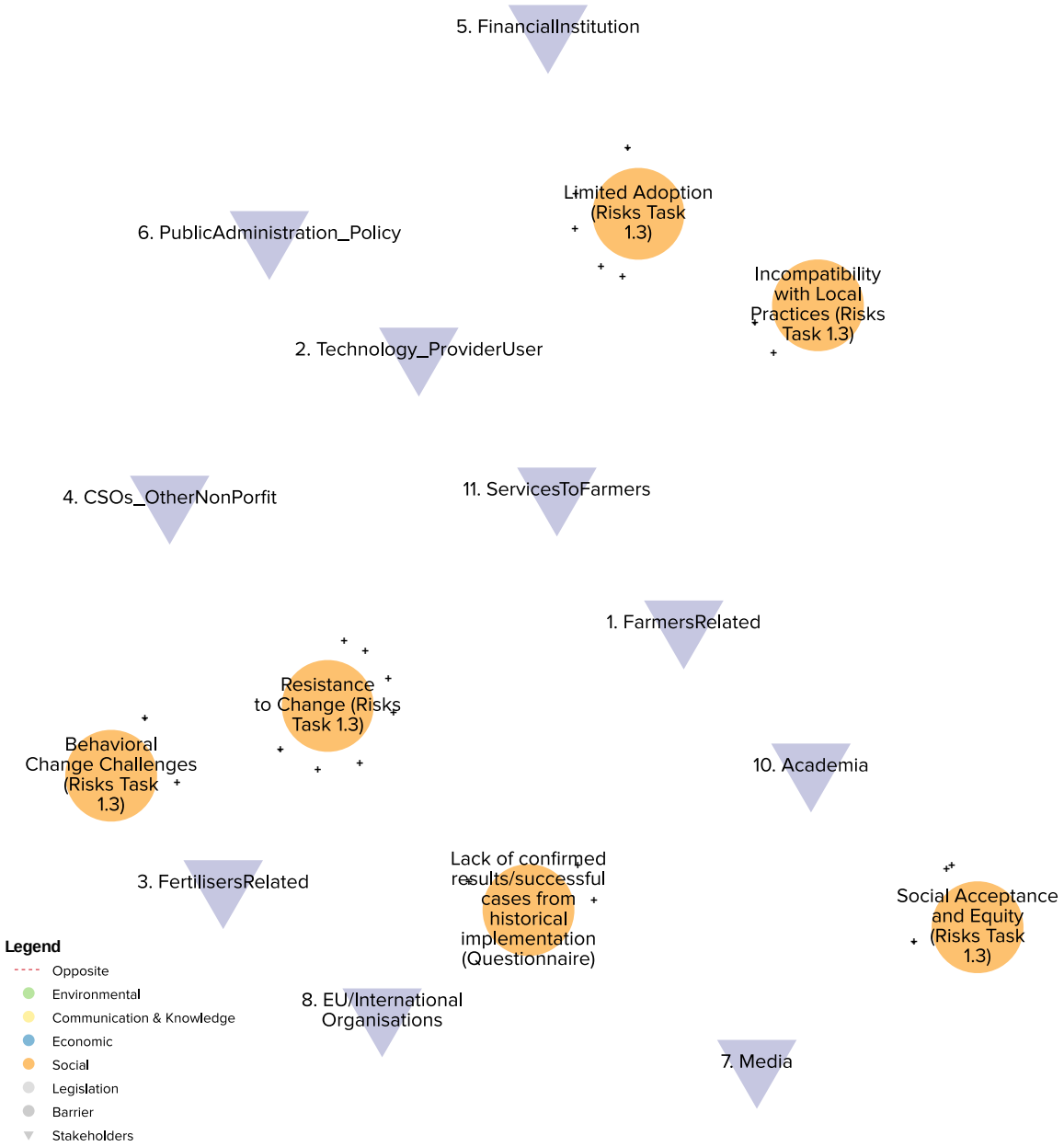
Environmental



Legislation



Social



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Target Groups

Farmers Related (Farming trade union, Farmers association, Professional association, Cluster, Expert groups, Local farmer Farmer association, Cooperative)	**Technology_Providers User** (Technology provider , Refinery, Biogas plant)
Fertilisers Related (Fertiliser company Biobased fertilising industry Fertiliser test lab)	**CSOs, Other Non Porfit** (NGOs, Consumer Associations, etc.)
Financial Institutions (Bank, Public funding agency Investor)	**Public Administration_Policy** (Regional government, County office/ other territorial services, Public council National government, National / Regional agency)

