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Farm System Management and Governance
for Good Water Quality and Drinking Water Supplies

FAIRWAY REPORT series

Multi-Actor Platforms in the FAIRWAY Project: Summary of Activities and Experiences

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Multi-Actor Platforms in the FAIRWAY project: Summary of Activities and Experiences

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SUMMARY

This report provides a summary of the FAIRWAY project's multi- actor platforms, their activities, and some experiences through the course of the project.

Firstly, we present the project's take on multi-actor approaches, and give a brief introduction to some key dimensions that have been important for the development and analyses of the multi-actor platforms (MAPs). Then we provide an overview of all of FAIRWAY MAPs; their history, their respective constitution and characteristics, as well as a summary of achievements and challenges. Further, we explain the steps we have taken in the project to establish new platforms or enrol existing platforms in the project, and give an account of the project activities as well as an overview of the level of activity in the respective MAPs. Finally, we discuss some of the changes over time based on an assessment by the different MAP coordinators on the functioning of the MAPs, at the start of the project and towards the end, before highlighting some key findings of the project with regards to multi-actor engagement.

1. INTRODUCTION

1.1 AIM AND OBJECTIVE

The overall objective of the FAIRWAY project is to review current approaches and measures for protection of drinking water resources against pollution from agriculture. The project further goes on to identify and develop innovative measures and governance approaches for more effective drinking water protection. With 13 case studies in 11 countries the project uses a multi-actor approach to facilitate effective cooperation between actors of different sectors and levels, including farmers, advisors, drinking water companies, scientists, and policy makers (see *figure 1*).

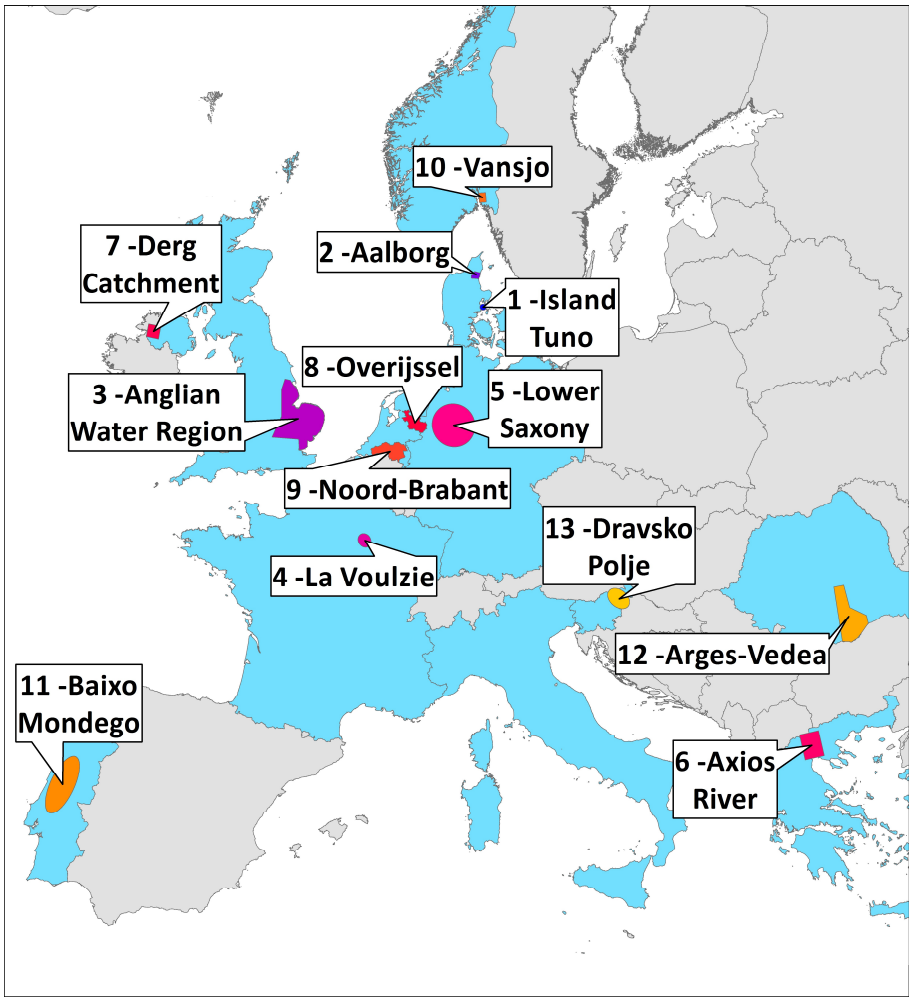

Figure 1: Map of Europe, indicated the FAIRWAY case study areas.

The objective of this report is to summarise all activities relating to multi-actor engagement in FAIRWAY over the course of the project, while also taking stock of the status and experiences of individual MAPs and for the project at large, also offering some policy recommendations.

2. MULTI-ACTOR PLATFORMS AND FAIRWAY

2.1 MULTI-ACTOR ENGAGEMENT

Public participation and stakeholder involvement have long been considered central in policy and planning processes (Reed 2008, Lamers, Ottow et al. 2010, Akhmouch and Clavreul 2016). Simpson and Löe (2020) argue that for complex environmental problems, such as groundwater protection, involvement of expert scientist are not enough, and that involvement of affected communities are essential for enabling a lasting solution that also pay respect to local knowledge, beliefs and values. Ideally, by involving a broad set of stakeholders one enlarges the knowledge base of the processes, increasing the ownership to and legitimacy of the outcomes (Lang, Wiek et al. 2012).

Broad participation has therefore increasingly become a prerequisite for decision-making processes, and a requirement of integrated and adaptive governance arrangements (Reed 2008, Lamers, Ottow et al. 2010, Akhmouch and Clavreul 2016). The European Water Framework Directive is a case in point, where the inclusion of interested parties in decision-making processes is a central tenet of river basin planning (WFD 2006), although the exact form of participation required is not given (Newig, Kochskämper et al. 2018). The promotion of stakeholder engagement is also at the core of the OECD water governance principles (OECD 2015).

In our attempt to address the agriculture-drinking water nexus within a multi-actor context, a useful point of departure has been the existing and vast literature on multi-stakeholder approaches and platforms (Steins and Edwards 1996, Warner 2006, Reed 2008, Fish, Ioris et al. 2010, Heinelt 2012, Lang, Wiek et al. 2012, Graversgaard, Hedelin et al. 2018, Kochskämper, Jager et al. 2018). This literature points out the promises of participatory approaches, but also some of the pitfalls and limitations. A further discussion can be found in other deliverables and papers of the FAIRWAY project (Sundnes, van den Brink et al. 2020, Nesheim, Sundnes et al. 2021, van den Brink, Hoogendoorn et al. 2021).

In a project setting, a multi-actor approach is devised to ensure meaningful involvement, with real impacts on the research process and outcomes through co-creation of knowledge and solutions (cf. Ostrom 2010). Such engagement should take place as early as possible in the project cycle; from the planning of work and experiments, their execution and implementation, up until the dissemination of results, and evaluation (Reed 2008). This will facilitate joint knowledge production and interactions between a range of actors, including end-users, in ways that will lead to shared ownership to both process and results (Levidow and Neubauer 2014, Belmans, Campling et al. 2018, Graversgaard, Hedelin et al. 2018).

Inspired by Warner and Verhallen (2012), we have developed a framework fit for multi-actor engagement platforms, highlighting some dimensions that we have considered relevant for assessing strengths, weaknesses and opportunities for change with regards to engagement platforms. These dimensions relate in different ways to *the process, the content* and *the context* of engagement processes. Some adjustments have been made in labelling and descriptions. Moreover, Warner and Verhallen suggest that a change towards “improvement” on each dimension is a move towards a more effective multi-stakeholder dialogue. Given the dynamic character of multi-actor processes, and the differences between MAPs in the kind of stakeholders they involve, contextual factors, mandates and governance frameworks, such linear development towards effectiveness cannot be supported. Steins and Edwards consider an engagement platform to be *“a negotiating and/or decision-making body (voluntary or statutory), comprising different stakeholders who perceive the same resource management problem, realize their*

interdependence in solving it, and come together to agree on action strategies for solving the problem" (1996:244). In line with this, we find that a more non-linear understanding of these platforms is necessary, to acknowledge the dynamic character of engagement processes. Our suggested framework is therefore more open-ended in terms of the ideal conditions for engagement. Key factors or dimensions that we consider important in designing well-functioning engagement processes are shown in *Figure 2*.

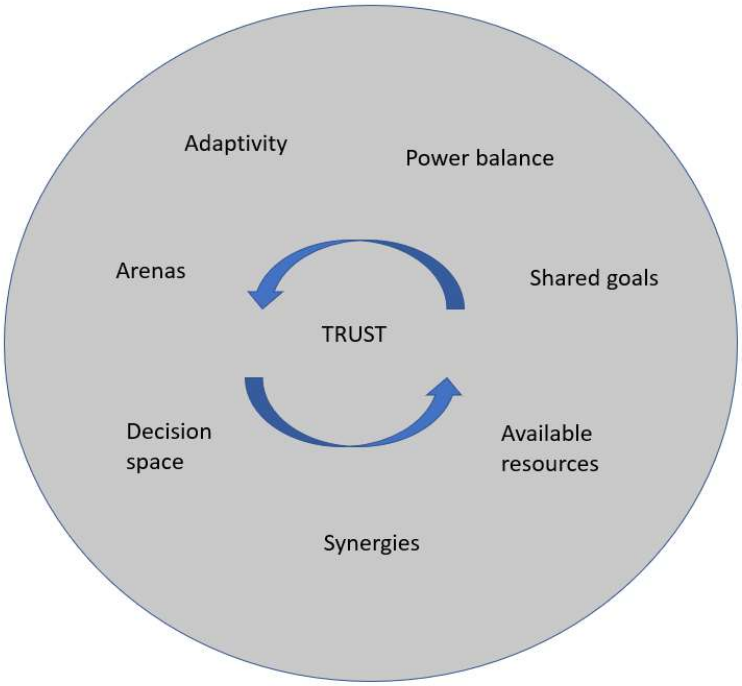

Figure 2: Key dimensions of multi-actor engagement processes

Arenas involve the range of actors involved from which sectors and at which levels; *Adaptivity* refers to the capacity of the platform to adapting to changing external circumstance, as well as adapting to the dynamics of the organization, and being flexible to change direction and goals depending on identified needs with the platform; *Synergies* in a platform ranges from a focus on each stakeholder's own interests (with no synergies), to a more joint effort to find solutions and innovations that bridges these different interests, as well as bringing in additional social learning outcomes; *Shared goals* refer to whether there is a shared understanding of the urgency and the nature of the problem, and consequently whether there is a goal that is shared by all parties and that everyone can rally behind and work towards; *Power balance* is here understood as whether within the engagement platform there are one or more actors that dominate discussions, decision-making and agenda-setting, or whether there is a more level playing field.; *Decision space* refers to the kinds of mandate and legitimacy a platform has, ranging from a small/narrow mandate, e.g. as a consultative body, or a broader mandate when influencing decision-making processes. This could refer to both internal mandate (constituency to representatives) and external mandate (enabling environment) (Warner and Verhallen 2012); *Available resources* refer to the extent to which the platform is seen as having resources with regards to institutional support, funding and

manpower, whether the structure set up with the voluntary contribution from all actor groups, or the platforms take the form of a network with a staffed secretariat or the like. Available internal resources may refer to different kinds of public, legal or financial support, while external resources on the other hand may be outside legitimacy of the platform with regards to the problem at hand. Finally, ***Trust*** is presented as a factor cutting across all dimensions, and refers in this context to a broad understanding of trust between actors, both encompassing relational trust (between oneself and the other) and calculative trust (relating to perceptions of past behaviour of the other and/or on constraints on future behaviour) (cf. Earle 2010).

