



EJP SOIL
European Joint Programme

**Towards climate-smart sustainable management of
agricultural soils**

SCALE

Managing Sediment Connectivity in Agricultural Landscapes for reducing water
Erosion impacts

Deliverable WP5-D3

**Report on prioritized plans of mitigation
strategies at the catchment with end-users'
feedback**

Due date of deliverable: M42 (July 2023)

Actual submission date: 28.02.2024

GENERAL DATA

Grant Agreement: 862695

Project acronym: SCALE

Project title: Managing Sediment Connectivity in Agricultural Landscapes for reducing water Erosion impacts

Project website: www.scale-ejpsoil.eu

Start date of the project: February 1st, 2021

Project duration: 42 months

Project coordinator: Elmar M. Schmaltz (BAW)

DELIVERABLE NUMBER: WP5-D3
DELIVERABLE TITLE: Report on prioritized plans of mitigation strategies at the catchment with end-users' feedback
DELIVERABLE TYPE: Report
WORK PACKAGE N: WP5
WORK PACKAGE TITLE: Mitigation measures and decision support framework for stakeholders
DELIVERABLE LEADER: CSIC
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ACKNOWLEDGEMENTS: Thank you to all participants in the focal groups



Abstract

This report presents the results of focus group meetings conducted in seven selected catchments of the SCALE Project to identify and select mitigation measures considering the perspective of the stakeholders and evaluate the social and economic barriers hindering their implementation. The meetings were attended by local stakeholders: farmers and public servants connected with the agricultural and environmental sectors. Participants were asked to assess the relevance and their perception of soil erosion risk and sediment transport, the usefulness of erosion models and maps to implement erosion control measures, and how to improve these tools. They were also inquired about the most suitable measures to be implemented and the actions needed to overcome the barriers for wider adoption.

Farmers expressed different perspectives about erosion risk. While there was a group of farmers in the Austrian, Flemish, and Spanish catchments who were aware of the impacts of erosion on soil quality, crop yield, and water quality, the farmers from Nordic countries do not perceive soil erosion as a significant threat. In general, farmers mistrust assessments based on erosion models and maps and would prefer to advocate for more intense field monitoring to obtain reliable and precise data.

The implementation of erosion control measures largely depends on farmers' experience and "tradition" and profitability analysis. Subsidies were considered as a promising tool to foster the adoption of new voluntary measures, but improving subsidy schemes, particularly by streamlining the administrative process, was remarked as a priority by all participants.

The diverse perspectives among farmers and stakeholders emphasize the need for tailored mitigation strategies considering the different perceptions of the relationship between soil erosion, crop yield, and the sustainability of farm systems, and the feasibility of implementing measures.



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1. Introduction

This report presents the results of focal groups meetings conducted in selected catchments of the SCALE Project located in Austria, Belgium (Flanders), Denmark, Finland and Spain. The primary objectives were (i) identify and select mitigation measures, considering the perspective of the stakeholders, suitable mitigation measures to be implemented for reducing on-site and off-site impacts of soil erosion and sediment fluxes; and (ii) evaluate the social and economic barriers hindering their implementation.

This deliverable significantly contributes to the realization of the objective 2 of the work package 5: “Cataloguing available mitigation measures against water erosion and developing a methodology for the assessment and selection of suitable mitigation measures tailored to the conditions of a given catchment by specifically addressing hydrological connectivity”.

In the first part of this report, we present the methodology along with data employed in the study. The outcomes of the focus group meetings are analysed in the second part. The report finalizes with a comprehensive summary, highlighting the most notable conclusions for each catchment.

2. Methods and data

We used the **focus group** methodology as to obtain data about a specific theme by **groups** interpretations, interactions and norms around a specific subject (Bloor et al., 2001). This methodology relies on the comparison of experiences by the participants and the understanding of the group dynamics in order to generate knowledge about the complexities of the studied social practices and the perspectives of the target population. These insights are often challenging to extract through individual interviews or surveys. The participants ask about each other's statements and comment on each other's experiences and understandings based on a contextual pre-understanding that may not have been evident from the researcher's point of view. Another key reason for employing the focus group interview method lies on its ability to mitigate influence an interviewer may have on shaping the content of the conversation.

In order to balance the interviewer's interferences well a semi-structured approach, combining a few predetermined questions and open-end questions, was used. By applying this approach, we gave opportunity to raise issues that participants deem pertinent and closely connected to their experience and expertise, thereby fostering ownership of the process.

Focus group meetings were conducted in 6¹ out of the 14 pilot catchments (a detailed description of the selected catchments can be found in WP5-D1) and were facilitated by a representative of SCALE's partners. Some of the catchments have been involved in long-term collaboration exercises among scientific, technical partners, and stakeholders, while others (Finland and Denmark) are just beginning this collaboration.

Participants were selected among land-users that are located in areas with a known soil erosion risk and where sediment transport hampers the water quality in adjacent water courses and bodies.

¹ In the Austrian catchment the information was gathered through individual interviews with the farmers



In the case of Flanders' catchments the focus groups targeted two different kinds of audiences. In both the Maarkebeek and Menebeek catchments two focus group meetings were organised. Here the main attendees were public representatives connected with the agricultural and environmental sectors. In the Maarkebeek catchment, a catchment that has been monitored and selected as experimental site in many research and demonstration projects, an additional focus group meeting was held, targeting local farmers. This meeting was led by an intermediate partner, who is closely connected with the local agricultural representatives. Due to the different background and perception on erosion issues between both study group audiences, i.e. public representatives and farmers, the results of these focus groups were considered based on participants of the focus groups, rather than by study area, for Flanders.

The focus groups meetings were attended by 2-11 participants and sessions lasted for 90-120 minutes. In the first part of the session the facilitator set the scene presenting the SCALE project and erosion risk assessment for targeted mitigation planning as a concept. This included existing information on soil redistribution risk, hydrological pathways and related mapped data in the catchments as well as a selection of available mitigation measures, or erosion control measures (ECM), and support schemes.

The second part of the sessions were focused on specific erosion- and sediment-related problems of the areas on which the participants might have local and personal perspectives. The facilitators provided participants with high-resolution maps of catchments allowing farmers to assess their own land (see Figure 1).

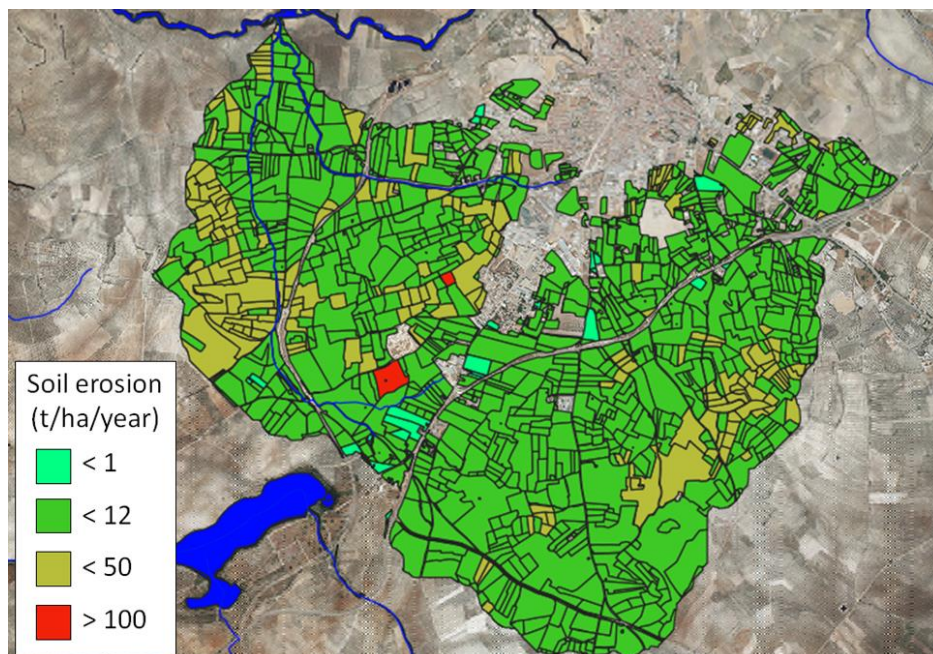


Figure 1. An example of high-resolution maps provided to participants in the focus groups meetings: Calculated soil erosion using RUSLE equation in Barriga catchment, Spain (J.A. Muñoz personal communication).

During the focus groups, the mediators could rely on the semi-structured approach, in order to gain insights on the two main research questions for this study. These questions were thought-up before the focus groups, and were shared with all participating partners of the SCALE project involved in this deliverable.

First, the extent and relevance soil redistribution and hydrological connectivity as considered by the participants was inquired. This was done by following questions:

1. **Relevance of soil redistribution:** Participants were asked to share their views of the relevance of water erosion and sediment transport in the landscape in their area. Is it seen as a problem, and if so as a threat to soil or water quality?
2. **Perception of erosion risk assessment:** Farmers inspected and evaluated the soil redistribution and other maps. They were asked to rank to which extent the mapped data represent soil conditions and sediment transport on their land on a scale from 1-5, where 5 is very good and 1 is bad agreement. They were also questioned on their opinion about usefulness of the erosion risk erosion maps provided.
3. **Uncertainties of documentation:** We asked the participants about their views on uncertainties in risk mapping and the way of minimizing by gathering and monitoring ground data. They were also questioned about their willingness to support in collecting data by ranking on a scale from 1-5, where 5 is active support in collecting data (a. o. citizen science approach) and 1 is no interest.
4. **Data access and transparency:** Farmers were inquired on the opinion about data access and ownership. Participants were asked to assess on a scale from 1-5, where 5 is high willingness and 1 is no interest, to which extent participants accept publicly available erosion risk maps.

Second, the views of the participants on the opportunities for implementing mitigation measures aided by risk assessment were explored. To this end, following questions were used during the focus groups:

1. **Mitigation measures:** The farmers were provided with a list of potential mitigation measures (Table 1) and were asked to rank, from most to least relevant, the three measures they consider most significant for their fields. The idea was not so much to obtain a number, but by asking farmers to rank, they will need to discuss and negotiate which practices are the three most relevant under their conditions/farming systems. During the discussion alternative measures could be mentioned.
2. **Implementation capacities:** The farmers were requested to assess their capabilities to adopt the three practices they had selected on a scale from 1-5, where 1 represent practices that they are currently incapable of implementing and 5 represent practices that they are fully capable of implementing. Discussion was oriented to identify the main barriers to implement and the needs to increase the capacity to address erosion on their farm appropriately.
3. **Identifying hotspots:** This topic concerned the views of the participants on how to promote concerted approaches for implementing ECMs as well as to cope with areas that manifest a long-term soil erosion problem. The farmers were asked to rank the usefulness of erosion risk assessments for administrating targeted mitigation planning on a scale of 1-5, where 5 represents a high degree of usefulness and 1 a low one.
4. **Funding sources:** The participants discussed on using voluntary measures or general regulation to mitigate erosion risk.

Data obtained and the main findings extracted from discussions were reflected in a common template (Annex 1), which was provided to all facilitators of the focus group meetings.



Table 1. Examples of mitigation measures for water erosion provided to participants in the focus group meetings and possible ranking by participants.

Rank	Mitigation option	Type
3	Residue management (crop residue left in the field)	On farm measure
	Reduced/minimum tillage	On farm measure
2	Zero tillage	On farm measure
	Grass in rotation	On farm measure
1	Use of cover crops (also called catch crops)	On farm measure
	Permanent grassland management (optimized grazing)	Landscape scale measure
	Buffer strips and set-aside areas	Landscape scale measure
	Afforestation	Landscape scale measure
	Hedgerows	Landscape scale measure
	Others	

3. Results

A comprehensive report of each of the focus group meetings can be found in the Supplementary Material. The main summarized findings and the conclusions are presented hereunder for each of the analysed aspects.

Characteristics of the participants

Table 2 shows the characteristics of the farmers who took part in the focus group meetings in Austria, Denmark, Finland and Spain and the typology of the farms.

Table 2. Farmers characteristics, farm type and size.

Catchment / Country	Gender		Farm type						Size (ha)			
	Male	Female	Conventional crops	Organic farming poultry farming	Vegetable/ plant breeding	Livestock	Pig farming	Integrated	≤50	50-150	150-500	>500
HOAL/ Austria	4		2				2		1	2	1	
Aurajoki/ Finland	10	1	8	1	1	1			2	3	5	1
Hesselbaek & Varbor/ Denmark	3		2				1		2	1		
Barriga/ Spain	8	2	3	1				6	4	5		1

Interviewers were mostly male, accounting for 89%, while females constituted only 11%. They manage a representative number of the European farming systems of which conventional crop production systems seems to be predominant, except in the Mediterranean catchment (Barriga), where integrated production systems doubled the conventional ones. Organic agriculture is underrepresented, with only two organic farms, one located in the Barriga catchment, the other in the Aurajoki catchment. The



Aurajoki catchment also includes a vegetables and plant breeding cultivation farming system. Additionally, pig farming production and fattening are present in the Austrian and Danish catchments. The typology of the farming considered in the Finish catchment shows notable differences from the rest of the catchments including livestock and other land uses such as forest-grasslands.

Farmers participating in the focus groups typically run medium, less than 150 hectares, (39%), and small, less than 50 hectares, (32%) sized farms, with only two big farms exceeding 500 ha in the Aurajoki and Barriga catchments.

The participants in the focus group meeting held in Maarkeebeek catchment were 4 farmers who are also representatives in a local environmental and nature council organised by the local government. but not more. No further detailed information on their personal characteristic and on their farming practices was provided in the report (see Supplementary Material).

Relevance and perception of soil erosion risk

Farmers across different groups exhibit varied perspectives on soil erosion (Figure 2). The findings shed light on farmers' attitudes towards the impact of soil erosion on crop yield, water quality, and their willingness to adopt mitigation strategies.