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MEDIA (Local media; Regional media, European media, Influencer Farming specilised)	**EU/INTERNATIONAL ORGANISATIONS** (EU agencies, Networks, etc.)
Short Term Actions (Project, Initiative, Collaborator)	**Academia** (Research institution, University, Agricultural student)
Services To Farmers (Farm advisor, Advisory platform, Agricultural contractor Trade chamber, Capacity building institution)	

OGs

OG1 S1. Slurry concentrator	OG2 S2. Manure management tool
OG3 S3. FERTICOOP-GO	OG4 IT1. Livestock manure and digestates treatment
OG5 IT2. SOS- AQUAE	OG6 IT3. GAS LOOP

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OG7 B1. RENURE	OG8 B2. POKETBOER 2
OG9 B3. Grass2Algae	OG10 IR1. Biorefinery Glas
OG11 IR2. MOPS	OG12 IR3. Duncannon Blue Flag Farming & Communities

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OGs Outcomes

OGs	OUTCOME	DESCRIPTION
OG1. Slurry concentrator	1TH_concentrator	Slurry concentrator propotype in two phases for a more efficient livestock waste management
OG2. Manure management tool	2TL_conductivitymeters	Optimisation of fertilisation using conductivity meters for in situ determination of NPK content of slurry
	2TL_computerApp	Use of a computer application to optimise procesess ang logistics
	2TL_economicreduction	Application of economic emission reduction strategies during slurry storage (acidification; addition of straw)
	2R_agrimanagement	Implementation of agricultural management improvements: use of hose equipment to apply liquid manure; application of liquid manure in crop cover; the adequacy of the dose of nutrients to be applied to crops.
OG3. FERTICOOP-GO	3R_BAT	Description of best available techniques (BAT) by assessing different methods to reduce ammonia and GHG emissions in farms and slurry pools
	3TL_rapidtesting	Facilitate the fast and reliable provision of recommendations for fertilisation by determining 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.
OG4. Livestock manure and digestates treatment	4TH_manuretreatment	Livestock manure and digestates treatment to reduce emissions and produce Struvite
	4P_struvite	Struvite
OG5. SOS- AQUAE	5R_packages	Identification and application of agro-technological 'packages' that allow to increase both productivity and the environmental sustainability.
OG6. GAS LOOP	6TH_airwashing	Development of an air washing system propotype with ammonia capture characterized by a Technological Maturity Level equal to TRL 9.
	6P_ammoniumsulphate	Continuous production of ammonium sulphate (fertiliing solution) in the "Amonia Washing Machine"
OG7. RENURE	7P_ammoniumsulphate	Development of infosheets resuming results of field trials of the stripping scrubbing of the liquid fraction of manure or digestate innovative technology.
	7R_evaluation	Evaluation and dissemination of the impact of this technology throughout Flanders.

OG8. POKETBOER 2	8R_pocketdigesters	Elaboration of recommendations based on the experiences dairy farmers who are already using pocket digesters, to find solutions for common problems and improve performance
OG9. Grass2Algae	9P_grassjuice	Dissemination products about the economic viability of the use of grass juice for growing microalgae with the excess of grass farners have:
		• Press release with main results from the project
		• Workshop with interested farmers
		• 2 scientific publications currently being prepared
OG10. Biorefinery Glas	10TH_mobilegrass	Demonstration of a small-scale mobile grass biorefinery on multiple farms in South West Ireland, producing and validating multiple products grom grass.
	10P_presscake	Improved fodder press-cake fibre for cattle
	10P_monogastrics	Protein concentrate feed for monogastrics
	10P_prebioticsugars	High value prebiotic sugars (for the food and feed markets)
	10P_recoveredfertilisers	Fertiliser from recovered nutrients
OG11. MOPS	11R_organiccropping	Optimisation of organic horticulture production and supply consistency through organic grower collaboration, developing an implementing organic cropping programmes improving land and crop management
	11TL_greenmanures	Optimisation of organic horticulture production and supply consistency through organic grower collaboration using green manures to improve sustainable practices and reduce reliance on imported nutrients
OG12. Duncannon Blue Flag Farming & Communities	12TL_PPZmaps	Development of education and engagement tools (farm-specific pollution potential zone 'PPZ' maps) to show farmers in a visual way the water-quality risks specific to their farms.
	12R_waterquality	Demonstration of innovative and cost-effective farm management practices for water-quality protection.
	12TL_rewardscheme	Development of a template for a water-quality focused, results-based, reward scheme which could be used to improve water-quality in particularly sensitive catchments.