The dimensions of multi-actor-engagement will be returned to in our discussion of changes over time, in chapter 5.

3. OVERVIEW OF FAIRWAY MAPS

The FAIRWAY project works through 13 cases, that we conceive of as multi-actor platforms (MAPs). These MAPs are either engagement platforms that have a longer history and have been brought in under the project to contribute to FAIRWAY's aims, or they have been set up within the project period. See *Table 1* below for an overview of the cases and their history.

Table 1. Overview of Multi-Actor Platform in the FAIRWAY project, indicating context and history of engagement, based on Sundnes et al (2020), adapted from Nesheim et al. (2021)

MAP, country	Status at start of FAIRWAY project	Main Pressures	History of Engagement
Tunø Island, Denmark	Historical reference case	The island has one waterworks. Aquifer vulnerable to saltwater intrusion and nitrate pollution from agriculture. Nitrate levels reduced significantly since the 1980's.	Project to protect drinking water and a water management working group established in 1986. New strategy in 1992 broadened protection zones and implemented best practices. Farmers mainly engaged through information, meetings and stakeholder participation. After the nitrate problems were solved in the 1990s, the multi-actor engagement ended.
Aalborg, Denmark	New platform set up under FAIRWAY	Drinking water quality is at risk. Drinking water comes from groundwaters, which are vulnerable to pollution from nitrate and pesticides. Measures are implemented by voluntary agreements with farmers since 1998 including compensation. Farmers are required to implement measures according to actions plans; expropriation can be used.	A "groundwater board (Grundvandsradet)" including 20 members that represent agriculture, environment, nature, forest, groundwater, etc. has been maintained by the municipality since 2011. This water cooperation is responsible for negotiation of agreements with farmers.
Anglian Region, England	New platform set up under FAIRWAY	Drinking water quality is at risk. Pesticide and molluscicide use lead to contamination of surface water, along with a lack of water treatment options. Measures include a knowledge exchange campaign. In a vulnerable catchment, there is also a campaign on product substitution, including financial incentives.	Since 2015, the Anglian Water (private water supply company) catchment adviser has adopted a catchment-based approach through knowledge transfer/exchange to farmers and the wider industry, as well as product substitution. Farmers rely on advisers and government campaigns, as "catchment-sensitive farming".
La Voulzie, France	Existing platform prior to FAIRWAY	The watershed is mainly agricultural and to a very little degree urbanized. The catchment gathers several springs. The water company has recorded nitrate concentrations for several decades, showing an increase from the 50s, reaching a plateau in the 90s. The atrazine concentration has been recorded since 2001, but concentrations are decreasing after it was banned in 2003.	There has been a long history of engagement in the area. The first actions have roots back in the 1990s, and different actions (mandatory or not) have been introduced since. The collaboration involved the farmers and the water company but also local, regional, and state authorities, farmers advisers (chamber, ubios), and a local association (aqui'brie)
Lower Saxony, Germany	Existing platform prior to FAIRWAY	Water quality is at risk in manure surplus regions. There is farm manure surplus in a region within the state. Drinking water is mainly sourced from groundwater wells. Measures include fertilization law, farm manure application techniques, discussions on inter-regional manure transport, and manure treatment.	Round table discussions initiated by municipalities on nutrient management and water protection have been organized in districts since 2017. Chairpersons are farmer representatives; participants are both agricultural and environmental representatives and local and regional authorities.
Axios River & Agios Pavlos, Greece	New platforms set up under FAIRWAY	Agricultural impact on groundwater and surface water (nitrates and pesticides). Authorities choose different sources for water use, rather than implementing a plan to minimize pollution.	Axios River: Minimum previous engagement of only certain farmers in projects. Financial incentives to change crop production or use alternative farming practices. No established engagement, nor experience with stakeholder networks for information exchange or pressure to higher levels of decision-making. Agios Pavlos: There was a farmer's union with established participation in similar projects, related to water quality and pollution abatement. Some farmers were driven to produce "green labelled" products with respect to environmentally friendly farming
Derg, Northern Ireland	Existing platform prior to FAIRWAY	Drinking water quality is at risk. There is runoff from agriculture and forestry, with a focus on pesticide use and impact on drinking water quality. Drinking water is sourced from surface water. Measures include a water utility-led land incentive scheme to improve drinking water. A final tranche of measures was implemented, and monitoring is continuing.	The national-level Water Catchment Partnership has involved the national government and NGOs with an interest in water management existed since 2013. A "Source to Tap" project in the Derg catchment was led by NI Water (Northern Irish water utilities) working with stakeholders to deliver a land incentive scheme to improve drinking water quality.
Overijssel, the Netherlands	Existing platform prior to FAIRWAY	Shallow groundwater nitrate standards are not met. Dairy farming causes nitrate and pesticide leaching toward groundwaters. Drinking water is sourced from groundwater wells. Measures include reducing nitrate and pesticide by better nutrient management and targeted pesticide use.	The province and the water company Vitens initiated the "Farmers for Drinking Water" project in 2011; as part of this, farmers have been invited to regional meetings to facilitate implementation of measures. The water company contributes with agricultural advice, agricultural accounting, regional rural development, etc.

MAP, country	Status at start of FAIRWAY project	Main Pressures	History of Engagement
Brabant, the Netherlands	Existing platform prior to FAIRWAY	Drinking water quality is at risk. Pesticides from agriculture and urban areas threaten the groundwater in several areas. Measures include the prevention of pesticides in rural and urban areas, and water purification measures.	The province, water company, and the water boards initiated an engagement project in 2012. The agricultural organization contributes by facilitating communication to their members and links to agricultural education.
Vansjø, Norway	Existing platform prior to FAIRWAY	Water quality has improved but is still at risk in certain areas. Nutrients from agriculture and sewage from dispersed settlement posed a high risk to surface water quality in early 2000. Lake Vansjø is a drinking water source. Measures include intensive monitoring, with a focus on all contributors, as well as tailored agreements with individual farmers for environmental practices.	There has been a long history of actor collaboration in the area since the 1970s. The Morsa project was established in 1999 to improve poor water quality, engaging local and national politicians. Forms of collaboration among inhabitants, farmers, and local, regional, and sectoral authorities have been ongoing, although collaboration has primarily been between authorities at different levels and municipalities.
Baixo Mondego, Portugal	New platform set up under FAIRWAY	Some drinking water sources exceed nitrate standards and other limits of pollutants coming from agriculture. There is an excess of nutrients caused by fertilizers such as manure and wastewater sludge. Drinking water is sourced from groundwater. Measures include national legislation and policy.	There has been previous engagement with individual farmers in projects. There has been no previous multi-actor engagement platform in the catchment involving authorities, water company, and farmers.
Arges-Vedea, Romania	New platform set up under FAIRWAY	There is a risk of drinking water pollution, but is more a site-specific problem than a diffuse one. Sources for nitrates in water bodies, and hence the pressure for groundwater pollution, comes from animal wastes inside the perimeter of build-in areas of villages. Measures are implemented by farmers according to the Action Plan for protection of waters against nitrate pollution.	From 2008 a World Bank project related to “Integrated Control of Fertiliser Use” is acting in the study site area having as the main objectives development of measures to mitigate the nitrate pollution of surface and groundwater, in which farmers and local public authorities are involved.
Dravsko Polje, Slovenia	New platform set up under FAIRWAY	Abstracted water in the lower parts of a shallow aquifer is polluted with nitrate (>50 mg/L). Agriculture impacts water quality. Drinking water is sourced from groundwater. Measures include a water protection zone, while water companies mix water from shallow and deep wells to reach an acceptable quality.	There has been previous engagement with individual farmers in projects. There has been no previous multi-actor engagement platform in the catchment involving authorities, water company, and farmers.

Whether the MAPs of the FAIRWAY project are new or have a longer history is only one feature of difference between the cases of the project. While some address quality of drinking water as surface water, others concern groundwater. While some MAPs address issues pertaining to nitrates and/or phosphorus, others deal with pesticides; while yet others engage with all these issues. In some cases, there is some level of conflict, in others the tensions are less visible, or absent. In some cases, the platform functions with an official and formal mandate; in other cases, it is a looser association around more or less common challenges or problems. The platforms also vary with regards to the kind of actors that participate. In all the MAPs, farmers participated either as individuals or through farmers’ associations, while, in some MAPs, agricultural advisors also participated. All MAPs engaged with relevant waterworks, drinking water companies, and/or water catchment associations/ boards where applicable, some also with the fertilizer or pesticide industry. While all the MAPs engage with the local-/district-level government, some also had the regional and national level included.

Table 2 gives a further overview of the FAIRWAY MAPs, their main characteristics, key participants, the MAPs’ respective aims and mandate, as well as brief reflections on the level of shared understanding amongst participants, the assumed synergies within the MAPs, and key points on achievements and challenges.