In the HOAL catchment, farmers are aware of the issue of soil erosion and are concerned about the impacts of sediment connectivity when the farm's spatial pattern facilitates the transport of sediment from a field to downslope plots. They are worried about food security, so good sites for crop production should not be compromised for the sake of soil protection. Instead, locations that have suffered permanent soil erosion impacts should be converted to grassland and other forms of permanent vegetal cover land uses. Regarding water quality issues, farmers are more concerned with nutrient pollution than sediment loads, so the measures are oriented towards reducing nutrient and pesticide washing through runoff.

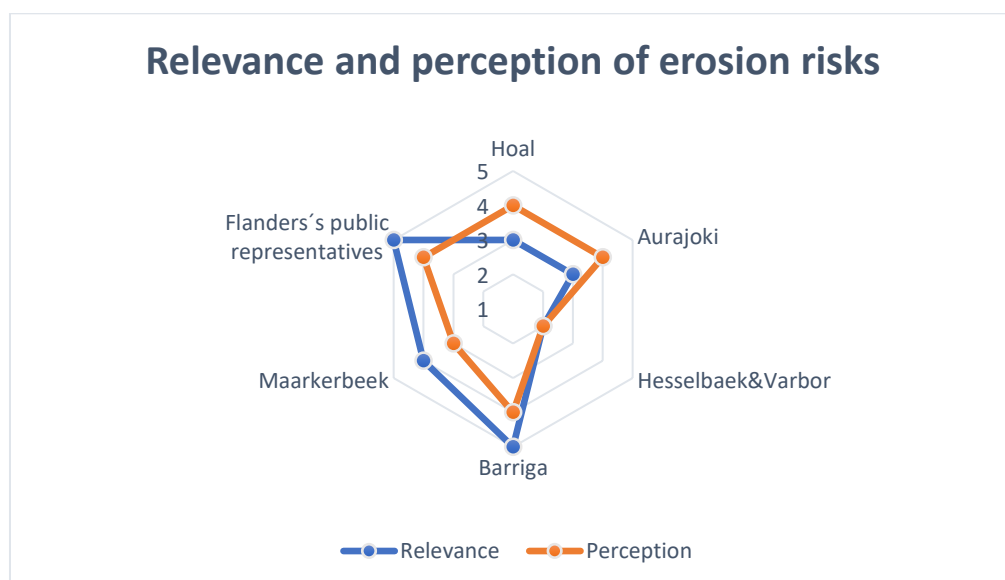


Figure 2. Relevance of soil redistribution and sediment transport in the landscape ranked from 1 (low) to 5 (high). Perception about the degree of agreement, where 5 indicates very good agreement and 1 indicates poor agreement, regarding the representation of erosion maps of soil conditions and sediment redistribution.



Shared concerns about erosion impact's on soil and crop yield are expressed by farmers from the Spanish catchment (Barriga) but are less worried about water quality that they linked to sediment loads. They highlight issues like gully formation that limit farming operations and find mitigation challenging due to cost and technical constraints, deeming it feasible only for larger farms. Farmers in Maarkebeek have a good understanding of the soil erosion phenomena and its impact on land. They emphasized how timing of crop and farming activities and the climate conditions influence the susceptibility to soil erosion.

Another group, mainly Nordic farmers, despite recognizing erosion on specific land conditions (such as steep slopes and clay soils in the Aurajoki catchment or after thaw and heavy rains in the Danish catchments) and acknowledging the necessity of cultivation limitations in specific areas for maintaining permanent grass cover, does not perceive it as a threat to soil quality or crop productivity.

Finally, the (technical and advisors) stakeholders interviewed in Belgium pointed out the local variability in erosion processes, influenced by agricultural activities and climate conditions. They share concerns about visible impacts after intense rain, recognizing that general mitigation solutions may not fit the local farm scale.

The diverse perspectives among farmers and stakeholders emphasize the need for tailored mitigation strategies considering the different perception on the relationship between soil erosion, crop yield and the sustainability of farm system and the feasibility of implementing measures.

Uncertainty and data access and transparency

The survey reveals a range of perspectives among farmers, with scepticism about the need for monitoring, concerns about data accuracy, and disappointment with how data is used by legislators.

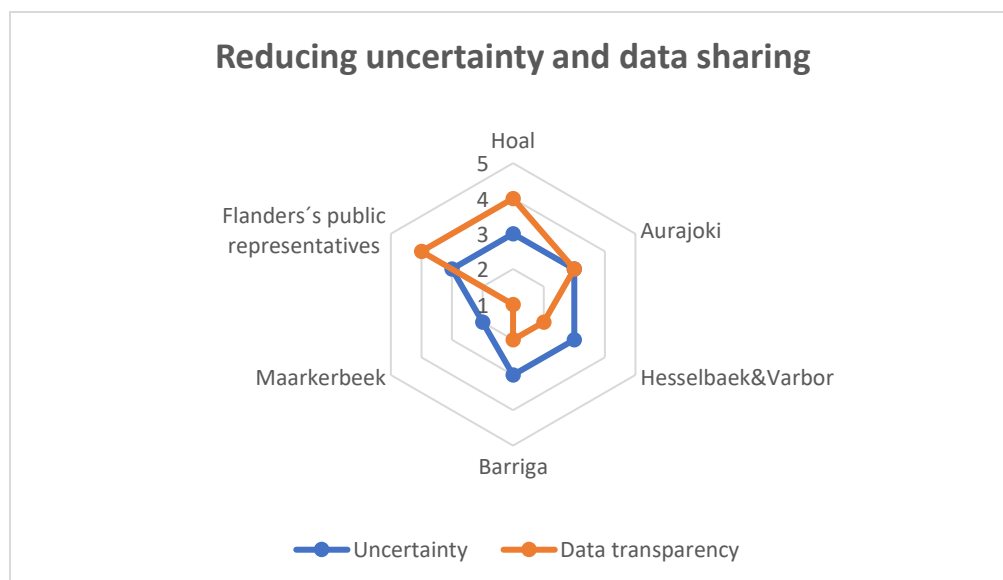


Figure 3. Participants' willingness to (i) collect data to reduce uncertainty in model estimation ranges from 5 (very active support, citizen science) to 1 (no interest); and (ii) to accept publicly available erosion risk maps ranges from 5 (high willingness) to 1 (no interest).

Farmers are sceptical about the necessity of monitoring, believing they know where the problems are and can address them without external intervention. Overall, farmers express little interest in

participating in data collection to validate models (Figure 3), as they see no direct benefit from these models.

Farmers are troubled by the accuracy and reliability of erosion maps, as numerous regulations rely on uncertain and imprecise data. They would prefer to advocate for more intense field monitoring to obtain reliable and precise data.

In general, farmers are quite disappointed by what they perceive as the misuse of data by legislators and they consider most model-based assessments to be inaccurate, leading to the imposition of restrictive norms on the agricultural sector. Sources of disappointment with erosion models' outputs stem from not considering essential input data. For example, Finnish farmers noted that the models did not use soil organic carbon data or included outdated values regarding crop types and land uses. The scale mismatching between general outputs and more detailed information within the parcel, where sediment sources are located, was also noted as a factor contributing to mistrust in erosion model outputs. They express a desire for more detailed maps that specifically identify sediment sources and the interconnectivity between neighbouring farms.

Despite their reservations, farmers affected by soil erosion, such as those in the Barriga catchment, demonstrate a willingness to collaborate with scientists and technical advisors. However, concerns about potential disruptions to farming activities during studies and experiments need to be addressed through formal agreements like Memoranda of Understanding.

Finally, the public servants interviewed in both catchments in Flanders are willing to participate as end-users, providing their own observations and terrain knowledge to validate the models. However, they remarked that there is not a standardized procedure to do it.

Participants acknowledge the potential advantages of transparency and the willingness to disclose data on soil erosion, recognizing its capacity to facilitate research into the causes and locations of soil erosion, ultimately striving to improve farming management practices. The more realistic the erosion risk maps are, the more farmers want to use them. However, there is a reluctance to publish maps lacking specificity in terms of sediment sources and flow paths so that the erosion problem can be properly attributed to specific locations. Farmers also struggle to relate data to on-farm occurrences as it is hard to allocate specific figures to a concrete farm.

Farmers are hesitant to share their own data, fearing misuse and anticipating potential restrictive regulations (Figure 3). This reluctance is rooted in concerns about the consequences of sharing farm-specific information. Many farmers share the concern that such information may reinforce the public opinion against the agricultural sector, which is shared by most farmers. Some of them specifically expressed concern apprehensions about the disconnection between administrative regulations and practical implementation. Regarding the sharing information, farmers in Maarkebeek are in favour of a one-stop platform that centralizes all data, including information that allows knowing which farmers comply and take mitigation measures and which are not willing to do so. Farmers in Spain remark the advantage of technical and extension institutions as brokers and peer-to-peer players to disseminate and make data available to final end-users.

Other stakeholders in Belgium emphasize the importance of making model outputs publicly available. They also underscore the necessity of understanding the basic data underlying the model results for accurate interpretation.



Mitigation measures

This part of the discussion aimed to identify the mitigation measures (ECMs) best suited to particular catchment conditions by asking the participants to rank the top three prioritised measures from a list of potential measures. The result is shown in Table 3. For some of the catchments the number of selected measures is higher than 3 since we decided to keep all ECMs that were equally ranked by multiple respondents.

Table 3. Most relevant erosion mitigation measures. Darker colours indicate higher relevance.

Measure	Catchments					Other stakeholders (Belgium)
	HOAL	Aurajoki	Hesselbaek Varbor	Barriga	Maarkebeek	
Residue management (crop residue left in the field)/Mulch-till	1	3	3	3	3	
Reduced/minimum tillage		2	2			2
Zero tillage/direct-tillage		3	3	2		
Use of cover crops (also called catch crops)	2		2	1	1	1
Strip-till						
Micro-dams with cover crops					2	
Buffer strips and set-aside areas			2		3	1
Vegetated waterways	3					3
Hedgerows			1			
Agro-forestry in cropland; afforestation						
Permanent grassland management (optimized grazing)						
Grass in rotation			2			
Rewetting of organic soils						
Use of soil amendments (gypsum, structural lime, pulp fiber)						
Winter cereals and winter oil crops		1				
Cultivation on contour lines						
Flattening the field						
Subdrainage						
Buffer strips in combination with buffer ditch						



The selection of mitigation measures to prevent soil erosion in agricultural practices in HOAL is predominantly influenced by the regulations of the Common Agricultural Policy (CAP) and the Good Agricultural and Environmental Conditions (GAEC) regulations. Farmers, drawing on their experience, also play a crucial role in choosing measures aimed at preventing soil erosion without compromising crop yields. Economic factors, such as reducing cultivation areas in favourable terrains, are also considered in the implementation of these measures.

In the Aurajoki catchment, the emphasis is placed on maintaining vegetal cover during the winter season. Reduced and zero tillage practices are primarily adopted to keep a green cover, although the latter is sometimes limited due to the high cost of machinery for direct sowing. Challenges arise in implementing grassed and buffer strips, mainly due to the overproduction of biomass due to the limited number of animals in SW Finland, leading to difficult and costly harvesting operations. Additionally, farmers in this catchment have identified additional measures, including contour farming, sub-drainage system installation, and terrain levelling.

The personal circumstances of interviewees sometimes determine the selection of mitigation options. In Danish catchments, those with a need for intensive production were more hesitant to adopt measures. Farmers expressed a willingness to adopt mitigation measures if they prove practical, adaptable, and compatible with their land use, farm management, and are associated with a sustainable agricultural business model. The increasing implementation of hedgerows over the past 50 years is noted, while residue management is seen as valuable for maintaining soil organic carbon content. Reduced and zero tillage practices, however, are considered problematic due to their impact on weed control.

In the Barriga catchment farmers tend to choose mitigation options that are the simplest to implement and are already included in the CAP as part of eco-schemes. Some measures, like the use of cover crops, are mandatory for certain agricultural systems, such as integrated farming in Spain. However, challenges such as managing cover crops during drought periods to avoid water competition with the main crop and reduced yields can be limiting factors. The use of zero and reduced tillage practices may also be constrained by the presence of fungi or soil compaction.

Farmers in the Flemish catchments emphasize the importance of selecting mitigation practices tailored to local soil characteristics, as not all soil types are suitable for every practice. Moreover, the perceived lengthy time required for these measures to have a positive effect on reducing soil erosion can discourage farmers from adoption.

Capabilities of the farmers, main barriers and needs for fostering the implementations

The farmers considered that they possess valuable experience with already implemented measures, eliminating the need for additional training. However, the adoption of new voluntary measures requires targeted training and instructions to ensure successful implementation.

Profitability stands as a critical factor influencing farmers' decisions; unprofitable measures are less likely to be adopted. Other obstacles identified to implementing potential measures include a lack of experience and incompatibility with existing land use and farming systems. Tradition is also acknowledged as a major barrier for innovation. To overcome this, peer-to-peer training emerges as a powerful strategy for upscaling measure adoption, especially when led by more supportive farmers. The organization of field days dedicated to erosion is another way to foster the implementation of new



measures. These events aim to showcase the practical implementation and impact of various measures, emphasizing benefits for both soil protection and crop production.

Other farmers do not perceive themselves as the target audience for erosion risk awareness and advocate for more ground-level control and less restrictive legislation. In this regard, they complained on the unfairness of monitoring obligations between registered and unregistered parcels and call for increased control and monitoring of unregistered parcels, instead of the inspections limited to the subsidized measures alone.

Table 4. Farmer's capability in implementing selected mitigation measures ranked from 1: incapable to 5: fully capable.