Barriers

RISK (TASK 1.3)	DESCRIPTION
SOCIAL	
Limited Adoption	Risk of low adoption rates among farmers or stakeholders.

Resistance to Change	Risks arising from resistance to adopting new practices or technologies, leading to limited effectiveness.
Incompatibility with Local Practices	Risks of the methodology being incompatible with existing agricultural practices or cultural norms.
Social Acceptance and Equity	Risks related to social acceptance, inclusivity, and equitable distribution of benefits from the methodology.
Behavioural Change Challenges	Risks related to the lack of expected changes required from farmers or stakeholders for successful adoption.
COMMUNICATION & KNOWLEDGE	
Insufficient Training and Capacity Building	Risks of inadequate training and capacity building, affecting the proper implementation and utilization of the methodology.
Lack of Technical Expertise	Risks due to a lack of technical expertise or knowledge required for effective implementation.
Data and Information Gaps	Risks due to the lack of relevant data or information needed for effective decision-making and implementation.
Scalability and Replicability	Risks of the methodology not being easily scalable or replicable in different agricultural settings or regions.
Lack of Monitoring and Evaluation	Risks arising from inadequate monitoring and evaluation efforts, hindering the ability to identify shortcomings and make improvements.
Technology Limitations	Risks associated with the limitations or technical constraints of the technology or tools used in the methodology.
Public Perception and Communication	Risks arising from negative public perception or inadequate communication about the benefits of the methodology.
Limited transferability to other contexts	Offers some transferable insights, but they may be applicable only in certain related contexts. The knowledge provided may not be easily adapted to diverse situations
ECONOMIC	
Inadequate Resources	Risks associated with insufficient financial, human, or technological resources, impacting the methodology's successful execution.
Economic Viability	Risks associated with the methodology's cost-effectiveness and affordability for farmers or stakeholders.
Market Constraints	Risks related to market access and demand for products or services associated with the methodology.
POLICY & LEGISLATION	
Regulatory and Policy Constraints	Risks arising from conflicts with existing regulations or policies related to nutrient management.
Policy Alignment	An assessment of the degree of alignment between the technology or solution and existing law policies.
Policy Integration	An examination of how effectively the technology or solution integrates with existing law policies.
ENVIRONMENTAL	
Unforeseen Environmental Impact	Risks of unintended environmental consequences, such as soil degradation or water pollution, from the methodology's implementation.
Climate Sensitivity	Risks related to the methodology's vulnerability to climate variability and extreme weather events.
Long-Term Sustainability	Risks associated with the methodology's ability to deliver lasting and sustainable improvements in nutrient management practices.
Compatibility with Ecological Systems	The technology/solution has limited compatibility with ecological systems. It may cause disruptions or negative impacts on local ecosystems and biodiversity.
Environmental Sustainability	The tecnology/solution has limited consideration for environmental sustainability. It may address some aspects of nutrient management but falls short in achieving comprehensive environmental benefits.

QUESTIONNAIRE BARRIERS	TYPE
Lack of confirmed results/successful cases from historical implementation	**Social**
Insufficient financial support from governments	**Economic**

Lack of information on the cost structure of implementing the OG outcomes	**Economic**
Additional investment is needed in infrastructure or to adopt new methods	**Economic**
It is difficult to obtain permit according to current legislation	**Legislation**
Trade barriers or protectionist measures to access markets in other regions	**Legislation**
Lack of Technical Expertise, Skills	**Communication & Knowledge**

9. Annex 4: Excel database with workshop data

Table 6: excel database of collected data from FCM WS 1 and 2, used for creating the maps in Kumu