Table 2 MAP characteristics, based on Sundnes et al (2020), adapted from Nesheim et al. (2021)

MAP, country	MAP characteristics					MAP development: Strategy, achievements, learning points, and risks challenging long term engagement
	MAP participants	Aim and MAP mandate	Shared understanding of the problem	Synergies associated with MAP	Economic resources available for MAP	
Tunø Island, Denmark	Local water company, farmer representatives, municipality, agriculture advisor, county authority	Water company and the municipality provided a mandate for a working group to draw up a strategy for safeguarding the drinking water supply, resulting in a sustainable water supply project.	High level of trust between farmers and regional authorities, but not a shared understanding of the problem or how to address it. After MAP ended, the farmers perceive it not as a success, but as a top-down development they had no share in.	The lack of a shared understanding was remedied by compensation to farmers. Conflicts avoided as farmers were given new land and compensation, and because respect and trust was created between stakeholders	Farmers were compensated, water works bought land for protection zones.	A project to achieve specific results. Trust between farmers and regional authority built over time through many physical meetings in the fields, and a dense monitoring programme showing clear effect. Farmers mainly engaged through information, meetings and stakeholder participation. MAP ended after achieving acceptable nitrate levels. Successful example of how to implement groundwater protection using permanent grasslands. From a farmer's perspective and a long-term monitoring perspective, commitment does not come easily. If long-term groundwater protection is implemented there needs to be a shared understanding of the issue, and a monitoring programme to document the effect.
Aalborg, Denmark	MAP initiated in 2017 including the water works, the municipality, farmers, farmer advisory org., Agri-Nord, SEGES. Facilitation: The waterworks, municipality.	Aim: Improve collaboration and contribute to common understanding of the pressures and processes. Mandate: Project supported by the municipality and the waterworks.	No shared understanding of the need for additional groundwater protection between the farmers and the Water Collaboration Aalborg.	Low level of synergies associated with the MAP. Farmers received some economic compensation from implementing measures.	Economic resources available for compensating farmers when they implement measures.	Strategy: Separate meetings were conducted with farmers and other actors to understand perspectives and to find a common space for dialogue. Achievements: Common platform for communication enabled in 2021. Learning points: Agronomic advice being individual and free of charge for farmers; transparent approach; compensation should be indemnified and fair. Risk: Conflicts.
Anglian Region, England	MAPs initiated in 2017 with Anglian Water (AW), ADAS, Environment agency, farmers, agronomists, agricultural industry. Facilitation: Univ. of Lincoln, AW, catchment advisor.	Aim: Develop bottom-up approaches to farmer engagement to meet their and the water company's needs. Mandate: MAP to be facilitated by the AW catchment adviser for continued engagement.	Initially different understanding of what is the problem of focus, the farmers focus on their problem with weeds, while the water company focus on water quality.	A focus on solutions affecting farmers, AW was able to develop a greater presence in the catchment. This created farm trials and projects of high synergy to both parties as they had been co-developed.	External funding was generated to develop MAP activities. In kind provided by AW, otherwise no resources. Continuation will be through AW catchment advisor.	Strategy: Focus on farmers' challenges. Field demonstrations; expertise in both farming and environmental protection. Achievements: Common knowledge-base, shared understanding, networks for continued engagement. Learning points: Understand farmers' issues for meaningful engagement; priorities of water companies may differ from farmers' – work to solve farmers' issues first to gain trust. Risk: Lack of funds for long-term continuation.
La Voulzie, France	The commitment of Eau de Paris for water quality started in 1990 and has continued with different action plans. The MAP now includes 200 farmers, the water company, rural communities and the scientific community.	Aim: Improve the groundwater quality for drinking water supply. Mandate: The mandate of the platform is limited to the catchment.	The understanding of the nature of the problem is shared, but less so for its urgency. A long history of water quality challenges related to pesticide and nitrogen parameters. Some farmers are actively involved, while other do not want to participate as the pumped water is for Parisians and is "not their business".	The water company, through their hired catchment officer, encourages synergies via partnerships, technical exchange meetings, and new organisations involving farmers.	Institutional support by state, water agency and water company	Water company makes decisions by elaborating a strategy to protect groundwater resources, calling on technical institutes (Inrae, Ubio) as partners, to guide the farmers through experiments or through communicating information in order to implement new water-friendly practices. There is continuous interaction and communication in the MAP, but a challenge to keep farmers and other stakeholders involved as it has been going on since the 1990s.
Lower Saxony, Germany	MAP initiated in 2017 – including representatives of district authorities for water and agriculture and local advisory services. Facilitation: A farmer representative is the chairperson.	Aim: Discuss viable compromise how farm manure surplus in the northwest by transfer to the southeast could work. Mandate: Support by municipalities and the federal state, no mandate to formally agree on measures.	Shared understanding on the need to reduce diffuse nitrate pollution from agriculture. Not all actors agree on inter-regional manure transport to reduce environmental pressure in the northwest.	High synergy level as all actors are very interested in the topic.	No formal legitimization of the MAP - hence there is no continuous external funding.	Strategy: Trust-building factors, official and informal meetings. Achievements: Varying perception of the success -some see the MAP as an information source, but not solving the actual issues. Learning points: Transfer of knowledge is ranked as the most important trust-building factor; increased farmer participation give legitimacy to the MAPs being achievements; need to tailor to particularities in the different districts. Risks: Weak mandate and lack of funds.

MAP, country	MAP characteristics					MAP development: Strategy, achievements, learning points, and risks challenging long term engagement
	MAP participants	Aim and MAP mandate	Shared understanding of the problem	Synergies associated with MAP	Economic resources available for MAP	
Axios River & Agios Pavlos, Greece	MAP established in 2018 with water utility company, farmers, agricultural companies, agricultural advisors, municipality, cattle/sheep producing farm	Aim: Platform for exchange of information between farmers, for dissemination and transfer of knowledge. Mandate: Informal, by national, regional authorities, farmer	Common understanding is the need to reduce nitrate/pesticide use and to find pollution abatement solutions. There is established trust within the farmers but not with the authorities. There is low connection to higher level of decision-making.	Axios River: Synergies are found between farmers, fertilizing producing companies, and water utility companies, and can in the future they be used to implement environmentally friendly practices.. Agios Pavlos: Synergies are still low. Some gradual developments related to creating bigger farms, common products, or introducing best-practices in order to produce better quality and more "green" products. Further engagement with the farming union and the water legislation authorities on local/regional level would be beneficial.	Axios River: The nascent MAP has focused informative / educational / guidance purposes. Agios Pavlos: While the MAP has focussed on educational / guidance purposes, the participants are in the future willing to use own resources to show new intelligent farming techniques, to reduce fertilizer use etc.	Strategy: Meetings for information/knowledge exchange, discussions of broader participation and the problems of water pollution. Learning points: MAP discussions are important to farmers and product buyers. For Axios these are educational task to water authorities related to decision-making. For Agios, active and educated farmers are necessary to influence others, while the water authorities' and farmer unions' participation is key for legitimacy. Achievements: Axios River: Building a network of trust, between stakeholders, find common issues to address, finding incentives that are common, participation of water authorities and municipal authorities. Rebuilding trust to gov authorities, setting up commercial networks and synergies for better products. Agios Pavlos: Setting up "role models/influencers" for the rest of the actors, building a network of trust between stakeholders, find common issues to address, finding incentives that are common. Rebuilding trust to farmer's union, setting up commercial networks to promote "green prodyucts" and env. friendly products. Risk: Only incentive had been profit from agricultural products, environmental issues were low priority, period of financial crisis followed by COVID and market risks, necessity to have financial incentives before every action in the MAP. Low trust to gov. agencies and ministries.
Derg, Northern Ireland	MAP initiated in 2017 builds on the Source to Tap project team and the Water Catchment Partnership, AFBI, Irish water, Northern Irish Water, Ulster University, Rivers Trust, East border regions.	Aim: Protection of drinking water by addressing pesticide use; comply with regulations on pesticide use. Mandate: By national, regional, local authorities, associated with requirements of the WFD, the ND and DWD.	Shared understanding of need to protect drinking water by reducing pesticide use. Also emphasized need for awareness raising at the national level and at the local level - communicate impact on their drinking water.	Access to information on best practice on sustainable land management or nutrients management and the MAP contribute to community engagement / involvement and raise awareness.	Resources available through projects Source to Tap, SCAMP and through NIWater. Insufficient funds for measures, slow implementation.	Strategy: Build relationships between partners; monitoring and evaluation of a farmer incentive scheme. Achievements: Increased knowledge and awareness, understanding of farmer's perspectives, relationship between water company and landowners, reduced pesticide levels. Learning points: Patience needed to see results, building trust takes time, information need to be targeted. Risks: Possible lack of funding, changing national policies; change of staff to less dedicated staff.
Overijssel, the Netherlands	MAP initiated in 2011. Farmers, agricultural contractors, municipalities, water company. Facilitation: The province and the water company Vitens.	Aim: Platform to discuss current situation, agree on measures and evaluate the implementation of these measures. Mandate: Provided by province and water company.	Broad consensus on the need to improve groundwater quality (lower nitrate levels) by improving the efficiency of the use of nutrients through a mutual gain approach.	MAP represents a network of people; Farmers use MAP to also discuss other issues and potential solutions such as the drought-issue.	Funds for the MAP and associated activities are provided on a continuous basis by the province and the water company.	Strategy: Creating a network for knowledge exchange. Individual advise on farm management in combination with economic impact. Achievements: Exchange of knowledge; new insights by actors; a trust-building platform between farmers, the province and the water company; Learning points: voluntary approach and measures may not be enough to meet the water quality standards. Risk: Continuity dependent on budget provided by actors.
Brabant, the Netherlands	Ongoing MAP initiated in 2011 includes: water boards, water company, agricultural org., local and regional authorities, farmers. Facilitation: Water company and agricultural organization.	Aim: Reduce pesticide in surface and ground waters. Mandate: Provided by the water company, provincial authorities and water boards to discuss measures and solutions.	Common understanding on the need to reduce pesticide use, and/or use pesticides "responsibly" to improve drinking water quality.	Access to advice and demonstration of new measures; insights into the complexity of pesticide regulations.	Funds have been available by means of a joint collaboration between water boards and the water company; agricultural organization contributes with in-kind resources.	Strategy: Building trust over time, collaboration to find solutions, include a variety of relevant local actors. Achievements: Reduced pesticide use possible for certain crops; MAP serves as basis for sharing perspectives and decision-making. Learning points: visualization of environmental impact important; trust-building involves mutual understanding among actors. Risk: Continuity of MAP depends on available resources and voluntary engagement.
Vansjø, Norway	The MAP established in 1999, incl. municipalities, political representation, a secretariat, water company, working groups, representatives from NGOs incl. farmers. Facilitation: Secretariat.	Aim: Improve the water quality and environment of the catchment. Mandate: By catchment municipalities, national authorities. Associated with implementation of the WFD.	A common understanding and awareness of problems achieved in the MAP – associated with monitoring efforts over decades. Some differences in political priorities at different governance levels.	Knowledge exchange and possibility to influence discussions.	Financial resources available from municipalities, from national and regional authorities for organization. ASlso for measures since 1999.	Strategy: Involvement by means of four thematic working groups (sewage, agriculture, environmental monitoring and the coastal area). Achievements: Proven and efficient measures that show results. Learning points: Political representation, a secretariat and thematic groups are cited as key elements to achievements. Risk: Few risks challenging long term engagement.