Catchment	Mitigation option	Capability
HOAL	Residue management (crop residue left in the field)/Mulch-till	5
	Use of cover crops (also called catch crops)	4.8
	Vegetated waterways	2
Aurajoki	Winter cereals and winter oil crops	4.9
	Reduced/minimum tillage	5
	Residue management (crop residue left in the field)/Mulch-till	4.8
	Zero tillage/direct-tillage	4
Hesselbaek&Varbor	Hedgerows	5
	Reduced/minimum tillage	2
	Use of cover crops (also called catch crops)	3
	Buffer strips and set-aside areas	3
	Grass in rotation	3
	Zero tillage/direct-tillage	1
	Residue management (crop residue left in the field)/Mulch-till	4
Barriga	Use of cover crops (also called catch crops)	5
	Zero tillage/direct-tillage	3
	Residue management (crop residue left in the field)/Mulch-till	3
Maarkebeek	Use of cover crops (also called catch crops)	4
	Micro-dams with cover crops	4
	Residue management (crop residue left in the field)/Mulch-till	4
	Buffer strips and set-aside areas	4
Maarkebeek&Menebek	Use of cover crops (also called catch crops)	4.4
	Buffer strips and set-aside areas	3.3
	Reduced/minimum tillage	3.4
	Vegetated waterways	1.9



New funding sources are sought for implementing measures like buffer strips, hedgerows, or set-aside areas, particularly in the initial years. The implantation of these types of measures concern farmers about potential loss of productive area. They also faced challenges in managing woody vegetation resulting from these measures due to regulations from forest and environmental administrations.

Recognizing that cost-benefit analysis emerges as the primary driver for changing farming practices. Belgium's public servant stated that farmers need assistance in conducting these analyses, including information about alternatives, sharing reliable data, and experiences that reduce uncertainty about the impact of certain measures. Providing relevant guidelines, conducting in-field experiments, and disseminating information about possible measures through trusted mediators are crucial in aiding farmers in their decision-making processes.

Identifying hotspots: The usefulness of erosion risk assessment to concerted actions

Farmers acknowledge the utility of erosion maps as guides but express concerns about their potential misuse for legislation purposes. They worry about mandatory obligations imposed by the administration based on these maps which could be problematic especially due to the scale mismatching between model outputs and ground variability. For example, when a small part of the entire parcel causes an extremely high risk, due to this scaling mismatch, the entire parcels could be classified as high erosion risk, resulting in a total cultivation ban, while these small areas of high erosion risk could easily be contained using the right ECM's. The latter is, however, often not represented by produced erosion maps.

Furthermore, farmers are sceptical about the efficacy of models in deploying concerted action against soil erosion. They argue for targeted measures at identified hotspots and stress the importance of individual farmers taking responsibility for implementing mitigation measures on their own farms, so the problems are not transferred to neighbouring farms.

Interestingly, farmers from the HOAL catchment in Austria emphasize the importance of considering land tenure and farmers' age when assessing the use of erosion models. They believe that landowners should also act as the land manager or farmer, particularly in the context of leased land where long-term soil conservation might not be a top priority. The significance of erosion risk assessment, conducted by an independent institute, lies in its ability to serve as a benchmark for comparing current conditions. This becomes especially crucial for (young) farmers inheriting a farm, offering insights into areas with high erosion risk. However, experienced farmers may rely more on personal knowledge of the land, rendering risk assessments less vital for them.

In contrast to this general scepticism, the group of civil servants in Flanders' catchments perceives erosion modelling as a great tool in the planning of ECMs because of the ability to run different scenarios that allow the assessment the impacts from possible interventions. They warn, however, that the model's shortcomings should be considered when presenting the results and emphasize the need for in-depth and in-situ verification of the model input and output.



Funding sources: What are their reflections regarding using voluntary measures or general regulation to mitigate erosion risk

Farmers generally express agreement with implementing obligatory measures where appropriate and voluntary measures in cases of recurring erosion problems. The adoption of more innovative measures such as buffer strips, hedgerows, or agroforestry in the Mediterranean catchments is contingent on receiving additional financial support. Farmers seek flexibility in timing and application periods to adapt to changing climatic and farming conditions. Farmers also highlight the importance of updating technology to align with regulations, as technology is often lagging.

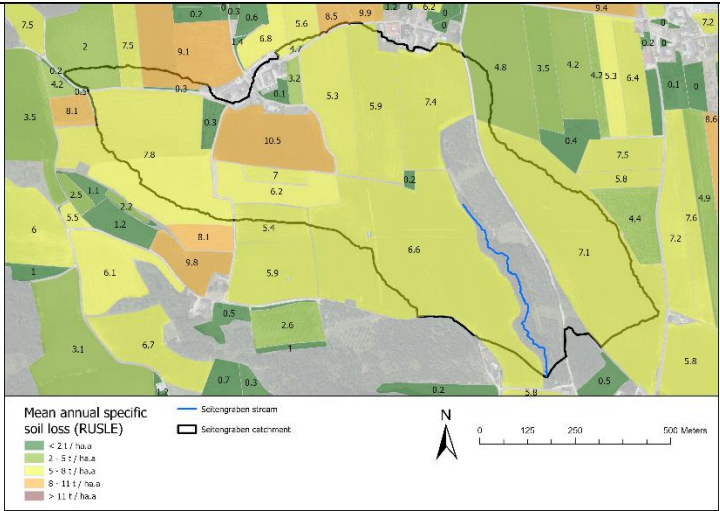
Subsidies are considered a convincing tool for farmers to implement measures. They emphasize the need for simplicity in subsidy schemes, advocating for streamlined processes and increased support for more effective measures. In addition to these, concerns arise as subsidies decrease, and some mandatory measures are no longer subsidized. This creates a sense of mistrust among farmers regarding the continuity and effectiveness of support mechanisms. Furthermore, they stress the importance of support schemes being applicable to diverse agricultural business models to accommodate varying needs within the farming community.

Farmers advocate for a simpler and more concise policy framework to track both mandatory and voluntary measures and their implications. They stress the need for flexibility in applying measures on a case-by-case basis, recognizing that one-size-fits-all approaches are not feasible. Streamlining bureaucracy is emphasized to incentivize farmers to adopt voluntary measures.




4. Summary of mitigation plans for each piloting catchments

In this section, we present an outline of the erosion control measures (ECMs) to be implemented in each of the piloting catchments, along with actions that would facilitate the adoption of these ECMs. The outline is based on the main findings of the focus group meetings regarding the participants' perceptions of erosion problems and their willingness to implement ECMs, as well as on catchment characteristics and the primary erosion processes described in WP5-D1 of the SCALE project.

Name of the catchment	HOAL (Hydrological Open Air Laboratory), Austria	Surface (ha)	66
Land uses	Conventionally farmed cropland with crop rotation for pig farms		
Erosion processes	Inter-rill, rill and gully erosion		
Erosion risk assessment	RUSLE WaTEM/SeDEM Morgan Finley	 <p>Mean annual specific soil loss (RUSLE)</p> <ul style="list-style-type: none"> < 2 t / ha.a 2 - 5 t / ha.a 5 - 8 t / ha.a 8 - 11 t / ha.a > 11 t / ha.a <p>Schöngraben stream Schöngraben catchment</p> <p>0 125 250 500 Meters</p>	
Relevance of erosion and sediment transport			
Expert opinion	On-site erosion with offsite consequences due to connectivity among parcels.	Farmers perception	Erosion is perceived as a threat to food security. Water quality issues are associated to nutrients washing out rather than sediment loads.
Mitigation measures	The selected measures pertain to residue management, the use of cover crops, and vegetated waterways. The selection is based on personal experience and the current regulations of the CAP and GAEC. These measures are focused on soil erosion control, promoting plant growth, and reducing nutrient losses caused by runoff.		
Facilitating actions	There is a need for training to apply the new measures (vegetated waterways) as many farmers have no experience with them. For the already implemented measures, no further actions are required. Subsidizing is needed to ensure the long-term implementation of measures to combat erosion problems. Additionally, simplifying and streamlining the rules for the implementation of measures is strongly demanded by the farmers; otherwise, they will not apply mitigation measures.		

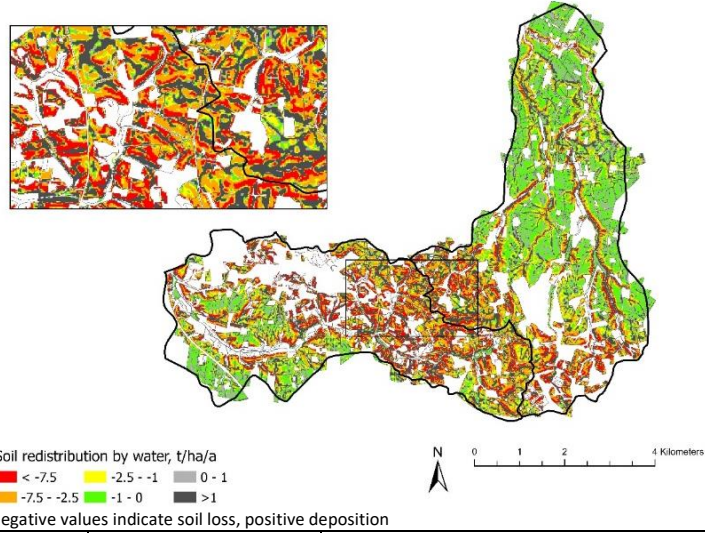


Name of the catchment	Maarkebeek and Molenbeek, Belgium (Flanders)		Surface (ha)	3040 and 5100, respectively
Land uses	Maarkebeek surface is occupied by 70% of cropland of which 29% is pasture. In Molenbeek 77% of the catchment is arable land with potatoes cultivation and fruits (10%).			
Erosion processes	Inter-rill, rill and gully erosion			
Erosion risk assessment	RUSLE WaTEM/SeDEM	<p>Maarkebeek Sediment delivery and Issue locations</p> <p>Sediment delivery Issue locations (top 10%)</p> <ul style="list-style-type: none"> ● Priority 1 ● Priority 2 ● Priority 3 ● Priority 4 ● Priority 5 <p>Sediment delivery</p> <ul style="list-style-type: none"> ≤ 0 t/yr 0 - 10 t/yr 10 - 20 t/yr 20 - 40 t/yr 40 - 80 t/yr > 80 t/yr <p>Sediment transport</p> <ul style="list-style-type: none"> 80 t/yr 0 t/yr <p>DEPARTEMENT OMGEVING Vlaanderen</p>		
Expert opinion*	The erosion problems are quite relevant in the area. On-site erosion hampers production and generates muddy flows. There is evidence of sediment related problems after heavy rains.	Farmers perception**	Farmers acknowledge the issue of erosion and understand its relationship with climatic and landscape conditions and the dependency on soil type.	
Mitigation measures	The selection of measures should take into account the soil type, as not all practices are suitable for all types of soils. Farmers are more inclined to implement well-known, proven measures whose results can be observed in the short term. The experts argue for implementing cause-oriented measures rather than short-term, symptom-oriented ones.			
Facilitating actions	Establish an in-situ monitoring program not only for mandatory measures but also to ensure that everyone takes their own responsibility. Subsidies lasting for a long period are a key incentive to encourage farmers to apply new mitigation measures. Experts point out the need to assist farmers in their cost-benefit analysis by informing them about alternatives and facilitating information sharing between farmers. Policies should also be simpler and remain stable over time. Bureaucracy should be streamlined.			

*Resulting from two focus groups meeting held attended by public servants which are connected with the agricultural and environmental sectors.

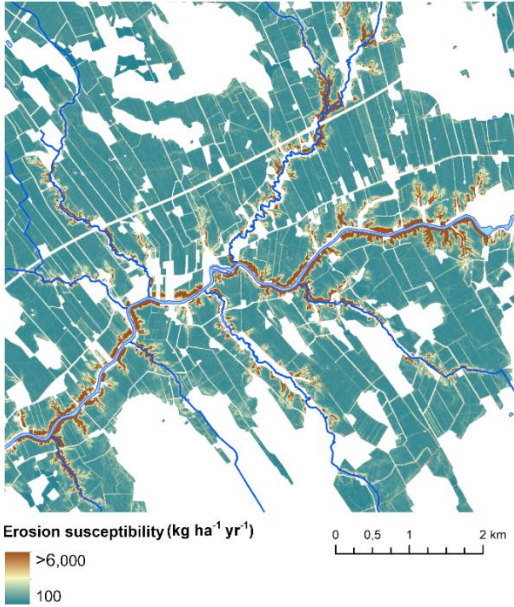
** Farmers from Maarkedal Catchment which are representatives in a local environmental and nature council.

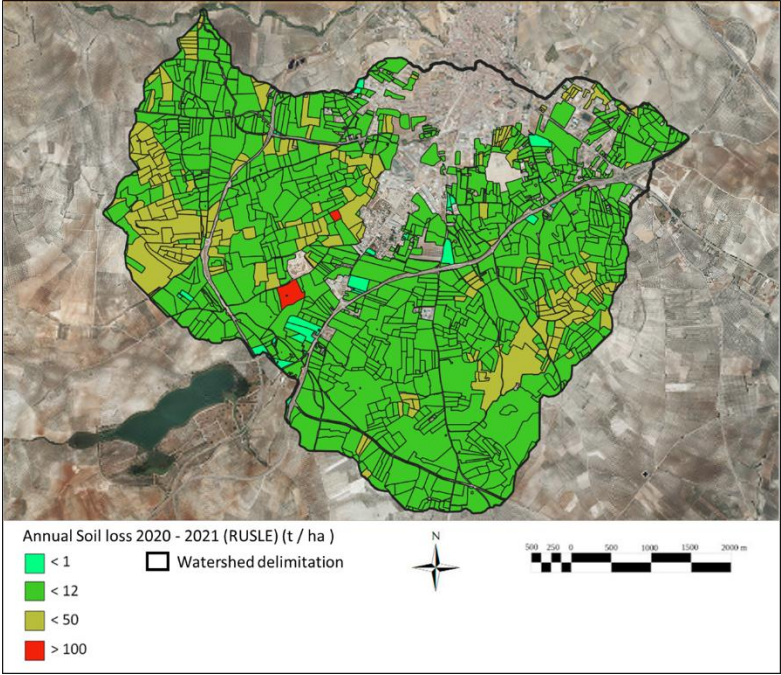


Name of the catchment	Hesselbaek and Varbro*, Denmark		Surface (ha)	2400 and 2000, respectively
Land uses	Mixed arable land			
Erosion processes	Rill and interrill erosion			
Erosion risk assessment	WaTEM/SeDEM			
Expert opinion	Erosion prevalent on steeper slopes with sandy soils (on central southern part) and connected to first order streams.	Farmers perception	Farmers do not consider erosion a threat to soil quality and crop yield on their lands, even though they observe erosion occurring after snowmelt and heavy rainfalls.	
Mitigation measures	Options depend on particular farm type. Residue management is seen as a valuable measure and is important for maintaining soil organic carbon content and improving soil structure, while reduced and zero tillage are considered problematic due to their impact on weed control. Hedgerows are considered pertinent, and their implementation has increased over the last 50 years.			
Facilitating actions	Farmers ask for greater regulatory flexibility and less prescription of national policies. They are open to supporting the implementation of measures provided it does not affect their business mode and costs are compensated for.			