Label	Type	Tags	Description	Related OGs	Mentioned as Country Specific
Data and information gaps	Barrier	Communication & Knowledge	From Risks Task 1.3	OG2 | OG3 | OG4 | OG11	
Different digital skills	Barrier	Communication & Knowledge	New in FCM WS 2 Spain		Spain
Different timings when communicating	Barrier	Communication & Knowledge	New in FCM WS 1		
Dispersion in communication channels	Barrier	Communication & Knowledge	New in FCM WS 2 Spain		Spain
Insufficient training and capacity building	Barrier	Communication & Knowledge	From Risks Task 1.3	OG1 | OG3 | OG5 | OG6 | OG7	
Lack of monitoring and evaluation	Barrier	Communication & Knowledge	From Risks Task 1.3	OG6 | OG7 | OG9 | OG10 | OG11	
Lack of technical expertise and skills	Barrier	Communication & Knowledge	From Risks Task 1.3 and Questionnaire of Task 2.2	OG4	
Limited transferability to other contexts	Barrier	Communication & Knowledge	From Risks Task 1.3	OG10	
Negative public perception	Barrier	Communication & Knowledge	From Risks Task 1.3	OG1 | OG2 | OG3 | OG4 | OG5 | OG6 | OG7 | OG8 | OG9 | OG10 | OG11 | OG12	
Scalability and replicability	Barrier	Communication & Knowledge	From Risks Task 1.3	OG 1 | OG2 | OG3 | OG4 | OG6	
Technology limitations	Barrier	Communication & Knowledge	From Risks Task 1.3	OG4	
Generational transition of farms	Barrier	Communication & Knowledge	New in FCM WS 2 Italy		Italy

Differences in language	Barrier	Communication & Knowledge	New in FCM WS 2 Italy		Italy
Insufficient communication capabilities	Barrier	Communication & Knowledge	New in FCM WS 2 Italy		Italy
Information overload and not tailored to the user	Barrier	Communication & Knowledge	New in FCM WS 2 Italy, Belgium		Italy | Belgium
Additional investment is needed in infrastructure or to adopt new methods	Barrier	Economic	From Questionnaire of Task 2.2	OG1 | OG2 | OG3 | OG4 | OG5 | OG6 |OG10	
Cost associated to be environmentally friendly	Barrier	Economic	New in FCM WS 1		
Economic viability (high transport costs, slow payback of initial investment, small profit margin, lengthy implementation period, etc.)	Barrier	Economic	From Risks Task 1.3	OG1 | OG2 | OG3 | OG4 | OG5 | OG6 | OG7 | OG8 | OG9 | OG11	
High risk/cost of conducting innovations	Barrier	Economic	New in FCM WS 2 Spain, Italy		Spain | Italy
Inadequate resources	Barrier	Economic	From Risks Task 1.3	OG1 | OG2 | OG3 | OG4 | OG5 | OG6 | OG9 | OG10	
Insufficient financial support from governments	Barrier	Economic	From Questionnaire of Task 2.2	OG4 | OG5 | OG6 | OG8	
Lack of information on the cost structure of implementing the OG outcomes	Barrier	Economic	From Questionnaire of Task 2.2	OG4 | OG6	
Lack of technology providers	Barrier	Economic	New in FCM WS 1		
Market constraints	Barrier	Economic	From Risks Task 1.3	OG4 | OG6 | OG8	
Uncertainty of the energy price and evolution of the agricultural market	Barrier	Economic	New in FCM WS 2 Spain		Spain
New Common Agricultural Policy (CAP)	Barrier	Economic	New in FCM WS 2 Italy		