MAP, country	MAP characteristics					MAP development: Strategy, achievements, learning points, and risks challenging long term engagement
	MAP participants	Aim and MAP mandate	Shared understanding of the problem	Synergies associated with MAP	Economic resources available for MAP	
Baixo Mondego, Portugal	MAP established in 2018 including national, basin and regional authorities, farmers' associations and farmers. Facilitation: Researchers familiar with actors in the region.	Aim: Platform for exchange of information between farmers and the public, for dissemination and transfer of knowledge. Mandate: Informal, by national, regional authorities, farmer association.	Shared understanding that aquifers have too much nitrate. Varying perspectives of purpose of MAP, some on practices for improved water quality, others on economic performance of agriculture.	Synergies in learning, but otherwise low levels – experienced as a concern for continued activity. Limited extent able to influence the priorities of the map.	Increased knowledge of farm management and current agricultural practices in the area.	Strategy: Contribute with increased knowledge-base, solving differences by means of open dialogue and informal meetings. Achievements: More interaction between actors; better understanding of other points of view - only partly regarding agriculture practices. Learning points: Changing practices takes time and depend on technology, funding, increased knowledge. Risk: Lack of funding and common goal a challenge for MAP continuation.
Arges-Vedea, Romania	MAP was established in 2018, with local public authorities, farmers, consultants. Facilitation: project researchers	Aim: exchange knowledge between different actors related to applying good agricultural practices for reducing or preventing water pollution from agricultural sources. Mandate: Informal, by local public authorities and farmers.	Shared understanding that it is mandatory to apply good agricultural practices either at farm or communal level in order to protect waters.	Synergies may be improved if different actors are better involved in a common effort to find solutions that connect their own interests (higher productivity and protected environment).	By applying measures, the farmers are financially compensated.	Strategy: a platform for knowledge exchange and informal meetings for dialogue between different actors. Achievements: a better understanding of common issues and of the efforts needed for applying good measures. Learning points: exchanging experience on agricultural practices adapted to different specific local conditions. Risk: future communication between different actors within the MAP may be discontinued.
Dravsko Polje, Slovenia	MAP established in 2018 with ministries, drinking water company, agricultural comp., agri. advisors, municipalities, farmers. Facilitation: Project researchers and local agriculture advisory service.	Aim: Solve problems of farming in the water protection buffer zones. Mandate: Given by the presence of authorities, but no real mandate to implement changes.	The actors reflect different goals: farmers/agri. comp./advisers – proper financial support or new land; water companies – less emissions, trust with farmers; municipalities - clean drinking water; Ministries – measures agreed with farmers, trust.	Outside of the MAP - low level of synergy about MAP future. The MAP reported contributing to improved synergy. Synergies could be improved if ministries would recognize local MAP as partner in communicating local issues.	Increased knowledge of farm management and current agricultural practices, regarding measures and subsidies. The MAP could become part of agri. adviser public service paid by Ministry for agriculture.	Strategy: Meetings for knowledge exchange and to discuss focus and priority of MAP. Achievements: Better communication between stakeholders, address a common issue. Learning points: MAP discussions need to be considered by decision makers; formal meetings are taken more serious by actors. Risk: Politicized issues, poor cooperation between gov. agencies and ministries, insufficient emphasis on the need for solving the problem.

4. MAP ACTIVITIES

4.1 THE PROCESS OF DEVELOPING AND NURTURING THE FAIRWAY MAPS

At the outset of the project, in November 2017, a workshop was facilitated on how to establish and nurture MAPs for constructive engagement on water-agriculture related issues. All the FAIRWAY MAPs participated in discussions on 1) how to establish a new engagement platform, 2) how to bring an existing platform into the project; 3) how keep track of the respective engagement processed and, 4) how to analyse the progress, successes and challenges of the different MAPs. *A summary of the workshop is submitted separately as project deliverable D2.3.* In same workshop, a framework of key dimensions of multi-actor engagement was presented to form a unifying thread through the project and across the cases; highlighting important dimensions of engagement processes (for details see Sundnes, van den Brink et al. 2020). The MAPs were further asked to rank their respective MAPs according to these dimensions, to inspire MAP coordinators to relate to this framework and learn from the suggested approach. This was also done with another purpose in mind, that when carried out again - towards the end of the project - one could track changes in the functioning of the MAPs over time, within the project period.

Following this workshop, all MAPs submitted an engagement plan with details on plans for engagement in term of actors included and the process of engagement throughout the project. The engagement plans of all the FAIRWAY MAPs were submitted separately as project deliverable D2.1.

Throughout the project, all MAPs have also reported annually on any activities carried out in the MAPs, including the purpose, participants, and outcomes of these activities. A minimum requirement has been an annual meeting with all MAP participants, while for most of the MAPs, the level of activities has been much higher. Details are given in chapter 4.2 in this report.

The WP2 lead team, consisting of RHDHV and NIVA, has also provided additional support to the newly established MAPs in Greece, Romania, and Slovenia, on how to plan for engagement processes, whom to include in the platform, and how to bring the MAPs into the project.

Half-way through the project, in 2019, an exercise of data collection on the functioning of the MAPs and the performance of the engagement processes was carried out. The aim of this exercise was to get feedback from MAP participants on the performance and functioning of the respective MAPs, and to enable the harvesting of lessons learnt and best practice. This cross-project data collection exercise led to an analysis of successes and bottlenecks of multi-actor engagement and was presented in D2.5, which again formed the basis for two peer reviewed publications (Nesheim, Sundnes et al. 2021, van den Brink, Hoogendoorn et al. 2021).

4.2 OVERVIEW OF FAIRWAY MAP ACTIVITIES

A range of activities have been carried out within the project involving the MAPs, in different ways relating to the establishment and further development of the MAPs, analysis of MAP processes, and experience sharing. FAIRWAY activities involving the MAPs are detailed in *Table 3*.

Table 3. FAIRWAY WP2 project activities, 2017-2021

Activity	Content	Participants	Place, time
WP2 session at FAIRWAYs kick-off meeting	Setting the stage for MAPs in Fairway	All partners and MAPs	*Amersfoort,* June 2017
WP2 workshop at FAIRWAYs 1st general meeting	Introduction to developing and running MAPs; introduction to engagement plans and activity logs. MAP ranking according to dimensions for engagement.	All partners and MAPs	*Naples,* November 2017
WP2 session at FAIRWAYs 2nd general meeting	Experience sharing, with special emphasis on Aalborg-Denmark.	All partners and MAPs	*Aalborg,* June 2018
LUWQ-conference presentations	Multi-actor approaches, and experiences from Norway and Overijssel-Netherlands	NIVA, RHDHV	*Aarhus,* May 2019
Data collection	For analyses of 10 FAIRWAY MAPs; functioning, achievements and challenges	Interviews and survey to MAP participants	2019
WP2 session at FAIRWAYs 3rd general meeting	Experience sharing, w special emphasis on cases: Slovenia, Northern Ireland and England.	All partners and MAPs	*Ljubljana,* September 2019
Writing workshop (WP2)	MAP analyses, towards D2.5	NIVA, RHDHV, AU; based on input from MAPs and MAP participants	*Copenhagen,* November 2019
WP2 session at FAIRWAYs 4th general meeting	Experience sharing, with special emphasis on cases Germany, Greece and Overijssel-Netherlands.	All partners and MAPs	*Webinar,* December 2020
Publication of FAIRWAY Key Message on MAPs	Summary of D2.5s main messages	NIVA, RHDHV; based on input from MAPs and MAP participants	*October 2021*
Writing workshop (WP2)	MAP analyses, towards D2.2	NIVA, RHDHV	*Oslo,* November 2021
Webinar hosted by NIVA / FAIRWAY	*Stakeholder Engagement and Governance Arrangements in European Agricultural Drinking Water Catchments.* Experience sharing: all MAPs, but special emphasis on cases Tunø-Denmark, Slovenia, Overijssel-Netherlands, Brabant-Netherlands, and Germany.	Open webinar; contributions from NIVA, RHDHV, AU, KGZS, LWK, COPA-COCEGA, EurEau, WUR. Special invitation to all MAP participants. ~100 participants.	*Webinar,* November 2021
Special issue in *Water*	*"Stakeholder Engagement and Governance Arrangements in Agricultural Catchments"* Sundnes F. and S. Langaas (eds.)	FAIRWAY contributions: Nesheim, Sundnes et al. (2021), van den Brink, Hoogendoorn (2021)	*Forthcoming, 2022*

Table 4 gives an overview of the different MAPs own engagement activities in the project period, based on activity logs for the duration of the FAIRWAY project. A more detailed overview per MAP is found in Annex I. The level of activity and the kind of activities carried out varies a lot between the MAPs. Those MAPs with a high level of engagement with farmers are also MAPs where farm visits have already been carried out as part of other overlapping projects and initiatives. It is therefore important to note that this in itself is not a reflection of the functioning of the MAPs, as they all have their own set goals, e.g. on changing farm management practice, improving decision-making processes or stimulating regulative change, that requires different strategies. Moreover, the MAPS are also in different stages of maturity, which also begs different levels and types of engagement. Hence, all MAPs have organized annual stakeholder meetings, while more targeted activities, workshops, meetings, and field visits were facilitated according to the engagement plans of the respective MAPs.

Table 4: Overview of all MAP activities based on respective activity logs, 2017-2021

MAP, country	MAP general meetings	Farm visits	Other MAP meetings/activities
Tunø Island, Denmark	*Historical reference case. No engagement activities in this period.*		
Aalborg, Denmark	4	-	10
Anglian Region, England	4	10	19
La Voulzie, France	4	4	20
Lower Saxony, Germany	4	-	4
Axios River / Agios Pavlos, Greece	8 / 6	-	3 / 4
Derg, Northern Ireland	17	236[1]	-
Overijssel, the Netherlands	4	150[1]	15
Brabant, the Netherlands	4	290[1]	54
Vansjø, Norway	16	10	13
Baixo Mondego, Portugal	4	-	3
Arges-Vedea, Romania	4	1	8
Dravsko Polje, Slovenia	4	3	3

[1] MAPs with a high level of engagement with farmers are also MAPs where farm visits are carried out as part of other overlapping projects and initiatives.

4.3 OTHER MAP CONTRIBUTIONS TO THE FAIRWAY PROJECT

As case studies in the FAIRWAY project, the MAPs have continuously contributed to the fulfilment of the aims of the FAIRWAY project and to individual tasks. All data requests coming from FAIRWAYs work packages (WPs) and information streams from the case studies to the different WPs have been organized by the information structure of the project, coordinated within WP2. *Figure* 3 gives an overview of the FAIRWAY activities that the MAPs have been part of, and related project outputs. For each case a case-study leader was appointed, tasked with being the primary contact for all matters regarding the data collection in relation to the case studies. For each case study a MAP coordinator was also appointed, responsible for setting-up and facilitating the engagement processes in each case. The case study leader and MAP coordinator have worked closely together, and in some cases these two roles have been taken on by one person. For the sake of feeding project results back to the MAPs and the MAP participants, but also to the general public, a series of infographics and key messages have been produced and shared under the FAIRWAY project.