* Participants in the focus group meeting are from an area in North Jutland where both catchments are located.



Name of the catchment	Aurajoki, Finland		Surface (ha)	14700
Land uses	Agricultural lands (33%) with spring cereals and perennial grass crops. Forest areas			
Erosion processes	Inter-rill and rill erosion			
Erosion risk assessment	RUSLE, Connectivity Index Sediment Delivery Ratio			
Expert opinion	River bank erosion and sediment delivery through open ditches.	Farmers perception	Erosion is mainly visible on sandy soils and the steepest areas that are not well managed, but not as much in flatter ones. It is also detected in ditches after digging. Farmers do not perceive soil erosion as a threat to crops or cultivation.	
Mitigation measures	The main mitigation measure is maintaining vegetative cover during the winter period. Reduced and zero tillage are also primarily adopted to keep a green cover in winter, but the adoption of zero tillage may sometimes be limited due to the cost of machinery for direct sowing. The implementation of buffer zones is rejected by farmers because of challenges derived from their management.			
Facilitating actions	Farmers are only willing to implement voluntary mitigation measures that are subsidized. Models and maps need to be improved with more accurate soil data inputs and the inclusion of new facilities to enable farmers to explore different options and their impact on soil erosion.			

Name of the catchment	Barriga, Spain	Surface (ha)	1711
Land uses	Olive crops		
Erosion processes	Inter-rill, rill and gully erosion.		
Erosion risk assessment	RUSLE		
Expert opinion	Rills and gullies with high connectivity among fields.	Farmers perception	Farmers understand erosion by visual features such as change of soil colour, rills after rainfall, permanent gullies, or exposed roots. They consider erosion a big problem for soil quality but do not link it to water quality issues.
Mitigation measures	The selected measures, cover crops, residue management, and zero tillage, are the simplest to implement and are already included in the CAP as part of the eco-schemes. The management of cover crops is highly conditioned by drought periods to avoid water competition with the main crops. On the other hand, zero tillage may not be applicable due to soil conditions or pest management. Use of vegetated barriers (hedgerows) permanently vegetating the trough areas could be a feasible action but is not implemented in this part of the country.		
Facilitating actions	They need funding sources for implementing measures such as buffer strips and hedgerows, which implies the loss of cultivated surface. Simplifying administrative regulations regarding the management of woody vegetation will also encourage farmers to adopt these types of measures. Enhancing agricultural extension services would help overcome tradition as a barrier and promote the adoption of new mitigation measures.		

5. Conclusions

Consistently across catchments, farmers expressed a 'contingent' interest in the topic. Although most of them recognize erosion and connectivity issues as problems to varying degrees, they encounter difficulties in establishing adequate management practices. Specifically, (i) they possess good knowledge of the problem on their farms; however, (ii) they do not trust the results of the models. In order to address the problem, they call for better design of subsidies, particularly streamlining the administrative process.

Particular attention must be paid to the relationship between science, modelling, and farm and landscape management. Farmers express distrust in the results provided by models, stemming from two aspects. First, outputs of erosion models have high uncertainty, especially when used at the farm scale. It is logical for farmers to expect accurate model outputs for their farms, which is not usually the case. Models may be adequate at a larger scale or provide 'average' results for a set of characteristics, but they do not accurately represent the specific farm managed by a farmer. Second, farmers distrust that an inaccurate model output may result in punishment (loss of subsidies or the introduction of regulatory restrictions), higher demands, or excessive focus from authorities on their farms. These issues are relevant to the final output of SCALE and must influence how modelling, guidelines, and policy recommendations are developed.

Interestingly, the current wave of protests in the EU agricultural sector, extending all over Europe, underscores profitability problems and the administrative burden as key issues that should be addressed by the EU to facilitate better economic management of farms. In this way, the results of the focus groups regarding erosion do not deviate from the major concerns of the EU agricultural sector. There is tension between subsidies as a source for balanced profitability and the cost and difficulty of implementing measures necessary to achieve the technical specifications in EU regulations. Therefore, the issue of erosion and connectivity cannot be managed outside of this general context. It seems there will be a need for better participation of the sector in the design and implementation of regulations and their technical specifications.



References

Bloor, M., Frankland, J., Thoms, M. & Robson, K. 2001. Focus groups in social research. London. Sage

Appendix

Annex 1: Common template used for the reporting of the outcomes of the discussions in the focus group meetings.

Background info on focus group				
When was the focus group conducted?				
Who completed the reporting				
Duration				
General characteristics of the selection				
Background info on focus groups participants				
	Land-use category	Farm type	Size of farm	Gender
Farmer 1				
Farmer 2				
(Insert more lines if needed)				
#1 Erosion risk assessment				
Relevance of soil redistribution and sediment transport in landscapes				
On a scale from 1-5, where 1 is low and 5 is high, rank the relevance of water erosion and sediment transport in the landscape in their area.				
Below please synthesize discussions: What are the group's reflections on water erosion as a threat to soil or water quality? (200-500 words):				
Perception of erosion risk assessment				
On a scale from 1-5, where 5 is very good and 1 is bad agreement, to which extent does the mapped data represent soil conditions and sediment redistribution on their land?				
Below please synthesize discussions: What are their reflections on erosion risk mapping? (200-500 words):				
How should uncertainties of risk assessment be addressed?				
On a scale from 1-5, where 5 is active support in collecting data (a. o. citizen science approach) and 1 is no interest: What is their willingness in participating in efforts for monitoring soil redistribution?				
Below please synthesize discussions: What are their reflections regarding the need for certainty in monitoring versus costs of monitoring? (200-500 words):				
Data access and transparency				
On a scale from 1-5, where 5 is high willingness and 1 is no interest, to which extent are participants willing to accept publicly available erosion risk maps?				



Below please synthesize discussions: What are their reflections regarding data access and ownership? (200-500 words):		
Other?		
#2 Implementing mitigation measures		
<u>Which mitigation measures are most relevant for you as a farmer? How would you assess your capabilities to implement these practices?</u>		
	Relevance (three most relevant)	Capability (rank from 1-5)
Residue management (crop residue left in the field)		
Reduced/minimum tillage		
Zero tillage		
Grass in rotation		
Use of cover crops (also called catch crops)		
Permanent grassland management (optimized grazing)		
Buffer strips and set-aside areas		
Agro-forestry in cropland; afforestation		
Rewetting of organic soils		
Hedgerows		
Others...		
Below please synthesize discussions: 1) Why do they select this prioritization? 2) What are the main barriers for implementation? 3) Were other measures suggested? (300-600 words):		
Below please synthesize discussions: What is needed to increase their capabilities on implementing relevant? (200-500 words):		
Identifying hotspots		
On a scale from 1-5, where 5 represents a high degree of usefulness and 1 a low one, rank the usefulness of erosion risk assessments for administrating targeted mitigation planning.		
Below please synthesize discussions: How can the implementation of measures be ensured in areas where there are erosion problems in the long-term? (200-500 words):		
Funding sources		
What are their reflections regarding using voluntary measures or general regulation to mitigate erosion risk?		
Below please synthesize discussions: What are farmers' requirements to support schemes? (200-500 words):		
Other considerations?		



Supplementary Material

Reports of the focus group meetings

1. HOAL catchment, Austria.

Background info on focus group				
When was the focus group conducted?	28.2.2023 to 8.3.2023			
Who completed the reporting	Gerhard Rab (colleague at BAW) did the personal interviews, Lisbeth Johannsen completed the reporting.			
Duration	0.5 to 2h			
General characteristics of the selection	The farmers of the HOAL catchment in Petzenkirchen, Austria			
Background info on focus groups participants				
	Land-use category	Farm type	Size of farm	Gender
Farmer 1	Arable land	Crop production, pig farming, pig fattening	Ca. 60 ha	Male
Farmer 2	Arable land	Crop production	Ca. 15 ha	Male
Farmer 3 (same as 2, but for state-owned farm)	Arable land, forest	Crop production, grassland, forestry	Ca. 300 ha	Male
Farmer 4	Arable land	Crop production, pig farming	Ca. 80 ha	Male
#1 Erosion risk assessment				
Relevance of soil redistribution and sediment transport in landscapes				
On a scale from 1-5, where 1 is low and 5 is high, rank the relevance of water erosion and sediment transport in the landscape in their area. 3, 3, 4, 2				
Below please synthesize discussions: What are the group's reflections on water erosion as a threat to soil or water quality? (200-500 words):				
They are aware of the issues of soil erosion, as they are often (every year) affected by it. Land use must be adapted to the erosion risk. There is a necessity to do something against erosion e.g. use of cover crops, not just due to soil protection but also to ensure the yield is not washed away. Persistent problem zones must be converted to grassland or similar.				



<p>The issues of erosion are region-dependent and farm type-dependent. Erosion risk can be very inhomogeneous within a region. Erosion also affected by structural composition of land use. E.g. problems occur when many fields used for crop production are situated together, rather than grassland. In this way they are aware of connectivity through field structure/layout, as erosion may start in a neighbouring field and run into their field.</p> <p>Focus on food security, rather than soil and water protection was also a theme. The good soils should be used to produce food and feed, not be taken out of rotation due to soil protection. On the other hand, if the field or part of it is so affected by erosion that it does not make sense to keep fighting the effects of soil erosion (soil loss, crop loss) year after year, then they may rather take that land out of rotation and make grassland/meadow.</p> <p>Rather a focus on reducing the runoff of nutrients (N) and pesticides (e.g. one resigned from using glyphosate) when thinking about water quality, not a focus on sediment from soil erosion.</p>
<p>Perception of erosion risk assessment</p> <p>On a scale from 1-5, where 5 is very good and 1 is bad agreement, to which extent does the mapped data represent soil conditions and sediment redistribution on their land?</p> <p>2, 4, 5, 5</p>
<p>Below please synthesize discussions: What are their reflections on erosion risk mapping? (200-500 words):</p> <p>All rather positive about the erosion risk mapping, and say that the mapping fits rather well. Although they do not all know the mapping, as it is not officially used. The mapping is more accurate for larger fields than for smaller fields, but still good on small fields. The mapping is perceived to not be so precise on fields with adjacent forest.</p> <p>Mapping might be useful, but every field should be looked at separately, and personal experience by the farmer is more important than a risk assessment map. They do not see the erosion assessment mapping as necessary for their land management. Large fields are harder to classify as it can be difficult to know whether the erosion starts on the field itself or if the erosion originates from the adjacent fields/area. The map could be useful to see where the erosion paths originate.</p>
<p>How should uncertainties of risk assessment be addressed?</p> <p>On a scale from 1-5, where 5 is active support in collecting data (a. o. citizen science approach) and 1 is no interest: What is their willingness in participating in efforts for monitoring soil redistribution?</p> <p>1, 2, 5, 2</p>
<p>Below please synthesize discussions: What are their reflections regarding the need for certainty in monitoring versus costs of monitoring? (200-500 words):</p> <p>They are generally sceptic towards the need for monitoring to reduce uncertainties of risk assessment. It is an interesting approach, but profitability calculations are necessary and monitoring may be difficult to apply in practice.</p> <p>Every land owner knows the risk on their land and can act on it accordingly. Uncertainties play a minor role, as they cannot be practically taken into account.</p>



When a very large erosion event happens, it cannot be hindered anyway. Then it does not matter if the mapping is 10 % more accurate due to validation through monitoring.					
Data access and transparency On a scale from 1-5, where 5 is high willingness and 1 is no interest, to which extent are participants willing to accept publicly available erosion risk maps? 4, 4, 5, 4					
Below please synthesize discussions: What are their reflections regarding data access and ownership? (200-500 words): They agree that the erosion risk map should be publicly available. The map gives a good overview of the erosion risk and can be used for researching the causes of the erosion (where does the erosion path likely start – on my land or on the neighbouring field). A publicly available map may also lead to an improvement of farming procedures in a practical sense. E.g. if machines can be better adapted to the specific soil conditions, which would both protect the soil and improve farming procedures/yields. On the state-owned farm there may be regulations regarding data access and ownership which need to be taken into account, but it is unknown if such exist. One issue could be the resolution of the map. If the erosion risk can be assigned to a specific farmers land, then it should rather not be publicly available, but at a coarser resolution it would be ok.					
Other?					
#2 Implementing mitigation measures					
<u>Which mitigation measures are most relevant for you as a farmer? How would you assess your capabilities to implement these practices?</u>					
	Relevance (three most relevant)	Capability (rank from 1-5)			
Residue management (crop residue left in the field)/Mulch-till	XXXX	5	5	5	5
Reduced/minimum tillage		2	3	3	1
Zero tillage/direct-tillage		1	1	3	1
Use of cover crops (also called catch crops)	XXX	4	5	5	5
Strip-till	X	5	-	1	1
Micro-dams with cover crops		1	-	1	1
Buffer strips and set-aside areas	X	2	-	5	1
Vegetated waterways	XX	5	1	1	1
Hedgerows		1	-	1	1
Agro-forestry in cropland; afforestation		1	-	1	1
Permanent grassland management (optimized grazing)		1	-	1	1
Grass in rotation	X	1	-	4	5
Rewetting of organic soils		1	-	1	1
Others...					