Climate sensitivity	Barrier	Environmental	From Risks Task 1.3	OG2	
Compatibility with ecological systems	Barrier	Environmental	From Risks Task 1.3	OG7 | OG9 | OG10	
Environmental sustainability	Barrier	Environmental	From Risks Task 1.3	OG1 | OG3	
Long-term sustainability	Barrier	Environmental	From Risks Task 1.3	OG2 | OG3	
Inconsistency of environmental labels on products for consumer awareness	Barrier	Environmental	New in FCM WS 2 Italy		Italy
Safety of fertilisers for use on crops and human consumption	Barrier	Environmental	New in FCM WS 2 Ireland		Ireland
Unforeseen environmental impact	Barrier	Environmental	From Risks Task 1.3	OG4 | OG7	
Bureaucratic overload of farmers	Barrier	Legislation	New in FCM WS 2 Spain		Spain
Complexity of legislation and actors involved	Barrier	Legislation	New in FCM WS 2 Spain, Italy		Spain | Italy
It is difficult to obtain permit according to current legislation	Barrier	Legislation	From Questionnaire of Task 2.2	OG8	Spain | Denmark | Belgium
Disagreements among policy makers/policies	Barrier	Legislation	New in FCM WS 2 Belgium		Belgium
Lengthy adaptation process of regulations to innovation	Barrier	Legislation	New in FCM WS 2 Spain		Spain
Policy alignment	Barrier	Legislation	From Risks Task 1.3	OG7 | OG10	
Policy integration	Barrier	Legislation	From Risks Task 1.3	OG3 | OG7	
Overload of regulations (old and new)	Barrier	Legislation	New in FCM WS 2 Belgium		Belgium
Regulatory and policy constraints	Barrier	Legislation	From Risks Task 1.3		
Saturation of the public administration	Barrier	Legislation	New in FCM WS 2 Spain		Spain

Trade barriers or protectionist measures to access markets in other regions	Barrier	Legislation	From Questionnaire of Task 2.2	OG4	Spain | Italy
Lack of trust of regulators in permitting process	Barrier	Legislation	New in FCM WS 2 Italy		
Behavioral change challenges	Barrier	Social	From Risks Task 1.3	OG2 | OG3 | OG7	
Generational gaps and aging of the sector	Barrier	Social	New in FCM WS 2 Spain, Italy		Spain | Italy
Incompatibility with current local practices	Barrier	Social	From Risks Task 1.3	OG3	
Lack of confirmed results/successful cases from historical implementation	Barrier	Social	From Questionnaire of Task 2.2	OG6 | OG11	Spain
Limited adoption	Barrier	Social	From Risks Task 1.3	OG4 | OG5 | OG9	
Resistance to change	Barrier	Social	From Risks Task 1.3		Spain
Lack of social acceptance and unequity	Barrier	Social	From Risks Task 1.3	OG8	Italy | Belgium
Difficult interaction between farmers and commercial sellers of nutrients	Barrier	Social	New in FCM WS 2 Italy		Italy
Lack of understanding between producers and users	Barrier	Social	New in FCM WS 2 Italy		Italy
Farmers tied to a single trade association	Barrier	Social	New in FCM WS 2 Italy		Italy
FarmersRelated	Stakeholders				
Academia	Stakeholders				
ServicesToFarmers	Stakeholders				
Technology_ProviderUser	Stakeholders				

FertilisersRelated	Stakeholders				
CSOs_OtherNonProfit	Stakeholders				
FinancialInstitution	Stakeholders				
PublicAdministration_Policy	Stakeholders				
Media	Stakeholders				
EU/International Organisations	Stakeholders				
ShortTermActions	Stakeholders				
Citizens_Consumers	Stakeholders		New in FCM WS 2 Italy, Belgium		

10. Annex 5: List of participants of FCM Workshop 1

Table 7: List of participants that attended the first FCM workshop in the GA

Name of participant	Organisation
Anna Bagó Mas	UVIC-UCC
Víctor Carbajal Perelló	UVIC-UCC
Sergio Ponsá Salas	UVIC-UCC
Gemma Rocadembosch Pujolar	UVIC-UCC
Beatriz Medina Parra	WE&B
Maria Pascual Sánchez	WE&B
Marta Daví Pous	DACC
Paula Jimeno Berdugo	DACC
Clara Fullana Pons	FCAC
Aoife Egan	Teagasc
Patrick Forrestal	Teagasc
Stephen Meredith	IOA
Hongzhen Luo	UGent
Céline Wyffels	Biogas-E
Allan Leck Jensen	AU
Claus Aage Grøn Sørensen	AU
Andrea Poluzzi	CRPA
Sergio Piccinini	CRPA
Giuseppe Moscatelli	CRPA
Derek Kelly	IOA

NUTRI•KNOW

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Commission. Neither the European Union nor the granting authority can be held responsible for them.