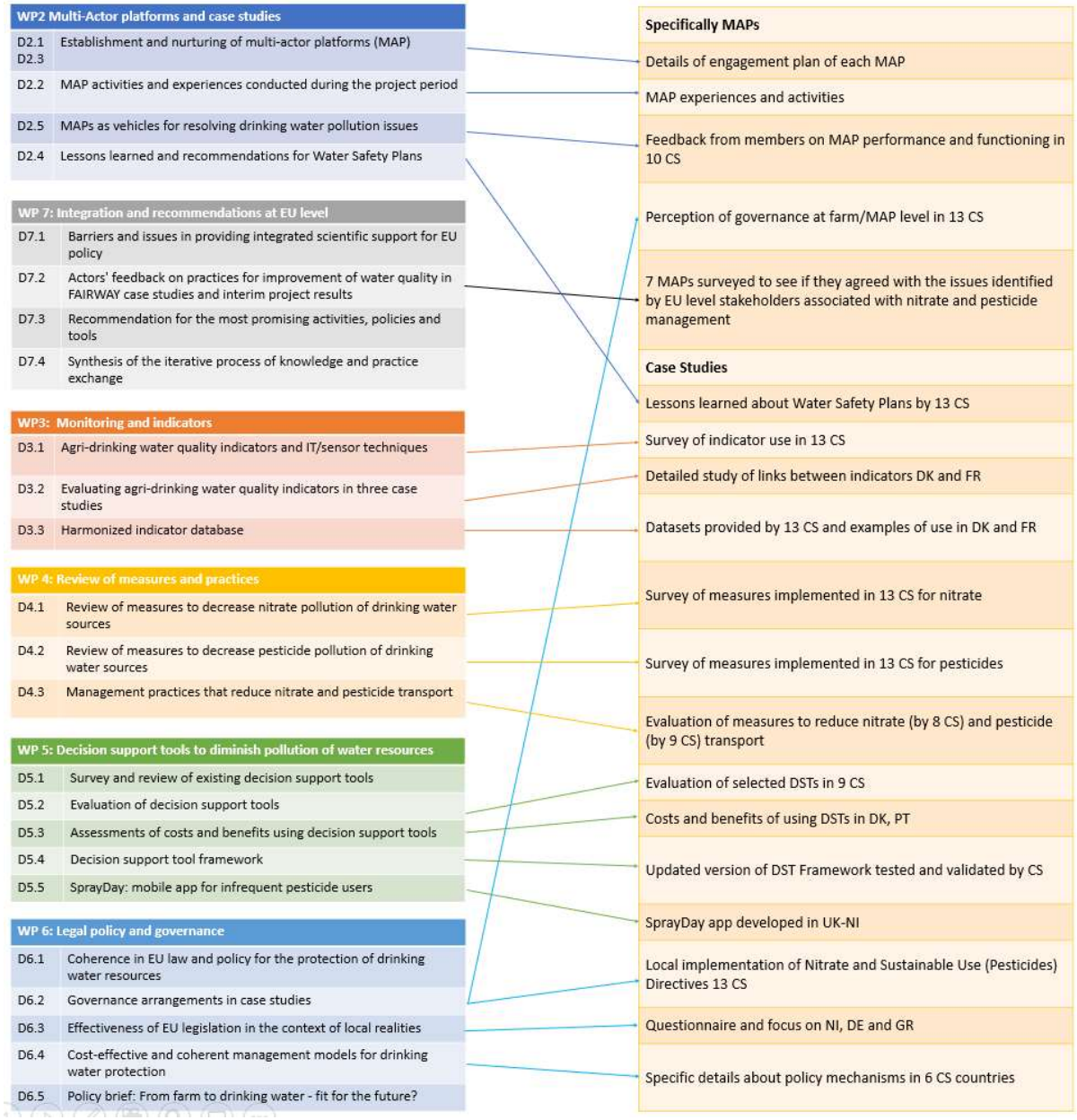

Figure 3. The work packages structure of the FAIRWAY project (from FAIRWAY D7.3)

A proposal has been submitted to EIP AGRI, to establish a working group on diffuse pollution so that the collaboration between MAPs and case studies can be contimued after the lifetime of FAIRWAY.

4.4 COVID-19

Covid-19 has heavily impacted on the activities of the FAIRWAY MAPs in the latter part of the project, from early 2020. Restrictions at national or local levels have varied in intensity and scope, but have in most cases made it difficult to carry out meetings, workshops and farm visits as planned. While some MAPs have been able to improvise and adapt to digital modes of interaction, this has been more difficult elsewhere, depending on the kind of actors that are involved, and the extent to which the pandemic has resulted in disruption of the social and business spheres. Most MAPs have however been able to assemble the MAPs for annual meetings also in the last year of the project, and have been able to carry on with activities albeit adapted to circumstances.

5. CHANGES OVER TIME

A framework of key dimensions of multi-actor engagement was presented early in the project to form a unifying thread through the project and across the cases, highlighting important aspects of engagement processes. The MAP coordinators were asked to rank their respective MAPs according to these dimensions during the workshop in Naples, 2017. Now, in 2021, the MAP coordinators were asked again to rank their respective MAPs, to track changes in the functioning of the MAPs over time, within the project period. Note that the ranking of the respective MAPs has been a qualitative assessment carried out by the MAP coordinators. According to earlier analyses (Sundnes, van den Brink et al. 2020, Nesheim, Sundnes et al. 2021) a distinction has made between newly established MAPs, i.e. MAPs established in the period between 2017 and 2018 facilitated for by the FAIRWAY project, and MAPs already existing for a longer or shorter period at the start of the FAIRWAY project.

5.1 CHANGES IN NEWLY ESTABLISHED MAPS

An overview of the changes in the newly established MAPs is shown in *table 5*. This table provides information on whether the changes over the considered period were positive or negative, and a reference to the main cause for this change. The causes are either labelled *internal*, pointing to internal dynamics, or opportunities and challenges of the respective engagement processes; or they are labelled *external,* relating to external factors that are outside of the influence of the MAPs, but with implications for the processes.

Table 5: ***Newly established MAPs (as part of the FAIRWAY project)****, changes and causes*

MAP, country	Changes in overall MAP-dimensions' score	Main cause (Internal/external)
Aalborg, Denmark	+	Internal
Axios River & Agios Pavlos, Greece	+	Internal
Baixo Mondego, Portugal	+	External
Arges-Vedea, Romania	+	Internal/External
Dravsko Polje, Slovenia	+	Internal

The scores of the dimensions reflecting the functioning of the MAP in **Aalborg** showed an increase, especially as result of exchanging perspectives and getting to know each other*: "The playing field has levelled out a bit, and stakeholders have expressed their perspectives to each other"*. This can also be seen as a general contribution to the development of *shared goals*.

The engagement process within the MAP of the **Greek case** contributed to a sense of common goals and urgency to solve environmental problems. Considering the feedback on *available resources*, stakeholders desire more than what the FAIRWAY project could offer in terms facilitating for information sharing, education and guidance, and would also have wanted funding for applications in the field/new intelligent farming practices/water cleaning processes etc. Interestingly, in the Greek case, the improved synergies within the multi-actor platform also contributed to the business perspectives of the farmers: *"The MAP members have realized that there is no funding for actual on-site applications, therefore they have understood that finding synergies with other members is also beneficial for their products".* Efforts put into the engagement

process also resulted in the Greek MAP having a role as a consulting body, however with little influence on decision-making.

The engagement process of the **Portuguese MAP** has, according to the MAP coordinator, benefitted from Portugal's Resilience and Recovery Plan[2]*: "There are, due to the Resilience and Recovery Plan [RRP] a set of dynamic processes going on, that are targeted to the involvement of more actors in solving some of the challenges of Portuguese agriculture and livestock breeding. This has increased adaptability sharply."* The involvement of more stakeholders also contributes to an improved *power balance*, improvement of the *synergies* and *decision space*. In addition, the post-COVID period contributed to the willingness to participate in engagement activities: *"The post COVID-19 context and the RRP increased the involvement of actors that seldom had a voice in these matters"*.

The engagement process of the **Romanian MAP** benefitted from their new Code of Good Agricultural Practice: *"The new Code of Good Agricultural Practices which was approved this year is not anymore mandatory for farmers. In this way the farmers have more flexibility in applying the measures from the Code and they can more easily adapt decisions regarding farm management."* In addition, the functioning of the MAP improved by joint recognition by stakeholders (incl. authorities and farmers) of the need to work towards a common goal. There is also a shared understanding that improved water quality can only be attained by complying with the current regulations. As result, the stakeholders seem to be better involved in common efforts to find solutions that connect their own interests, such as higher productivity in a well-protected environment. The improved functioning of the Romanian MAP is also illustrated by the improved decision space felt by the stakeholders within the MAP: *"Presently, the stakeholders within the MAP participate in debates relating to the measures included in the regulations on water quality."*

The engagement process of the **Slovenian MAP** improved for 6 out of 7 dimensions considered, illustrating that the functioning of the MAP improved over the relatively short period between 2017 and 2021. In general terms, the MAP has contributed to establishing a joint understanding that the quality of drinking water is at stake, highlighted by the MAP coordinator as an important outcome: *"During the course of the project - from establishing the MAP until the end of the project - the most important outcome was better understanding among members, loss of fear of speaking out or asking for help or even be in the same room with certain members. That is a good investment for the future."* Stakeholders however have different ideas on how to address the challenges. While the MAP has been important for participants to better understand each other's viewpoints and behaviour, it does however have no power to change processes or activities in place, as legislative and financial powers reside with the relevant ministries. While drinking water protection is regulated at the national level, MAP participants from the Ministries do not have an active role. They come and explain the situation, but they cannot promise anything. *"The MAP was formed as part of the project, but there is no formal mandate. Experiences in this project, and others, show that many municipalities would need official water boards. Urgent and sensible tasks could be carried out faster if official communication and interaction was in place."*

[2] *"Portugal's Recovery and Resilience Plan provides for nationwide implementation of an innovative mechanism created directly by Brussels. […] The RRP aims to be an instrument that is capable of triggering structural transformation with strong reformist impact in its response to the effects of the pandemic crisis. Accordingly, it is organized into three structural dimensions: Resilience, Climate Transition, and Digital Transition."* (https://www.bbva.pt/en/incentivos-e-apoios-publicos/plano-de-recuperacao-e-resiliencia-prr.html, accessed 22.11.2021)

5.2 CHANGES IN EXISTING MAPS

An overview of the changes in the existing MAPs is shown in table 6. This table provides information on whether the changes over the considered period were positive, negative or absent and information on the main cause for this change.