Below please synthesize discussions: 1) Why do they select this prioritization? 2) What are the main barriers for implementation? 3) Were other measures suggested? (300-600 words):

The selection of measures is mainly based on the regulations of the CAP and the measures they have to follow according to GAEC regulations. Their personal experience on which measures are needed also plays a role. In addition, the prioritization is selected based on which measures are best for erosion control and plant growth (to hinder nutrient runoff). The measures are also soil, climate and farm-dependent, e.g. slope of fields and available machinery affects the choice of measure. The area and the measure must fit together. E.g. soils with good yields should be kept as fields for crop production and not be converted to hedgerows or vegetated waterways, as this would mean a loss in yield.

Economic interests in combination with possible later costs of erosion when the measure is not applied are also considered. Profitability calculations are made and if it is not profitable to implement the measure, it will not be done.

The main barriers for implementation are also based on the current regulations and lack of personal experience with a certain measure. The vegetated waterway is a new voluntary measure in the Austrian agri-environmental programme ÖPUL. An instruction on how to implement the waterway is thus needed by most farmers, as they have never done this before. Some of the not highly prioritized measures could not be implemented on their land due to small fields with too steep slopes. Further, there is the issue of the farms having animal husbandry, which means that they cannot change their land use or crop rotations, as they need the feed for the animals.

No other measures were suggested.

Below please synthesize discussions: What is needed to increase their capabilities on implementing relevant? (200-500 words):

For the already implemented measures no further actions are needed, as they already have experience with those and also software exists for complete farm calculation of farm management actions still allowed within the confines of the CAP regulations (Agrar Commander etc.).

The implementation of new voluntary measures is questionable as it is a cost factor. However, instruction is needed on how to implement e.g. the vegetated waterways. Otherwise, the already existing information evenings by the Agricultural chambers are sufficient to gain insight into the new regulations.

Larger farms have more flexibility in implementing measures on their land, as they can rotate crop production. Small farms with animals have less flexibility in changing crop rotation towards less erosion-prone crops, as they need the feed for the animals. This should be considered in the regulations for implementation of measures.

Identifying hotspots

On a scale from 1-5, where 5 represents a high degree of usefulness and 1 a low one, rank the usefulness of erosion risk assessments for administrating targeted mitigation planning.

N.A, 4, 4, 4



Below please synthesize discussions: How can the implementation of measures be ensured in areas where there are erosion problems in the long-term? (200-500 words):

Landowner should also be the land manager/farmer. If the land is leased you may not care so much about soil conservation in the long-term, as you do on your own land. The erosion risk assessment is useful as it is an independent institute which calculates it, thus it can be used in comparison with actual conditions. The risk assessment is important for (young) farmers taking over a farm to know where the erosion risk is high. For more experienced farmers the risk assessment is not important as they have the personal experience with the land.

It is easier for larger farms to reorganize the farmland. Small farms are often less flexible. The usefulness of the measures is dependent on this and it has an impact on the implementation of measures.

Subsidies are needed to ensure the implementation of measures to combat erosion problems in the long-term. However, the rules for implementation of measures should not be too complicated, otherwise they will not be applied by the farmers.

Moreover, field days with a focus on erosion should be held, where the farmers can see the implementation and impact of the different measures and how it benefits both soil protection and crop production.

Funding sources
What are their reflections regarding using voluntary measures or general regulation to mitigate erosion risk?

Below please synthesize discussions: What are farmers' requirements to support schemes? (200-500 words):

The obligatory measures have to be implemented. Targeted measures should be implemented where appropriate. Otherwise, voluntary measures have to fit to the area and the regulations should not be too many. Voluntary measures can be applied when the erosion problem is very large. If erosion occurs year after year on the same area, then farmers may themselves decide to convert the land to grassland instead of crop production. Look at whole farm not just each field, as it may not always be possible to implement a measure on one field due to the regulations when looking at the farm as a whole.

On the whole, the subsidy schemes have too complicated rules. The regulations under the support schemes should be made simpler. The measures should be fewer and less complicated, but the most effective should be better subsidised.

Sometimes it occurs that by using measure A, then measure B cannot be implemented, as it is not subsidised or not allowed under the rules for measure A.

Technology (e.g. trackable GPS, automated recordings) could also be updated, it is often lacking behind the regulations.

Other considerations?



2. Farmers in Maarkedal catchment, Belgium (Flanders).

Background info on focus group				
This interview was organised by one of the participants of our focus groups in Maarkebeek in order to get the opinion of local farmers on the model usability and erosion control measures. Hereunder is a summary of the report provided from that interview. We as VPO do not have direct contact with the farmers and were therefore not able to partake in the focus group, due as well to the often delicate relationship between government and farmers. The presence of government officials could make the farmers uneasy and reluctant to reply to some statements.				
When was the focus group conducted?	June 2023			
Who completed the reporting	Gemma Besard (Local government official)			
Duration	90 – 120 min			
General characteristics of the selection	4 farmers in the Maarkedal Catchment. These farmers are representatives in a local environmental and nature council organised by the local government.			
Background info on focus groups participants				
	Land-use category	Farm type	Size of farm	Gender
NO INFORMATION				
#1 Erosion risk assessment				
Relevance of soil redistribution and sediment transport in landscapes				
On a scale from 1-5, where 1 is low and 5 is high, rank the relevance of water erosion and sediment transport in the landscape in their area.				
4				
Below please synthesize discussions: What are the group's reflections on water erosion as a threat to soil or water quality? (200-500 words):				
<i>The farmers acknowledge the issue of erosion in the region. They understand the role of the landscape and climate interactions and the dependency of soil type for the severity of the soil erosion. They also realise that the period of the crop cycle and the crop choice can greatly influence the susceptibility to erosion. Farmers feel the need to protect their fertile soils from erosion and therefore are looking for ways to better manage the soil.</i>				
Perception of erosion risk assessment				
On a scale from 1-5, where 5 is very good and 1 is bad agreement, to which extent does the mapped data represent soil conditions and sediment redistribution on their land?				
3				



Below please synthesize discussions: What are their reflections on erosion risk mapping? (200-500 words):

When looking in detail to the model output, farmers were confronted with quite some 'errors'/uncertainties. They indicated some locations which were grassland on which the model showed sediment transport, which was believed to be an error. This could however be attributed to the modelling year (2020) compared to the current situation. This indicates the importance of providing correct and complete information about what is being modelled, so that it can be interpreted by the user in a correct way.

Farmers are well familiarised with the Flemish 'erosion map' on which policy is based. They know what it means and can make remarks if they do not agree with the output. With these new sediment model results, however, they do not see any advantages and argue that for the studying of erosion patterns field observations have a much higher value, since models are prone to error.

The use of more maps will only lead to more doubt and disinformation for the farmers. There is also a fear that more different maps and models will lead to an increase in control and obligatory measures that should be taken by the farmers and that misinterpretation of the maps will lead to more resistance in the agricultural community.

How should uncertainties of risk assessment be addressed?

On a scale from 1-5, where 5 is active support in collecting data (a. o. citizen science approach) and 1 is no interest: What is their willingness in participating in efforts for monitoring soil redistribution?

2

Below please synthesize discussions: What are their reflections regarding the need for certainty in monitoring versus costs of monitoring? (200-500 words):

As farmers do not see any advantage in the modelling, they do not wish to participate in the monitoring and the improvement of the model.

Data access and transparency

On a scale from 1-5, where 5 is high willingness and 1 is no interest, to which extent are participants willing to accept publicly available erosion risk maps?

1

Below please synthesize discussions: What are their reflections regarding data access and ownership? (200-500 words):

The farmers are against making the model output publicly available, due to their fear of reinforcing the negative view on agriculture for damaging the environment. They feel like the misinterpretation of such maps leads to image damage. The negative impact, however, is caused by the few farmers that are not willing to take any measures, mostly tenants, non-professional farmers, retired farmers, major landowners. When not applying for any subsidies, there is no real control and no measurements have to be taken, this



leads to an unfair competition and struggle for farmer who want to comply and take action.

They also think that everything should be handled on one platform. They have the obligation to fill in the parcel registration and there they can see what they have to do to comply with the policy, however, if multiple channels are providing other information there will be a lot of confusion on what to do and where to look. They prefer to keep it simple and organised in one place.

Other?

#2 Implementing mitigation measures

Which mitigation measures are most relevant for you as a farmer? How would you assess your capabilities to implement these practices?

	Relevance (three most relevant)	Capability (rank from 1-5)
Residue management (crop residue left in the field)/Mulch-till	3	4
Reduced/minimum tillage		
Zero tillage/direct-tillage		
Use of cover crops (also called catch crops)	1 most important	4
Strip-till		
Micro-dams with cover crops	2	4
Buffer strips and set-aside areas	3	4
Vegetated waterways		
Hedgerows		
Agro-forestry in cropland; afforestation		
Permanent grassland management (optimized grazing)		
Grass in rotation		
Rewetting of organic soils		
Others...	Buffer strips in combination with buffer ditch (1)	3

Below please synthesize discussions: 1) Why do they select this prioritization? 2) What are the main barriers for implementation? 3) Were other measures suggested? (300-600 words):

The farmers raised the question that policy is trying to reduce kettle farming, but also promotes the conversion from arable land to permanent grassland, that seems contra-intuitive.



When looking at agronomic erosion control measures, the farmers warn that attention should be paid to the soil type, because not all soil types are suitable for all practices. For example reduced tillage on loamy soils can potentially increase erosion in the case of heavy rain events. Some measures (e.g. reduced tillage or increasing OC) take a long time to really have a positive effect on soil erosion or to bring a stable yield that would be economically feasible. This increases reluctance to change to these long term practices.

Below please synthesize discussions: What is needed to increase their capabilities on implementing relevant? (200-500 words):

The farmers struggle with the unfairness in monitoring of taken measures. Only farmers with registered measures (obligatory or voluntary) are being monitored and fined. Unregistered parcels do not fall under the restrictions and obligations and therefore they never get monitored or fined. There is no way to enforce these unregistered parcels to take any measure and if a registered parcel nearby gets in trouble due to practices on the unregistered parcels, the registered parcel has to compensate for the unregistered ones. The farmers claim that most of the severe erosion problems come from these unregistered agricultural practices, and they lead to the bad image of farmers when it comes to the environment.

In order to better implement measures, the farmers suggest more control on all agricultural fields, not only the subsidised parcels. They also want in-situ monitoring on well-known hotspots. Lastly, they want a subsidy to leave parcels covered year-round as an extra measure.

Identifying hotspots

On a scale from 1-5, where 5 represents a high degree of usefulness and 1 a low one, rank the usefulness of erosion risk assessments for administrating targeted mitigation planning.

2

Below please synthesize discussions: How can the implementation of measures be ensured in areas where there are erosion problems in the long-term? (200-500 words):

The farmers do not really think the model can help in creating a coordinated approach in erosion mitigation. They feel like too much information and different maps will not aid and could even have an adverse effect on the efficiency. Farmers know the erosion hotspots and they say that mandatory measures should be taken for these specific hotspots.

They do feel the need for a coordinated approach in erosion mitigation, however they do not think there is a one-fits-all solution and local specific approaches are necessary to create a more effective and well considered mitigation effort. Sediment should always be kept inside the originating parcel, otherwise neighbouring farmers have to take measures for sediment that is not generated on their fields, which is not efficient.

Farmers state that it is important to have in-situ monitoring and control, and not only for mandatory measures, in order to make sure everyone takes responsibility for the problems they cause.



Some farmers fear that temporary measures will be converted in permanent measures if they are kept for longer time periods. In order to avoid this, farmers sometimes remove the measures after some time. This to make sure the parcel will not lose its economic value when it is sold or leased due to the loss of production area. It should be better documented and shared with the farmers that this is not the case, so that they do not undo the efforts made by the implementation of the measures.

Funding sources

What are their reflections regarding using voluntary measures or general regulation to mitigate erosion risk?

Below please synthesize discussions: What are farmers' requirements to support schemes? (200-500 words):

The subsidies help a lot in convincing farmers to take some measures. In recent years, however, the subsidies have been lowered and are sometimes not sufficient anymore. Some measures became mandatory and are no longer subsidised, which is not to the liking of the farmers and creates uncertainty and distrust when new measures or regulations are proposed.

Other considerations?

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3. Flanders' public representatives in Maarkebeek and Menebeek catchments, Belgium (Flanders).

Background info on focus group				
<p>These focus groups were mainly focussing on discussing the erosion model with actors that could possibly be interested/benefit from the model. We presented on the one hand how the model works and what input is used for the modelling, and asked feedback on these input layers. On the other hand, we showed some model outputs and possible model scenarios which could be of interest to the participants. Hereby, most participants were public servants which are connected with the agricultural or environmental sectors, but no (current) farmers were involved.</p> <p>We made a summary of the answers provided by the participants which were given in written forms and the discussions we had in the focus groups. The focus groups were organised in the Maarkebeek and the Menebeek catchment. In both catchments 2 focus group meetings were organised (May and September), each with more or less the same participants. The first focus group meeting was mostly based on modelling input improvement and evaluation of model perception, while the second focus group meeting was oriented to more scenario case modelling and improvements based on the feedback gathered.</p>				
When was the focus group conducted?	May 2023 and September 2023			
Who completed the reporting	Petra Deproost, Seth Callewaert			
Duration	2x 3h			
General characteristics of the selection	Local government and public servants from environmental agencies			
Background info on focus groups participants				
	Land-use category	Farm type	Size of farm	Gender
Provincial Administration (2)	Arable Land	-	-	M + F
Regional Environmental Agency	Waterways	-	-	M
Erosion Coordinator	Arable Land	-	-	F
Regional Environmental Agency	Waterways	-	-	F
Erosion Coordinator	Arable Land	-	-	M
Local Government Administration and Erosion Coordinator (2)	Waterways + Arable Land	-	-	M+F
Local Waterway Agency	Waterways	-	-	M
#1 Erosion risk assessment				
Relevance of soil redistribution and sediment transport in landscapes				



On a scale from 1-5, where 1 is low and 5 is high, rank the relevance of water erosion and sediment transport in the landscape in their area.

4, 5, 5, 5, 4, 4, 5

Below please synthesize discussions: What are the group's reflections on water erosion as a threat to soil or water quality? (200-500 words):

The erosion problems are quite relevant for the study areas, and participants are all working on erosion mitigation.

They mention that this awareness is shared by the farmers and civilians in the region. There are quite often signalisations of occurrences of sediment problems, especially after heavy rainstorms, made by citizens. Measurements in the areas confirm the need for erosion control.

The participants are aware of the high variability of the erosion phenomenon, based on topography, period of the year, precipitation and crop types. Therefore, general approaches are often not valid on farm level and contradictions can occur due to policy implications.

A lot of efforts are being made to counter the sediment problems, often losing focus of erosion problems.

Perception of erosion risk assessment

On a scale from 1-5, where 5 is very good and 1 is bad agreement, to which extent does the mapped data represent soil conditions and sediment redistribution on their land?

- , 4, 4, 4, 4, 3, 4

Below please synthesize discussions: What are their reflections on erosion risk mapping? (200-500 words):

The overall appreciation of the model was quite good. The participants were able to recognise some of the erosion prone parts of the study area, however they felt some parts were over- or under-represented by the model.

Often the global patterns were validated by the participants, but if they looked into more detail, some modelled erosion paths were found to be not realistic. This was often due to scale problems or lack of sufficiently good input data.

The participants, however, noted the importance of field observations as being as or even more important than model outputs. Nevertheless, they think that the model output can be a base for discovering new/other problem areas, especially in places where there is no direct impact on the local population (roads, infrastructure, agricultural fields,...). For local governments the impact of erosion and sedimentation on these other locations (e.g. waterways or nature reserves) are often considered to be less important, since there is no direct impact on the population and it is often not reported or visible, while environmental agencies appreciate the model for showing that there is also a reasonable threat to these environments.

How should uncertainties of risk assessment be addressed?



On a scale from 1-5, where 5 is active support in collecting data (a. o. citizen science approach) and 1 is no interest: What is their willingness in participating in efforts for monitoring soil redistribution?

-, 2, 3, 5, 2, 4, 4

Below please synthesize discussions: What are their reflections regarding the need for certainty in monitoring versus costs of monitoring? (200-500 words):

Most of the participants would like to participate as end-users, more than helping with the data collection. They feel like their input can be a validation for the results based on their experiences in the study areas, but they feel like they cannot bring much to the table considering the model input data.

The participants want to share their terrain knowledge, however at the moment there is no standardized manner of doing this. At the moment, due to small inaccuracies they sometimes feel like the model output is not useful and rather focus on their own knowledge and field observations, without reporting these errors. Therefore, a tool has been developed to make it possible to easily comment on the model output in the online viewer, in the hope that the exchange of info and the validation of the model can be done in a more efficient way.

Data access and transparency

On a scale from 1-5, where 5 is high willingness and 1 is no interest, to which extent are participants willing to accept publicly available erosion risk maps?

-, 4, 4, 4, 3.5, 4, 4

Below please synthesize discussions: What are their reflections regarding data access and ownership? (200-500 words):

The participants indicate the importance of making model results publicly available. They find it helpful to better understand the erosion patterns of their field observations. Moreover, they feel the need for more insight into the basic data on which the model runs, in order to better understand some dynamics and results that can be seen in the model output. There is also interest in products derived from the model output, such as flow direction maps.

The web portal on which the model output is available is well perceived, however, often the participants noticed that it is somewhat difficult to find the correct layers due to the structure of the portal.

Other?

#2 Implementing mitigation measures

Which mitigation measures are most relevant for you as a farmer? How would you assess your capabilities to implement these practices?

	Relevance (three most relevant)	Capability (rank from 1-5)
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Residue management (crop residue left in the field)/Mulch-till	3.6/2.7	3.3/1.9
Reduced/minimum tillage	4.7	3.4
Zero tillage/direct-tillage	3.1	2.1
Use of cover crops (also called catch crops)	4.9	4.4
Strip-till	2.4	1.6
Micro-dams with cover crops	3.9	3.6
Buffer strips and set-aside areas	4.9	3.3
Vegetated waterways	4.6	1.9
Hedgerows	-	-
Agro-forestry in cropland; afforestation	2.4/2.4	1.5/0.9
Permanent grassland management (optimized grazing)	4.1	2.8
Grass in rotation	-	-
Rewetting of organic soils	-	-
Others...		

Below please synthesize discussions: 1) Why do they select this prioritization? 2) What are the main barriers for implementation? 3) Were other measures suggested? (300-600 words):

There must be made a clear differentiation between symptom-oriented and cause-oriented measures. There is often too much attention for the symptom-oriented measures, due to their clear and measurable significance, i.e. you can see how much sediment is captured by a dam, while you cannot clearly see how much erosion is averted by reduced tillage which often has a lower impact on land management for the farmers. The measures with high relevance are often the 'older' and more well known measures, which are already implemented and have proven to be helpful in mitigation of erosion and/or sedimentation issues.

Large investments in the past are also still an important part of the farmers' expenses, and they are not able/reluctant to change their production methods or specialize in other crops. Often older farmers do not have any drive to change their actions because they do not want to put in any more expenses than necessary, especially because they have already seen a lot of policy changes in the past years and do not feel confident towards future policies. They are also scared that implementation of some measures will be discounted from the total value they will get when selling the parcels.

Below please synthesize discussions: What is needed to increase their capabilities on implementing relevant? (200-500 words):

The choice (relevance and capability) often comes down to a cost-benefit analyses for the farmer. Thereby, however, only appreciated and personal benefits are counted by the farmer. It often comes down to an economic calculation, considering extra working hours,



loss of land, investments in new machinery, economic value of crops and the subsidies received.

The participants feel the need to aid farmers in their cost-benefit analyses, by informing them of alternatives and sharing information between farmers. Therefore, however, more reliable data and experiences are needed. Uncertainty is often mentioned to be the main barrier for the farmers. This uncertainty can come from not knowing the impact of certain measures, but also from changing policies and subsidies. This gives farmers little perspective for the future and does not give any incentive to change their production methods. Subsidies should also include future perspectives and be made more interesting for farmers, since their benefit will be higher, but so is their risk.

Relevant guidelines, in-field experience and information about possible measure should be made available to the farmers to inform them in a personal manner of the possible measures they could implement. This should come from trusted channels for the farmers, and not in policy driven obligations, since farmers are often doubt the reliability of governmental decisions.

Identifying hotspots

On a scale from 1-5, where 5 represents a high degree of usefulness and 1 a low one, rank the usefulness of erosion risk assessments for administrating targeted mitigation planning.

4, 4, 3.5, 4, 3.5, 4

Below please synthesize discussions: How can the implementation of measures be ensured in areas where there are erosion problems in the long-term? (200-500 words):

The use of models is perceived as being a great tool in the planning of ECMs. The ability to compare different scenarios is of great interest, however, the need for a correct interpretation is very high and the model shortcomings should be well understood. With the help of different scenarios the impact of measures could be relatively well quantified, which is useful when making erosion reduction plans. If used properly the model can also be a tool to illustrate the impact of certain measures for a certain location, this is however a very theoretical approach and should be communicated in a careful manner.

The model can give an overview of the broader erosion patterns that are prevailing in the catchments, and can show even some hidden issues. Nevertheless, there is still a need for in-depth in-situ verification of the model in- and output.

Funding sources

What are their reflections regarding using voluntary measures or general regulation to mitigate erosion risk?

Below please synthesize discussions: What are farmers' requirements to support schemes? (200-500 words):

The need for voluntary as well as mandatory measures is apparent. However, there should be an equilibrium between to open and to strict regulations. If regulations are too specific or strict, the farmers will not feel supported and this could have an adverse impact on the willingness to contribute. The policy should also be more simple and concise in



order to keep track of the mandatory and voluntary measures and their implications for the farmer.

Some measures should be implemented in a more case specific manner, there is no one fits all solution for most measures, and there should be opportunities to make some measures mandatory when erosion issues can be linked to certain practices, while some mandatory measures should be lifted in some specific cases if there is no real impact shown from a certain measure.

There is a need for clear and structured goals to be achieved with policies, and this should be well communicated to the farmers. With these goals, a toolbox could be deployed to help farmers in achieving certain goals and really seeing the 'predicted' impact of their selection of measures. By making this more interactive, farmers could be more drawn to think about the benefits of erosion control measures.

If farmers are willing to take certain voluntary measures, this often comes with more paperwork and control, which will often lead to less interest by the farmers to take these measures, especially if the reward is not in comparison with the added effort.

Other considerations?

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4. Hesselbaek and Varbro catchments, Denmark.

Background info on focus group				
When was the focus group conducted?	Tuesday the 16 th of May 2023			
Who completed the reporting	Goswin Heckrath, Martin Thorsøe & Kasper Krabbe			
Duration	2 hours			
General characteristics of the selection	Livestock/arable farmers from an area in North Jutland, which is characterized by a hilly landscape with signs of water erosion			
Background info on focus groups participants				
	Land-use category	Farm type	Size of farm	Gender
Farmer 1	Fodder grain	Pig farming	93 ha	M
Farmer 2	Arable farming	Plant breeding	17 ha	M
Farmer 3	Potatoes and arable farming	Plant breeding	5 ha	M
#1 Erosion risk assessment				
Relevance of soil redistribution and sediment transport in landscapes				
On a scale from 1-5, where 1 is low and 5 is high, rank the relevance of water erosion and sediment transport in the landscape in their area. 2.				
Below please synthesize discussions: What are the group's reflections on water erosion as a threat to soil or water quality? (200-500 words):				
Farmers do not think erosion is a threat to soil quality and crop yields on their land, even though they describe several examples of how erosion takes place during snow melt and heavy rainfall and describe how local potato fields have intense surface runoff events after harvest during winter. They do not agree that the extent and volume of the sediment transport will affect their ability to cultivate and produce high yields in the foreseeable future.				
Perception of erosion risk assessment				
On a scale from 1-5, where 5 is very good and 1 is bad agreement, to which extent does the mapped data represent soil conditions and sediment redistribution on their land? 2.				
Below please synthesize discussions: What are their reflections on erosion risk mapping? (200-500 words):				
Farmers were very skeptical towards the data quality of the different input factors to the erosion risk model presented at the meeting due to the heterogenic character of the landscape. Farmers especially did not agree that they have areas with fine sandy				



soil as indicated by the soil maps, which they claim are areas typically with loamy soil. This fact had the implication that the credibility of the erosion risk map was questioned by the attending farmers, even though they felt the other data, such as landscape structure and rainfall data, represented their area quite well.

Farmers were also questioning the model prediction of sediment delivery to surface waters in the area resulting from localized runoff breakthrough at stream stretch with narrow buffer zones. They agree, however, that soil has been redistributed within fields over many years resulting in a smaller degree of 'land levelling'. This is not necessarily perceived as a nuisance by the farmers when managing their soils. *(NB, the authors: The model-estimated rates of water erosion would not lead to substantial changes in topography. Instead, tillage erosion is a widespread process in the area that has a stronger levelling effect.)*

In short, farmers acknowledge that water erosion takes place, however, they do not fully agree on the implications of it, nor that the data used to do risk assessment in their area is sufficiently representative – especially the soil texture mapping used by Aarhus University.

How should uncertainties of risk assessment be addressed?

On a scale from 1-5, where 5 is active support in collecting data (a. o. citizen science approach) and 1 is no interest: What is their willingness in participating in efforts for monitoring soil redistribution? **3.**

Below please synthesize discussions: What are their reflections regarding the need for certainty in monitoring versus costs of monitoring? (200-500 words):

The need for certainty in monitoring is very important for the farmers, since they in general were very sceptic towards the risk assessment model presented at the focus group meeting, which they felt did not accurately enough represent the soils and the erosion in their area. Therefore, they would prefer a considerable amount of monitoring to obtain *precise* data.

Farmers think that they are monitored a lot already, but fear that the current – according to them inaccurate data, will be misused by legislators and result in restrictive measures such as a tillage ban. In general, the farmers have limited trust in research models and authorities, because of recent experience with catch crop and leaching policy, that was according to them, based on imprecise data from universities.

Further, they argue that “The soil is more stable in terms of yield now compared to previously” which is taken as an evidence that the soil erosion that has take place since the modernization of agriculture after WWII has not had a serious effect on the growing conditions on their fields and on account of that it is not a problem that need to be addressed.