*Table 6. **Existing MAPs** prior to FAIRWAY, changes and causes*

MAP, country	Changes in overall MAP-dimensions' score	Main cause (Internal/external)
Tunø Island, Denmark	N/A[3]	N/A
Anglian Region, England	+	Internal
La Voulzie, France	0	0
Lower Saxony, Germany	-	External
Derg, Northern Ireland	+	Internal
Overijssel, the Netherlands	-	External
Brabant, the Netherlands	+	Internal + External
Vansjø, Norway	+	Internal

For existing MAPs, less changes maybe expected, as expressed by the **French case study**: *"Almost nothing has changed in the French case study (considering the set dimensions). The main explanation is that the MAP has existed for many years; the first measures were taken in the 90's. So the good habits (and the bad ones) are set. There is interaction and communication in the MAP, but the true difficulty is to keep all the farmers and other stakeholders really involved."*

The French case study is however the only MAP reporting no changes at all. The functioning of the MAP improved in the UoL-driven **case study in England**. An external factor (national legislation) caused phasing out of the pesticide metaldehyde, which was one of the aspects of concern in the MAP. However, the MAP showed agile and able to consider other water quality challenges with regards to farming as well. A relevant internal factor is that the initiators of the MAP have been able to increase the number of stakeholders engaged, and hence broadening the MAP as an *arena*. This has positively affected the *power balance* in the MAP. The increased number of participants has created *synergies* in terms of mutual learning, while also had a positive impact on the resources: *"The MAP process of seeking to involve more stakeholders resulted in more local funding, albeit in small amounts".*

In **Northern Ireland**, stakeholders have over time become much better informed about the purpose of the MAP, and processes that are ongoing to achieve this. Due to these MAP activities the scores for 'shared goals' increased over the lifetime of FAIRWAY. The fact that stakeholders were better informed also improved the synergy of the interaction: *"With a greater understanding of shared goals, there is a greater willingness to consider different solutions".*

The **Norwegian MAP** has over the last years experienced increased interaction with civil society and farmers. The MAP, through its daily manager, has been key to access funds to local projects involving local actors, including farmers. One example recently observed is a project involving tree planting along rivers and streams. Another example is a focus group discussion organised as part of FAIRWAY's involvement with the MAP, consisting of farmers, farm advisors on municipal level, and regional state authorities. The aim of the focus group was getting input to a process of revising

[3] The MAP of the Tunø case study already ended before the start of FAIRWAY, is included in FAIRWAY as an historical reference case.

a Regional Environmental Programme, that includes economic and soft incentives for implementation of measures. This initiative was set up to face the challenge of limited farmers' involvement in policy development.

Despite the effort put into meaningful engagement and knowledge transfer though a range of MAP activities, some existing MAPs report a decrease in dimensions describing the functioning of the MAPs. In the **German case study** this is attributed to external factors. These relate to impacts on agriculture and/or the economics of the farms, such as drought and the prices for agricultural products, but are also related to external factors such as COVID-19: *"The MAP has been affected by various external changes (changing fertilization law, weather extremes, volatile prices for fertilizers and animal products, coronavirus pandemic, etc.). […] Up to now the MAP has been able to adapt to these changes and participants of all different actor groups still participated in the meetings and joined the discussions. However, the coronavirus-caused online meeting prevented informal communication which made the meetings less interactive".* National and regional regulations also decrease the functioning of the MAPs *decision space*: *"MAP participant experienced that despite their work within the MAPs, new top-down regulations on both national and federal state level were imposed on agricultural management. For the MAPs it is quite frustrating since they experienced that these kinds of voluntary and interactive approaches are not appreciated by higher-level decision-makers."* So, over time, external factors affected the functioning of the German MAP despite the effort which was put into the engagement processes.

The Dutch case study **Overijsse**l showed a decrease in power balance, shared goals and synergies of the interaction. The MAP, as a provincial project, became part of a National Agreement regarding nitrate leaching in vulnerable groundwater protection areas. Consequently, the *power balance* and *decision space* of the provincial project decreased. Power did now only shift from regional to national level, also from the farmers to the authorities, as strict objectives were part of the national agreement. Since these time-bound objectives are not possible to influence, farmers changed their attitude and in meetings the groundwater quality goals were referred to as goals of the authorities rather than shared goals of the case study. In addition, the synergies of the interaction decreased*: "Objectives (nitrate concentrations in groundwater) are not met. Farmers are concerned about 'what's next'. And farmers are more directly asking to get something in return, indicating that 'mutual gains' are not felt as mutual gains by the farmers".* Important reasons for this decrease in the functioning of the MAP also has to do with other external factors, such as socio-economic pressures on agriculture and increasing evidence and reports showing the impact of Dutch agriculture on the environmental quality in general and specifically in vulnerable natural areas. As result, the trust of farmers in the Dutch government is low. From an I&O Research survey among 1.000 farmers for a national Dutch newspaper *De Volkskrant*, only 4% of the farmers mention that they trust the government (see *figure 4*).

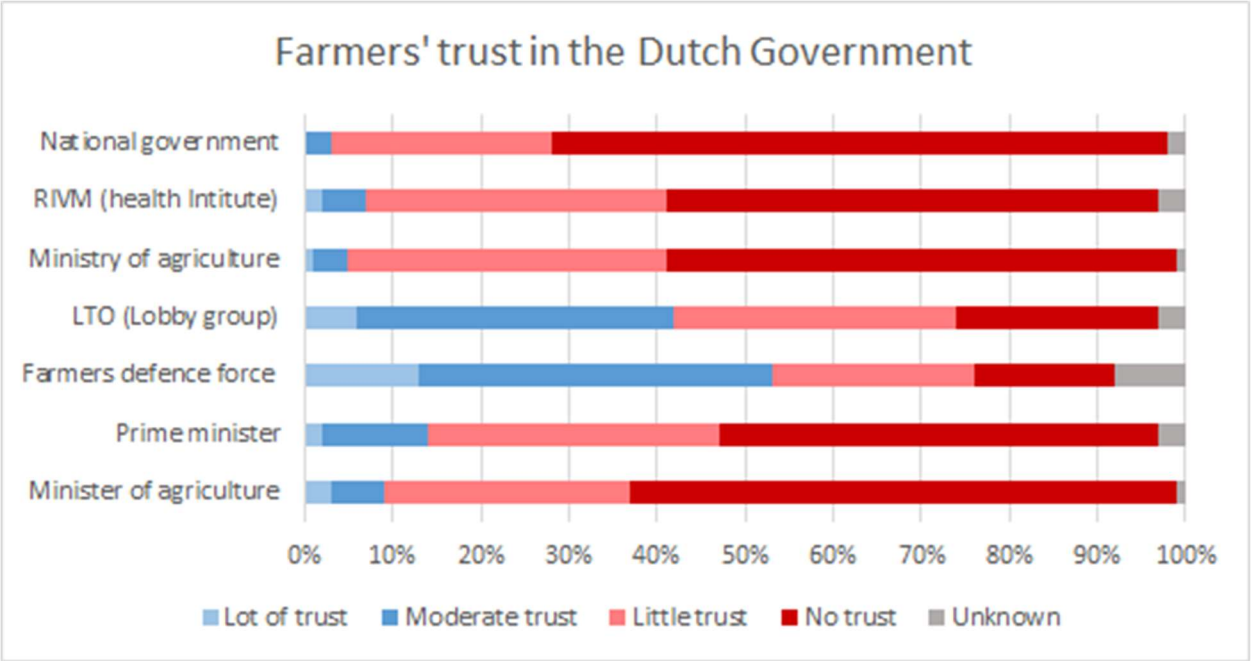

Figure 4. Trust of Dutch farmers in the Government.[4]

Despite the pressure of civil society on agriculture in general, the engagement process of the Dutch case study **Brabant** is not really affected. This might be due to the fact that a specific time-bound objective of pesticides in vulnerable drinking water protection areas is missing, in combination with the fact that the objectives can be met without business economic losses (van den Brink, Hoogendoorn et al. 2021). In addition, the Brabant case benefits from external research in which groundwater friendly techniques were developed, and available to the project. Concern in the engagement process was the ending of the project phase 2016 – 2020 and starting the next project phase: *"The 2016 project ended at the end of 2020. The process to develop and start a new version of the project took a long time, so an interim project was started. This interim project had limited funding, and in combination with Covid-19 this resulted in fewer activities for farmers. Out of sight, out of mind applies to this situation."* The province of Brabant and the MAP participants have now decided to prolong the project with at least two more years. In this new period the MAP will focus on both stimulation of farmers, as well as options to include regional regulations, to achieve protection of the groundwater sources.

[4] Source: I&O Research, De Volkskrant, October 21 and 22 2021.

6. CONCLUDING REMARKS

The FAIRWAY project has through its multi-actor approach facilitated a range of interactions between farmers, agricultural advisors, waterworks, authorities at different levels, and researchers, across Europe, in the pursuit to identify approaches to reduce agricultural impacts on drinking water. Important vehicles for these interactions have been the project's multi-actor platforms (MAPs), that have also been study objects for better understanding and improving engagement processes.

In examining the changes over time in the various MAPs, it seems that the efforts put into the engagement processes has in different ways resulted in improvements in the functioning of these platforms. Changes to external factors can however be conceived of as both threats and opportunities. For some of the existing MAPs, changes in regulations at national or regional levels has challenged, or even jeopardised engagement processes in the MAPs, as illustrated in the cases of the Netherlands and Germany. An example of opportunity development is the new Code of Good Agricultural Practice, in the Romanian case, in combination with the fact that this code is no longer mandatory. For the Portuguese case study, the Resilience and Recovery Plan [RRP] has initiated a set of dynamic processes that are targeted to the involvement of more actors in solving some of the challenges of Portuguese agriculture and livestock breeding. Another important aspect affecting the functioning of the MAP is the number and type of stakeholders participating into the engagement processes. While most dimensions benefit from engaging a broad set of stakeholders, there are also challenges in facilitating larger arenas, and to ensure that everyone is given the opportunity to have an active voice and to influence the processes.

Based on the experiences of the FAIRWAY MAPs, the issue of *trust* has come up as crucial for successful engagement platforms, and essential for achieving tangible outcomes in the longer run (Sundnes, van den Brink et al. 2020). While not initially included in our framework, we do consider that trust is an issue that cuts across all the dimensions. Some of the descriptions of the changes over time support this, for instance how stakeholders who are better informed and as result show a greater willingness to consider different solutions (Northern Ireland, Romania) and MAPs for which the functioning improved and the engagement became more meaningful with a broadened arena (e.g. Norway, England, Portugal)). On the other hand, the trust between stakeholders in some cases decreased by external factors, especially top-down measures at regional or national level (Germany) or as response to a general low trust in the government and authorities regarding N-issues (Netherlands-Overijssel). A key issue for developing relations of trust is to have active facilitation of engagement platforms that allows for regular and physical meetings, be it official or informal meeting, or field visits. Likewise, being able to keep the same individuals involved over time is also key for the shared sense of direction towards set objectives.

The FAIRWAY MAPs are generally successful in terms of creating arenas for dialogue and exchange and have contributed to trust building between stakeholders. However, many of them - at this point – still lack tangible impacts. A dilemma for engagement processes is that they need to be conceptualised and planned for in a long-term perspective, while the lack of immediate impacts can be a threat to trust in facilitators and processes over time, which might lead to participant fatigue that jeopardise the processes. In this context there is a dual lag-time; firstly in respect to the time is takes for engagement processes to result in certain objectives and/or recommendations for improved farm management, and then secondly, the lag-time from the introduction of certain measures to actual results can be measured and communicated.

Setting ambitions and goals based on who is participating, the mandate and legitimacy of the platform, and the governance context, is therefore important, as not to create unrealistic expectations. There is evidence from the MAPs of how the lack of impact might jeopardise the MAP-processes, creating disappointment or fatigue on the part of the participating actors. This

issue therefore speaks to a need of thinking of engagement processes in a long-term perspective. We also see that for some MAPs, voluntariness in terms of implementation of measures can help in the trust-building process, but on the other hand, can be a reason for why objectives and tangible impacts are hard to reach (van den Brink, Hoogendoorn et al. 2021). There are also apparent differences in perspective within the MAPs, on whether the increased dialogue is to be considered a success-factor in itself, or whether success only can be determined when there are real impacts.

In addition to aspects related to meaningful engagement, it should be considered that the socio-environmental issues to be solved in the case studies are within the water-agriculture nexus. This governance approach based on voluntary measures as carried out in FAIRWAY is effective, but complying to the (ground)water objectives cannot be enforced because the playing field and mandate to comply to the objectives is within the governing rules and regulations (van den Brink, Hoogendoorn et al. 2021). Despite the establishment of the MAP and stakeholders knowing and trusting each other, the engagement process needs additional fuelling to guarantee long-term engagement and commitment to maintain and improve the outcomes in the longer run: (ground)water quality “doesn't pay”. The Greek MAP is however an example of a MAP that clearly has contributed to added value for the farmers: *“Synergies with other farmers, with fertilizing producing companies, with water utility companies, have proven beneficial. Their professional network has been strengthened. These synergies are ready and established, and in the future they can be used to implement environmentally friendly practices that could be of benefit to the community.”*

7. POLICY RECOMMENDATIONS ON ENGAGEMENT

- Engagement platforms, if successfully set up as multi-actor, multi-sector and multi-level platforms, can play an important role in bringing actors together and enable information and knowledge sharing.
- By fostering such exchange, multi-actor platforms have a potential to contribute to creating common understanding amongst actors and challenge predetermined ideas, persistent norms, and preconceived impressions of other positions and stakeholders.
- While knowledge and information sharing and shared understanding can be valuable, it should be acknowledged that there is a number of constraints on MAPs to move from this stage to reach set goals and achieve real change in farm management or regulations.
- Engagement processes are resource demanding and require commitment over time. Predictability in terms of human resources for facilitation is a key factor. Ensuring funding for a daily manager of the engagement platform can be essential for continuity and steady facilitation.
- A dilemma for engagement processes is that they need to be conceptualised and planned for in a long-term perspective, while the lack of immediate impacts can be a threat to trust in facilitators and processes over time, which might lead to participant fatigue that jeopardise the processes. Setting ambitions and goals based on who is participating, the mandate and legitimacy of the platform, and the governance context, is therefore crucial for not to create unrealistic expectations, and is key for meaningful engagement to take place.

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APPENDICES

ANNEX I: SUMMARY OF ACTIVITY LOGS OF THE FAIRWAY MAPS

Table summarising the activity logs of the FAIRWAY MAPs. Meetings on annual basis if not otherwise specified.

Annual meetings	Aalborg, Denmark		Anglian Region, England		La Voulzie, France		Lower Saxony, Germany		Axios River & Agios Pavlos, Greece		Derg, Northern Ireland		Overijssel, the Netherlands		Brabant, the Netherlands		Vansjø, Norway		Baixo Mondego, Portugal		Arges-Vedea, Romania		Dravsko Polje, Slovenia	
General MAP meeting	1	Aarhus University, Municipality, water company, agricultural and experts	1	UoL, ADAS AW, stakeholders	1	state services, water agency, farmers, local authorities, technical partners, local economic organizations.	1	farmer's reps., local auth., fed. auth. for env. and water, fed. auth. for geology, agr. advisors.	1	farmers' reps., state water auth., water companies and local reps. the pesticide and nutrient market.	5	Steering com.: NIWater, Irish Water, East Border Regions, Rivers Trust, Catchm. Officers, researchers	1	Province, water company, agricultural lobby org., agr. adv., groundwater quality experts, farmers	1	Province, water company, water authority, agricultural lobby organization, agricultural advisors, farmers	2	River sub-basin district; members of the agr. theme group, reps. from the County	1	researchers (agr. and water) APA, CCDR, regional auth., water company	1	Farmers, Academic media, Consultants, Regional agricultural authorities	1	Farmers, Agribusiness, agr. advisors, Municipality representative , Water company, Ministry of Environment, Researcher
Ind. farm advice	-		4		-		-		-		-		2	Farmer and agricultural advisor	1	Farmer and agricultural advisor	-		-		-		-	
Group meeting	2	Farmers and/or agricultural advisors	1		1	Farmers and/or advisors	-		-		-		2-4	Farmers and agr.advisors /expert	1	Province, water company, water authority, farmers	3	Meeting sub-basin agr. group	3	Various: meetings in 2019 with stakeholders	-		2	Farmers (25-35) and agricultural advisers
Technical group meetings	-		1		3	Tech. advisors, farmers and Eau de Paris project manager	-		-		-		-		2-4	Farmers and agricultural advisor/expert	X	Various meetings with local authorities, Water Company, regional authorities, national level authorities and farmers	-		-		1	2019: Presentation of the ANCA tool (NL) tested in the Case Study Dravsko polje.
Other meeting	2	Field exc. (2018) and the making of a movie on groundwater protection	4		2	Lab staff from the water company, Lab staff from BRGM, water company hydrologist	1	Additional meeting of relevant authorities	-		-		-		-		1	Continuous activity with 10 private companies	-		-		-	

ANNEX II: REPORTING ON KEY DIMENSIONS FOR ENGAGEMENT PROCESSES, 2017 AND 2021

Table showing the MAPs reporting on key dimensions for engagement processes, in 2017 and 2021. Dimensions scored 1-5.

	Adaptivity		Power Balance		Shared Goals		Arenas		Available resources		Synergies		Decision space	
	2017	*2021*	*2017*	*2021*	*2017*	*2021*	*2017*	*2021*	*2017*	*2021*	*2017*	*2021*	*2017*	*2021*
Aalborg, Denmark	2	2	2	3	2	3	3	3	3	3	2	2	3	3
Anglian Region, England	1	3	1	4	2	4	3	4	2	4	3	4	3	4
La Voulzie, France	3	3	3	3	2	2	5	5	5	5	3	3	3	3
Lower Saxony, Germany	4	3-4	3	3	2	2	4	3	4	3	3	3	3	1-2
Axios River & Agios Pavlos, Greece	3	3	2	2	2	4	4	4	3	2	3	4	2	3
Derg, Northern Ireland	3	3	2	2	2	4	3	3	4	4	3	4	2	2
Overijssel, the Netherlands	4	4	4	3	5	4	5	5	5	5	5	4	3	3
Brabant, the Netherlands	4	4	3	3	3	3	4	5	3	4	4	3	3	3
Vansjø, Norway	4	4	3	3	3	3	3	4	5	5	5	5	4	4
Baixo Mondego, Portugal	1	2	1	2	4	4	5	5	5	5	2	3	1	2
Arges-Vedea, Romania	4	4	2	3	3	4	3	3	3	3	3	4	3	4
Dravsko Polje, Slovenia	3	3-4	2	3	2	3-4	3	4-5	2	2	3	4	2	2-3

ANNEX III: PUBLISHED PEER-REVIEW ARTICLES BASED ON FAIRWAYS MAPS

Published peer-review articles in the journal *Water* based on FAIRWAYs multi-actor platforms, as part of the special issue: Sundnes and Langaas (eds.) *Stakeholder Engagement and Governance Arrangements in Agricultural Catchments (forthcoming 2022)*:

Nesheim, I., et al. (2021). *"Multi-Actor Platforms in the Water–Agriculture Nexus: Synergies and Long-Term Meaningful Engagement"* Water 13(3204).

van den Brink, C., et al. (2021). *"Effectiveness of Voluntary Measures to Reduce Agricultural Impact on Groundwater as a Source for Drinking Water: Lessons Learned from Cases in the Dutch Provinces Overijssel and Noord-Brabant."* Water 13(3278).

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Article

Multi-Actor Platforms in the Water–Agriculture Nexus: Synergies and Long-Term Meaningful Engagement

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Abstract: Solutions to current complex environmental challenges demand the consultation and involvement of various groups in society. In light of the WFD's requirements of public participation, this paper presents an analysis of the establishment and development of nine different multi-actor platforms (MAPs) across Europe set up as arenas for long-term engagements to solve water quality challenges in relation to agriculture. The MAPs represent different histories and legacies of engagement; some are recent initiatives and some are affiliated with previous government-initiated projects, while other MAPs are long-term engagement platforms. A case study approach drawing on insights from the nine engagement processes is used to discuss conditions for enabling long-term multi-actor engagement. The perceived pressure for change and preferred prioritization in complying with mitigating water quality problems vary within and among the MAPs. The results show that governmental and local actors' concern for water quality improvements and focusing on pressure for change are important for establishing meaningful multi-actor engagement when concerns translate into a clear mandate of the MAP. Furthermore, the degree to which the MAPs have been able to establish relationships and networks with other institutions such as water companies, agricultural and environmental authorities, farmers, and civil society organizations influences possibilities for long-term meaningful engagement.

Keywords: water governance; agriculture; multi-actor approach; engagement; participation; trust; social networks

1. Introduction

It is acknowledged that, to solve today's complex environmental challenges, the consultation and involvement of various groups in society including actors from the industry,

farmers, civil society, and politicians are needed [1–3]. While scientific knowledge is important for knowledge-based policy development, combining science and local knowledge from stakeholders is necessary for developing more inclusive approaches and locally targeted solutions [4,5]. In parallel with this recognition, stakeholder participation as a norm has been adopted by global institutions, i.e., UNCED, OECD, and the World Bank, and included in governance and conceptual frameworks such as the Integrated Water Resources Management (IWRM), the EU Water Framework Directive (WFD), Environmental Impact Assessments, and the Aarhus Convention (UNECE). Theoretical frameworks have also been developed to better understand the strengths and weaknesses of different participatory approaches in environmental matters [1,6]. However, debates continue over what are best practices for meaningful participatory approaches [7,8], as well as the possible benefits in terms of outputs and outcomes from enhanced stakeholder participation [9–11].