Data access and transparency

On a scale from 1-5, where 5 is high willingness and 1 is no interest, to which extent are participants willing to accept publicly available erosion risk maps? **2.**

Below please synthesize discussions: What are their reflections regarding data access and ownership? (200-500 words):



Farmers are generally not willing to share soil- and erosion risk data from their farm areas, because they fear for its' misuse. (See the section above).		
Other?		
#2 Implementing mitigation measures		
<u>Which mitigation measures are most relevant for you as a farmer? How would you assess your capabilities to implement these practices?</u>		
	Relevance (three most relevant)	Capability (rank from 1-5)
Residue management (crop residue left in the field)	1	4
Reduced/minimum tillage	2	2
Zero tillage	1	1
Grass in rotation	2	3
Use of cover crops (also called catch crops)	2	3
Permanent grassland management (optimized grazing)	N/A	N/A
Buffer strips and set-aside areas	2	3
Agro-forestry in cropland; afforestation	N/A	N/A
Rewetting of organic soils	1 (there are none in the area)	N/A
Hedgerows	3	5
Others...		
<p>Below please synthesize discussions: 1) Why do they select this prioritization? 2) What are the main barriers for implementation? 3) Were other measures suggested? (300-600 words):</p> <p>The farmers responses were very much representative of their personal land use type. The pig farmer who needs a very intensive fodder grain production had a negative perception of most of the mitigation measures as they constitute a barrier for his operations, whereas others were less categorical in their attitudes towards specific mitigation measures.</p> <p>Residue management is considered by farmers to be valuable to potato producers e.g., that feeds of hummus accumulation in the soil. In general farmers claim that they already maintain good soil cover during most of the year including autumn. They refer to requirements of having a certain proportion of catch crops and they suggest that winter cereals are sown earlier than previously. Residue management is seen as measure for maintaining adequate soil organic matter contents. They were very skeptical about the use of reduced tillage practices due to problems with controlling grass as weed.</p> <p>Hedgerows are considered relevant, and they have been increasing in amount for the past 50 years, even though some trees have been felled.</p>		



<p>In short, the farmers at the meeting were very open towards mitigation measures, as long as they have a practical use, adoptability, and capability in relation to their land use type and agricultural enterprise.</p>
<p>Below please synthesize discussions: What is needed to increase their capabilities on implementing relevant measures? (200-500 words):</p> <p>Farmers ask for a bigger amount of control and less prescriptions of national policies, and don't see themselves as the right audience for the awareness on erosion risk, and generally prefer if others - whom they find more affected by erosion - to be targeted by erosion mitigating legislative measures.</p>
<p>Identifying hotspots</p> <p>On a scale from 1-5, where 5 represents a high degree of usefulness and 1 a low one, rank the usefulness of erosion risk assessments for administrating targeted mitigation planning.</p>
<p>Below please synthesize discussions: How can the implementation of measures be ensured in areas where there are erosion problems in the long-term? (200-500 words):</p> <p>We established that they do not think the current erosion model can reasonably estimate soil redistribution on their lands and therefore do not consider the erosion models to be a valuable tool.</p>
<p>Funding sources</p> <p>What are their reflections regarding using voluntary measures or general regulation to mitigate erosion risk?</p>
<p>Below please synthesize discussions: What are farmers' requirements to support schemes? (200-500 words):</p> <p>Farmers requirements for support schemes, would be that they should not affect their agricultural business in a financial degrading manner. Also, they would need the general regulation mitigation measures, to be applicable by diverse land use type-businesses. At the moment, all of the mitigation measures in the excel table above, are voluntary and within the European CAP, and most of them are known by the farmers and used to a certain degree depending on the different farmers' land use types. They are very open towards adopting measures that will not affect their potential yield.</p>
<p>Other considerations?</p>



5. Aurajoki catchment, Finland.

Background info on focus group				
When was the focus group conducted?	2 nd March, 2023			
Who completed the reporting	Jaana Uusi-Kämpmä (jaana. uusi-kamppa@luke.fi), Riitta Lemola and Timo Räsänen			
Duration	2 hours			
General characteristics of the selection	Two - three active farmers associations from Aurajoki catchment were contacted by MTK-Varsinais-Suomi (Regional office of The Central Union of Agricultural Producers and Forest Owners)			
Background info on focus groups participants				
	Land-use category	Farm type	Size of farm	Gender
Farmer 1	arable farming & vegetables	livestock	200	male
Farmer 2	arable farming	conventional crop production	-	male
Farmer 3	arable farming	vegetables	50	male
Farmer 4	arable farming	conventional crop production	100	male
Farmer 5	arable farming	conventional crop production	150	male
Farmer 6	arable farming	organic crop production & poultry farming	240	male
Farmer 7	arable farming	conventional crop production	200	male
Farmer 8	arable, perennial grasses (<5 yr) and permanent grasses	conventional crop production	160	male
Farmer 9	arable farming, perennial grasses (<5 yr)	conventional crop production	200	male
Farmer 10	arable farming, perennial grasses (<5 yr)	conventional crop production	510	male
Farmer 11	arable farming, perennial grasses (<5 yr)	conventional crop production	40	female
#1 Erosion risk assessment				
Relevance of soil redistribution and sediment transport in landscapes				
On a scale from 1-5, where 1 is low and 5 is high, rank the relevance of water erosion and sediment transport in the landscape in their area. 2.5 (3, 3, 3, 2, 3, 2, 2, 2, 3, 2, 3)				
Below please synthesize discussions: What are the group's reflections on water erosion as a threat to soil or water quality? (200-500 words):				
Farmers opinions:				
<ul style="list-style-type: none"> - No visible erosion on clay soil, but on sandy soil you can see rills in the spray furrows. - Erosion is visible on the steepest slopes. 				



- Erosion has no observed effects on the crop or cultivation.
- On steep slopes, cultivation is technically difficult or impossible. These areas are kept under grass.
- The amount of erosion depends on the year. If you cultivate sensibly, erosion has only a small effect (fields are green in the winter).
- It would be good to get the main ditches involved in the erosion mapping. Erosion can be detected in ditches after digging.
- For the farmer, the map would be more useful if it showed the variation within the parcel.
- In some parts of the parcel, the erosion-sensitive areas have had a confusing effect on the erosion average of the entire parcel.

Perception of erosion risk assessment

On a scale from 1-5, where 5 is very good and 1 is bad agreement, to which extent does the mapped data represent soil conditions and sediment redistribution on their land? 3.5 (3, 4, 4, 3, 2, 3, 4, 4, 4, 4)

Below please synthesize discussions: What are their reflections on erosion risk mapping? (200-500 words):

- The basic assumption of the erosion risk maps was autumn plowing and spring cereals, which was not considered a common method in current farming practices.
- Plowed fields are sensitive to spring drought, therefore it is not thought to be a good method. Today's practices are more versatile, e.g. sowing of winter crops and direct sowing. The aim is to keep the ground green.
- Spring plowing of (steep) slopes is not possible on heavy clay soils.
- Maps are mostly based on elevation curves. Not all erosion sites have identified, there may exist erosion also in flat fields.
- On clay soil, you can hardly see rills made by the water. There must really be heavy rain to cause visible rills.
- Old filled ditches are still visible on the maps.
- Erosion has not been observed in all areas marked in a red color. The whole parcel is defined as red, although only a small part of it has steep slope with a high risk of erosion.
- Heavy clay soil keeps its structure well, no visible erosion was observed.
- Erosion occurs in the sandiest mounds.

How should uncertainties of risk assessment be addressed?

On a scale from 1-5, where 5 is active support in collecting data (a. o. citizen science approach) and 1 is no interest: What is their willingness in participating in efforts for monitoring soil redistribution? 2.5 (3, 3, 5, 3, 3, 3, 1, 1, 2, 3, 1)

Below please synthesize discussions: What are their reflections regarding the need for certainty in monitoring versus costs of monitoring? (200-500 words):

- Maps are not absolute truth. What is the pressure of the above field parcel's erosion to the lower block?
- The amount of organic matter in the parcels has not been considered, nor crop production.
- A bigger harvest also means a higher straw yield and a better soil cover against erosion.
- Measures that are not included in the CAP Plan do not affect the results of the risk assessment.
- There was no interest in measuring erosion from the parcels. Risk maps can be evaluated with the third party, but the maps must be more precise (variation between parcels). The



farmers were very interested in comparing the erosion results of their own parcels with those of their corresponding neighboring plots.

- (In the beginning of the session, erosion results from Finnish experimental fields were presented.) According to the farmers the results through drainage systems were too high. They had no experience of soil accumulating in wells of the drainage systems.
- Adding of suction ditches would reduce surface runoff and erosion

Data access and transparency

On a scale from 1-5, where 5 is high willingness and 1 is no interest, to which extent are participants willing to accept publicly available erosion risk maps?

3,0 (-, 3, 4, 2, 5, 2, 3, 2, 2, 3, 4)

Below please synthesize discussions: What are their reflections regarding data access and ownership? (200-500 words):

The more real the maps become the more people want to use them. Now the maps reflect elevation curves, which are well known to farmers.

All steep slopes are in red. What does happen in the flat areas and what would happen if all steep slopes would be under a buffer zone?

The differences between parcels should be brought out better. Would soil scanning give more information for the modelling?

Other?

#2 Implementing mitigation measures
Which mitigation measures are most relevant for you as a farmer? How would you assess your capabilities to implement these practices?

	Relevance (three most relevant)	Capability (rank from 1-5)
Residue management (crop residue left in the field)	5	4,8 (=24/5)
Reduced/minimum tillage	6	5
Zero tillage	5	4
Grass in rotation	1	2
Use of cover crops (also called catch crops)	2	4
Permanent grassland management (optimized grazing)	1	2
Buffer strips and set-aside areas	4	3,8
Agro-forestry in cropland; afforestation	0	
Rewetting of organic soils	0	
Hedgerows		



Other: Use of soil amendments (gypsum, structural lime, pulp fiber)	0	
Other: Winter cereals and winter oil crops	8	4,9
Other: cultivation according to the height curve	1	5
Other: Flattening the field	1	3
Other: subdrainage	3	4,5

Below please synthesize discussions: 1) Why do they select this prioritization? 2) What are the main barriers for implementation? 3) Were other measures suggested? (300-600 words):

- 1) - Reduced tillage: primarily a green surface for the winter
- Zero tillage: on the other hand, fields under grasses and special plants require plowing, direct seeding machines are expensive
- Grass in rotation: no cattle or other grassland users in the area.
- Catch crops: not suitable for autumn cereals, short growing season, little effect
- Permanent grass: not enough grass-using animals
- Buffer strips: depends on the location, perennial silage grass is good, there is no need to harvest from steep slopes such as the protection zone, for which it is difficult to get a contractor, and there are not many grazing animals available
- Agro-forestry in cropland: No forest for the field since it spoils the cultural landscape. It might be suitable for apple orchards, agroforestry means strips with trees and crops in strips, not afforestation.
- Rewetting of organic soils: no organic soils in this area.
- Soil amendments: structure lime and pulp fibres are ok but gypsum may cause problems in soils with low Mg concentration. Pulp fibres are quite unknown in this region because their suppliers are far away, and the transport costs are high. Fiber would be suitable for clay soils.
- Other flattening the field: a flatter land surface reduces erosion
- Other: Adapting the tillage to the contours of the surface

Below please synthesize discussions: What is needed to increase their capabilities on implementing relevant? (200-500 words):

The farmers were worried if the administration wanted to decide what they were allowed to do in their own fields. On the basis of the maps, there must give no mandatory measures to control erosion.

The use of maps as an aid in targeting voluntary measures was not criticized much.

Identifying hotspots

On a scale from 1-5, where 5 represents a high degree of usefulness and 1 a low one, rank the usefulness of erosion risk assessments for administrating targeted mitigation planning. 2,7 (3, -, -, -, 2, 4, 2, 2, 2, 2-3, 4)

Below please synthesize discussions: How can the implementation of measures be ensured in areas where there are erosion problems in the long-term? (200-500 words):

Targeting the correct erosion control methods is not possible based on these maps since they are too imprecise. However, establishment of buffer zones according to the maps was not opposed.

The steepest slopes, where the risk of erosion is the greatest, are largely managed in the other way than cereal cultivation due to the technical difficulty of cultivation.



Determining the entire parcel as a high erosion risk area based on the steep slope area at the river's edge was considered bad.

The red color of the entire parcel also 'scared' the farmers and led to the idea of banning cultivation and taking coercive measures.

Funding sources

What are their reflections regarding using voluntary measures or general regulation to mitigate erosion risk?

3, -, -, -, -, -, -, -, -

Below please synthesize discussions: What are farmers' requirements to support schemes? (200-500 words):

Based on the information on the maps, there must be no mandatory measures to control erosion. The use of maps as an aid in targeting voluntary measures was not criticized very much.

Voluntary subsidized measures are ok.

There is no legislation against erosion because farming practices can also affect erosion. In addition, other environmental, economic and farming issues must also be taken into account. All cultivation cannot be solved based on erosion. Farming is a balancing act with many things.

Other considerations

According to the farmers mandatory buffer zones are a horror scenario due to the problematic nature of their management (vegetation harvesting). Harvesting grass from steep slopes is difficult. Grazing of buffer zones is rare due to small number of cattle in this area. It is also difficult to get to the buffer zone to harvest the grass when the crop plant grows above the buffer zone area. There is no purpose for the harvested grass of the buffer zone.

Riparian fields are also thought to be good farmland.

Soil type should be better considered in the maps, now elevation curves seem to prevail.

The Finnish soil database is not very accurate in this region.

Winter cereals are popular in the area, fields for winter cereals are often not ploughed in autumn, so erosion control is probably better than the research results presented. (A research idea for Kotkanoja leaching field at some point: autumn plowing and rye/rye as direct sowing).

Other erosion control measures: adding organic matter, improving soil growth, deep-rooted plants improve soil structure

Improvement ideas for maps:

- Explaining why there is the red color on the parcel when the cursor is moved to the spot. Now the maps in red scared the farmers.
- In a similar way, exporting the cursor to the parcel would give options on how changing the cultivation would affect the erosion risk (direct sowing, etc.).
- It would be good to have a service where you can change e.g. cultivation method and plant, and see its effect on erosion.



6. Barriga catchment, Spain.

Background info on focus group				
When was the focus group conducted?	2 nd June 2023			
Who completed the reporting	IAS - CSIC			
Duration	2 hours			
General characteristics of the selection	Farmers in the area of Andalusian in the watershed of the Guadalquivir river			
Background info on focus groups participants				
	Land-use category	Farm type	Size of farm	Gender
Farmer 1	Olive	Integrated production	35 ha	Male
Farmer 2	Arable land	Direct drilling – Ecologic	1000 ha	Male
Farmer 3	Arable land - Almond	Conventional – Direct drilling	100 ha	Male
Farmer 4	Olive – Arable land	Conventional – Direct drilling	100 ha	Female
Farmer 5	Olive	Integrated production	100 ha	Male
Farmer 6	Vineyard - Olive	Integrated production	45 ha	Male
Farmer 7	Olive	Integrated production	180 ha	Male
Farmer 8	Olive	Integrated production	36 ha	Female
Farmer 9	Olive	Integrated production	13 ha	Male
Farmer 10	Olive	Conventional	90 ha	Male
#1 Erosion risk assessment				
<p>Relevance of soil redistribution and sediment transport in landscapes <i>On a scale from 1-5, where 1 is low and 5 is high, rank the relevance of water erosion and sediment transport in the landscape in their area.</i></p> <p>Farmers consider with a punctuation of 5 the relevance of water erosion and sediment transport in the landscape in their area. Also, they think that erosion mitigation strategies allow a relevant reduction of these problems.</p>				



Below please synthesize discussions: What are the group's reflections on water erosion as a threat to soil or water quality? (200-500 words):

Farmers consider water erosion more as a threat to soil than water quality. The main problem for them is the sediment transport and the soil losses in their plots. In general, they believe that the majority of farmers are resistant to change in their management and there are few interests in this change due to the long-term problems. It is a global problem that the majority of farmers do not control because it means a major effort for them (time and money). For this reason, the big farmers can apply easier these strategies. They have permanent personnel on the farm that can resolve this problem when there is less work to do.

In this area, is easy to localize gullies in the plots, which causes division in the own parcel, and hinders the traffic on the farm. Also, we find water reservoirs that suffer the effect of sediment transport clogging them. They consider it a really big problem in the long-term, that currently we start to see the negative effects.

In permanent crops, mainly in olive groves, they perceive problems that cannot change to minimize the risk of erosion, like the management because the machinery is not still enough adapted to the landscape (e.g. harvesting within a plot with significant slopes). Also, it is necessary to a minimum tillage due to in this area appear cracks in the plot in summer, especially in clay soils in dry farming.

Perception of erosion risk assessment

On a scale from 1-5, where 5 is very good and 1 is bad agreement, to which extent does the mapped data represent soil conditions and sediment redistribution on their land?

Farmers consider with a punctuation of 4 the good agreement with this point. We have shown regional maps (Majority of sheet erosion between 12 – 50 t/ha year), national maps (sheet and rill erosion between 25 – 50 t/ha year), and European maps (soil loss rates between 5 – 20 t/ha year). In the maps, the majority of the areas are marked with yellow and orange colours. In those plots where they have not been able to introduce measures of erosion control effectively, they agree with the data of soil losses in the maps.

Below please synthesize discussions: What are their reflections on erosion risk mapping? (200-500 words):

Farmers consider a big problem the erosion risk in the landscape, but they do not associate it with a numerical value. For example, 50 tons of soil loss per hectare is a value of erosion that they do not perceive as low or high. When farmers observe erosion risk mapping they analyze mainly the color of the area. Our area presents one of the riskiest regions in erosion (we have already mentioned the national and European risk erosion maps to the farmers), where the risk was more relevant than the majority of the areas.

Some of them knew the existence of these types of maps, but they did not know how access to them. However, in some regions, where farmers are advised by technicians, in olives cooperatives, they have more knowledge about this type of information. They



do not need to know how to access them because the technicians can show and explain them.

They associate the worst data from soil losses and erosion in the maps to the traditional olive groves, with a distribution of 10x10 m o major and no cover crops, and to the arable lands with tillage management. Farmers understand erosion visually. The existence of a rill after a storm, a permanent gully or a visible root of the tree crop are the criteria for being worried about erosion.

How should uncertainties of risk assessment be addressed?

On a scale from 1-5, where 5 is active support in collecting data (a. o. citizen science approach) and 1 is no interest: What is their willingness in participating in efforts for monitoring soil redistribution?

Farmers consider with a punctuation of 3 the active support in collecting data, especially if they have erosion problems in their plots.

Below please synthesize discussions: What are their reflections regarding the need for certainty in monitoring versus costs of monitoring? (200-500 words):

In general, farmers are available to try to help technicians and researchers in assessment, especially when they have problems in their lands. The idea that a person will be in their plots detecting, analyzing and solving problems is very attractive for them.

Many of them show a bit of discrepancy regarding collaboration, since this can hinder management tasks (especially during the harvest), but technical assistance to the farm with the contribution of data obtained or payment for harvest losses or occupation of part of the surface, can be considered like the payment for as an economic compensation for their collaboration. The coordination of farmers and researchers is the best solution to avoid discrepancies that trigger incomplete completion of trials.

On the part of the farmers, the possibility of drafting legal documents is proposed where the conditions of the experiments are reflected, their coordination with the management of the farms and determining the responsibilities of each of the parties involved.

For this reason, in our area, the lack of farmers willing to collaborate in monitoring is not a problem. However, they need to feel that if the essay is not to their liking they can set limits or even delete it. When doing a trial with a farmer it is important to know what these limits are to avoid problems in the future.

Data access and transparency

On a scale from 1-5, where 5 is high willingness and 1 is no interest, to which extent are participants willing to accept publicly available erosion risk maps?



Farmers consider with a punctuation of 2 are willing to accept publicly available erosion risk maps. They have not shown special interest in this type of information. They want to know how to solve problems, if they detect symptoms of any type of erosion.

Below please synthesize discussions: What are their reflections regarding data access and ownership? (200-500 words):

In general, farmers are unaware of the programs and public strategies to combat erosion and the estimates of soil losses that are made. In the same way, they are unaware of direct access to this information. In some specific case, they are aware of erosion follow-ups that have been carried out in the local administrative area where their farm is located.

Regarding the specific data on soil losses, they see no relationship between them and the soil losses that occur on their farms. Due to the impossibility of assessing the losses in their farms.

Farmers prefer personal contact with technicians on erosion problems. It will be more interesting to ask about the interest of agricultural technicians willing to accept publicly available erosion risk maps because they can adequately translate them for farmers. Farmers ask technicians not only about erosion problems but also about fertilization, pest control, prizes, costs, best management practices, regulation, among others. This is the most relevant point that explains how agricultural cooperatives have come to survive with traditional crops and small areas. In addition, the advances in the modernization of the CAP will mean that farmers are supported by technicians.

An individual farmer may be interested in this type of information, but in most cases, he will not approach this information for use on his plot. Also, erosion risk maps can show a general description of your area, which may or may not be the same for farmer's land. If this farmer uses erosion mitigation strategies, he may believe that the erosion problems are caused by the rest of the farmers, who do not apply the strategies.

Mention is made about the replacement of knowledge transfer modalities, such as local administrations in areas where experiments are carried out, by forms of global transmission, such as the Internet, which causes misinformation among the closest people.

Other?

Farmers are concerned about the disconnect between the administrative and executing aspects of farming. The individuals responsible for creating laws and regulations often lack firsthand experience in the field, resulting in a noticeable lack of communication and understanding between them and the farmers. In Spain, climate change has led to higher temperatures and reduced rainfall, exacerbating the challenges faced by farmers. Moreover, the rising costs of essentials like fuel and pesticides have significantly increased production expenses. The unpredictable nature



of profits further complicates long-term planning for farmers. To this is added that there are fewer and fewer workers in the field.

Management should adopt a more flexible approach, particularly during periods of uncertainty. In many cases, adhering to the CAP becomes impractical. Farmers believe that regulations should be tailored to the specific farm or agricultural enclosure rather than applied rigidly to individual plots

#2 Implementing mitigation measures

Which mitigation measures are most relevant for you as a farmer? How would you assess your capabilities to implement these practices?

	Relevance (three most relevant)	Capability (rank from 1-5)
Residue management (crop residue left in the field)	3	3
Reduced/minimum tillage		
Zero tillage	2	3
Grass in rotation		
Use of cover crops (also called catch crops)	1	5
Permanent grassland management (optimized grazing)		
Buffer strips and set-aside areas		
Agro-forestry in cropland; afforestation		
Rewetting of organic soils		
Hedgerows		
Others...		

Below please synthesize discussions: 1) Why do they select this prioritization? 2) What are the main barriers for implementation? 3) Were other measures suggested? (300-600 words):

- 1) These types of management are the simplest to implement and that the CAP will contemplate as measures as eco-schemes. They try to do cyclical actions to create routine in the annual field work, with an accurate manage in the cases that it will be required. They don't take account the cost of these measures because they associate it with something that is necessary for the crop. In integrated production is mandatory the establishment of cover crop in Spain. In ecologic crops, the use of cover crop with legumes is recommended by the fixed of nitrogen to the soil.
- 2) In the case of Zero tillage, if the farmers realize direct drilling, the will depend of the rainfall in the next days. Some crops, like sunflowers, need a little tillage in the time to avoid problems with plagues. Also, they consider necessary a deep tillage if there is a problem of soil compaction in the field. In residue management, they would like to combine with cover crops, but if you let residues in the soil first the growing season, the cover crop will have more difficulties for a correct develop. Also, in some crops, like vineyards, the



residues management can provoke illness due to the develop of fungis. Finally, the main barriers for cover crops is that in a drought period, the cover will not have a well establishment in the soil, and if it cannot be controlled, the harvest can be seriously reduced.

- 3) Reduced/minimum tillage, in the case of Zero tillage, they see important in any time during a long period do a tillage deep. Also, for permanent crops with steepest plots or degraded soils, they suggest permanent grassland management, with the sheep like the animal most accurate grazing in olives groves. In arable lands, the grass in rotation was important too for farmers due to the association the bare soil like a potential source of erosion.

Below please synthesize discussions: What is needed to increase their capabilities on implementing relevant? (200-500 words):

They need funding sources for measures like buffer strips, set-aside areas, agro-forestry and hedgerows. These measures need a relevant support in the first years of the implantation, but they have not seen the lower cost in the next years. The only way to implant in a voluntary way is because the area which is going to adapt this measure is in the less problematic area for the management or near of the country house.

Another important point is the loss of cropland, measures like buffer strip, agro-forestry, hedgerows and permanent grassland management They see these measures like strategies that compete with the area of the crop, and if they feel that one bad harvest is due to this is really difficult for them trust in similar strategies.

And finally, the administrative problems specially in woody measures is probably one of the points that avoid that farmers feel comfortable with these measures. In Spain the management of controlled cutting in a forest area, or non-productive lands, they scared about the wildfire for example, require a lot of time in resolve administrative requirements. They will feel more secure with a declaration of responsibility, where they can explain what they are going to do with these areas for the conservation.

Identifying hotspots

On a scale from 1-5, where 5 represents a high degree of usefulness and 1 a low one, rank the usefulness of erosion risk assessments for administrating targeted mitigation planning.

Farmers consider with a punctuation of 5 the usefulness of erosion risk assessments for administrating targeted mitigation planning. Farmers are satisfied if their plot present a healthy state, so they want to know the possible problems they have and how to solve them.

Below please synthesize discussions: How can the implementation of measures be ensured in areas where there are erosion problems in the long-term? (200-500 words):

One of the main difficulties to implement measures that reduce existing problems is tradition or custom. The belief that when a management has been done for many years



it is because it works. Fact that in most cases is true, but does not consider the consequences.

For this reason, it is important to show the consequences of certain actions against the results of the implementation of new measures. Considering the premise that farmers are very observant of the actions of the neighbors and try to copy the strategies if they consider that the results of the neighbors are better. Farmers who correctly apply the best management practices and obtain good results are our best allies. When a farmer starts an unknown strategy in the nearest area, the rest of the farmers would consider it as a mistake. Patience is another of the best allies we have.

They are willing to apply erosion control measures, but if, for example, in the next year they have detected some difficulties or problems that they did not expect, they will reject these measures for a long period of time or even never attempt them again. . For this reason, it is very important to support farmers who want to follow these procedures and inform them about the critical point in the implementation of these measures.

Funding sources

What are their reflections regarding using voluntary measures or general regulation to mitigate erosion risk?

Farmers agree with the current use of voluntary measures o general regulation, but they suggest more flexibility in certain areas. The type of soil, the rainfall, and the established crop are factors that should condition these measures.

Below please synthesize discussions: What are farmers' requirements to support schemes? (200-500 words):

They agree with current general regulations to mitigate erosion risk, in the permanent crop they consider a minimum strip of cover crop, but they refuse the exact time of maintaining the measure. A drought period can considerably reduce the yield of the crop if the cover crop is not previously controlled.

Respect the voluntary measure, in permanent crops, one of the programs in the eco-schemes (Practice VI) supposes an ampliation of the width of the cover crop, so they see the viability. Also, Practice VII (inert covert) could be interesting in that it supports the previous practice in drought periods. In temporal crops, direct drilling (Practice IV), associated with zero tillage is the best management for the farmers who want to receive the paid for voluntary measures.

The farmers, in special for permanent crops, do not consider implementing measures with woody species or competing with the cropland, like hedgerows or buffer strips, only with special funding sources for the establishment of spaces of biodiversity. They do not consider choosing Practice V (Spaces of biodiversity in herbaceous farmland and permanent crops).

They will consider implementing buffer strips, hedgerows, and woody measures in their plots in general if they find enough financial support at least for the necessary materials for the initial plantation.



Other considerations?

Applying uniform agricultural management practices across all agricultural areas is not always suitable. Climate change poses significant challenges to maintaining erosion mitigation measures in certain regions. The lack of biodiversity within farms creates a substantial imbalance. In some cases, farms have a limited seed bank and an insufficient presence of animal species. Conversely, other farms face an overabundance of animals, which makes it impossible to maintain vegetative mitigation structures. Farmers strongly emphasize the importance of achieving a balanced biodiversity within their plots to mitigate such issues effectively.