Practices of involvement typically referred to short-term involvement, with a distinctive top-down approach [12]. Public participation described in the WFD implies a shift in water governance across Europe, aiming for continuous involvement associated with the water management cycle [13]. The WFD requires participation during key stages of the planning process: when developing a work program to produce a river basin management plan, in prioritizing what are the most significant water management issues, and in drafting the river basin management plan. The directive states that "Member States shall allow at least 6 months to comment in writing on those documents in order to allow active involvement and consultation" [14] and that "Member States shall motivate for more active participation" (ibid.). The emphasis on participation by the WFD stands out from other EU directives that are important for governance of water and agriculture, i.e., the Nitrate Directive, the Sustainable Use of Pesticides Directive, and the Drinking Water Directive, as these do not address participation. In the WFD, however, participation is only specified in general terms, while no practice regarding type of actors or involvement on levels of governance are referred to. Access by local actors to platforms where perspectives can be presented and discussed is not regulated in the WFD or in other EU legislations [15]. The discretion perspective of the WFD allowing total freedom for Member States to decide the participatory approach adapted to the local context may reduce the effectiveness of the participation principle of the directive [16,17]. According to Jager et al.'s [18] study on WFD implementation, "broad engagement of 'all interested parties', including the general public, communities, and stakeholders, at all stages of the planning process has not materialized". Other authors have demonstrated that the engagement platforms established with reference to the WFD vary in terms of their functionality, stakeholder representation, and opportunities for long-term engagement [17–19]. However, access to actors' knowledge and perspectives is promoted by coordination platforms on different levels of governance, which is important for tailored and effective policy implementation [20–22]. There is a need for more research on how different multi-actor platforms with varying contexts and settings evolve, and how this may be associated with structural input factors such as economic resources, specified mandates, and connections to the government system.

In light of the WFD and the common implementation strategy for participation referring inter alia to continuous and ongoing participation as important for successful engagement [13], we discuss in this paper conditions promoting the long-term engagement of stakeholders. The paper provides an analysis of the establishment and development of nine different multi-actor platforms (MAPs) across Europe set up as arenas for long-term engagement aiming to solve water quality challenges in relation to runoff from diffuse agricultural sources. The MAPs represent different histories of engagement; some are new initiatives and some are affiliated with previous government-initiated projects, while other MAPs refer to long-term engagement platforms. To analyze the situation in the nine MAPs, we present MAP characteristics, as well as the MAP participants' perspectives on the problem situation and their perspectives of synergies and added value of the engagement. Furthermore, risks challenging long-term engagement identified by MAP participants are presented. Factors and conditions required for enabling meaningful long-term multi-actor

engagement are frequently underestimated. To improve the outcomes of participatory processes, there is a need to advance the understanding of conditions promoting long-term engagement platforms. The concept of meaningful participation is used to discuss frames and conditions important for enabling long-term multi-actor engagement. While several articles focus on end results of participation for environmental status or for democratic rights [23,24], this paper discusses the different conditions that are important for the establishment of lasting multi-actor engagement platforms.

Multi-Actor Platforms—Added Benefits?

Multi-actor approaches have become important alternatives to the more techno-scientific avenues to environmental policy, with the purpose of increasing societal involvement in research and policymaking [25]. Multi-actor approaches refer to arenas organized for the interaction between different groups of actors and stakeholders including authorities, experts, and representatives, in our cases, from land and water user groups. Hence, this also implies the inclusion of a participatory approach, ranging from very low levels of involvement to high levels of involvement [6,26]. These different levels of involvement are closely related to the outcome of participation concerning democratic processes, trust building, collaboration, and long-term relationships [27]. Where policies impact people's everyday practice, work, and/or economic situation, as is the case for farmers in agricultural areas, active involvement to avoid inefficiency, protests, and conflict is particularly important. Multi-actor approaches aim for "more demand-driven innovation through the genuine and sufficient involvement of various actors . . . " [28]. The vast literature assessing such approaches indicates the impacts of improved decisions and better environmental performance. Engagement processes can ensure that produced knowledge is scientifically valid and relevant [29], and that this can contribute to democratic rights if engagement is representative and transparent, with legitimate processes [30]. Moreover, ensuring the inclusion of multiple perspectives can lead to maximizing benefits and minimizing losses amongst stakeholders and actors. Benefits are often associated with social learning, emphasizing the engagement's process dimensions. Such gains can be expected but may not be immediately realized. Yet, studies have also shown the possible pitfalls and limitations of such approaches [1,31,32]. One challenge is to ensure appropriate representation of relevant actors, which can be practically difficult or not financially viable [2,33]. Another risk is unequal power dynamics influencing the quality of the engagement process and its outcomes, as groups and individuals with more resources are typically overrepresented and, thus, exert more influence on the agenda and the discourse. Care should be taken to ensure that participatory processes do not reinforce existing power imbalances [6,34,35]. Unequal power relations also impact the sense of meaningful engagement and the stakeholder endurance, which can be difficult to sustain over time [36,37]. The WFD mandates management in a participatory fashion, as well as the development of river basin management plans and programs of measures. Several studies, however, have described the continuation of centralized decision-making realities of one-way information flows and limited delegation of power to decentralized levels [38–40]. The WFD has been a strong influence for establishing multilevel governance in a nested system including platforms for stakeholder participation [38]. However, as noted by Huitema et al. [34,41], contested boundaries, a lack of transparency between sector institutions, and problems of vertical and horizontal interaction are challenges that need to be addressed by the river-basin institutions.

2. Conceptual Approach

To study multi-actor approaches and conduct analysis of the establishment and development of nine different MAPs, we developed a conceptual approach based on the literature illustrating how long-term and successful multi-actor engagement is constituted by four elements: (1) meaningful engagement, (2) a defined pressure for change to work toward a common goal, (3) the social network and social interplay, and (4) the need of

added value for the participants in the MAPs (Figure 1). In the next sections, we elaborate on these four dimensions.

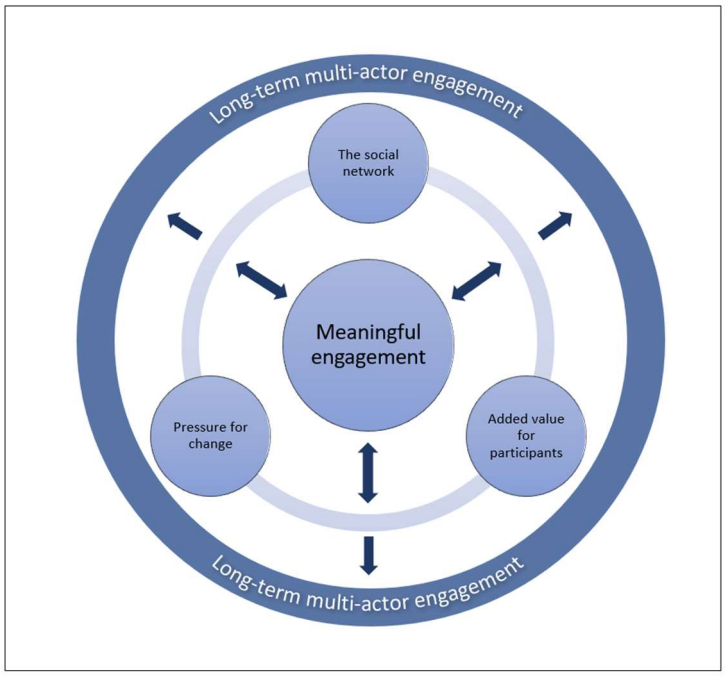

Figure 1. Key factors for long-term multi-actor engagement.

2.1. Meaningful Engagement

It can be expected that actors will not participate unless participation is experienced as meaningful. Meaningful engagement is defined as the right to be heard and the possibility to contribute to setting objectives [25,29,42,43]. Other factors known to have an impact on engagement are, for example, available time for participation, economic resources, and well-designed processes [7]. Refusal to participate might be a choice if there is risk of confrontation and conflict, or if actors' understanding of the problem situation differs (Ibid.), all to the detriment of meaningful engagement.

2.2. Pressure for Change

A pressure for change to mitigate diffuse water pollution from agriculture reflects a sense of urgency among local people and/or the government. This will have an impact on actors' views on participating in problem solving, thereby perceiving the engagement as meaningful [44]. Media, local or otherwise, can also be effective in providing a sense of urgency for bottom-up action and change. The degree that there is a mutual understanding of the main problem and objectives impacts the sense of pressure. Furthermore, actors who disagree with the objectives may choose not to engage, as they expect few achievements toward what they experience as more important objectives. While bottom-up concern is important for engagement, pressure for change reflected in mandates, policies, and regulations, representing political anchoring in the paper, are equally important [6,45]. Koontz and Newig [38] argued that it is the government that has the authority to initiate and regulate for collaborative planning between formal and informal sectors. The importance of top-down anchoring is also reflected in a study of multilevel governance networks associated with the Water Framework Directive in Norway by Hovik and Sandkjær Hanssen [46], where they argue for political anchoring and connections to the government system for water quality achievements, as implementing measures for improved ecological status of water is highly political.

2.3. MAPs and Social Networks

Due to the inherent nature of MAPs, as a platform where activities happen, it is important to analyze the broader social network to better understand what drives successful and long-lasting MAPs. Social network theory refers to the study of a network consisting of a set of nodes or actors and the ties between these nodes [47]. The nodes can be individuals, organizations, or institutions [48]. Ties may refer to personal relationships, or ties can reflect long-term policy practice and practice regulated by law. Social network analysis has been applied, inter alia, to study farmer knowledge exchange [49], to determine social capital and collaboration among actors [50], and to identify key stakeholders in governance and land-use decisions [51].

Within the social network theory context, we understand the MAP as a node where ties to other nodes, such as authorities and civil society organizations on horizontal and vertical levels, can be developed. It is assumed that nodes directly connected to the MAP reflect flows of information, important for vertical and horizontal communication of knowledge and coordination. We draw on these aspects of social network theory by focusing on the relations of MAPs with other institutions: whether the MAP is embedded within a formal governance structure, and whether the relationships (ties) make available financial resources for organizational purposes and implementation of measures. The emphasis of social network theory on relations among actors is in our study used to reflect on characteristics of well-established and long-lasting engagement platforms. The emphasis on social networks in this paper follows the increasing focus on network governance and its role for processes of social learning [41,46,52]. In line with Pahl-Wostl's [41] approach to analyzing environmental governance regimes, the relationship between formal state and informal nonstate institutions in networks needs to be considered in the analysis of meaningful and long-term multi-actor engagement processes.

3. Materials and Methods

In this study, we analyzed nine European initiatives to facilitate multi-actor engagement aimed at solving water quality challenges related to agricultural production. These initiatives have all been case studies in the FAIRWAY- Farm systems management and governance for producing good water quality for drinking water supplies project running from 2017–2021. The specified objective was to establish long-lasting platforms for engagement and cooperation between actors of different sectors and levels, including farmers, advisors, drinking water companies, scientists, and policymakers from the drinking water and agricultural sector, under the assumption that multi-actor interaction will ultimately improve water quality. The project's approach to multi-actor platforms can be described as action-based research where project partners contributed by taking part in developing the platforms, while taking part in the assessment and evaluation of this process [53]. A workshop was convened for project partners on how to establish and nurture MAPs for constructive engagement, which was organized according to key dimensions of engagement processes, adapted from Warner and Verhallen [33]. The aim was to critically assess the process of participation to identify opportunities and bottlenecks for meaningful engagement, shed light on challenges and how they have been addressed, and explore the future sustainability of the engagement platforms beyond the lifetime of the project.

To analyze the planning, implementation, and development of specific multi-actor processes, we conducted a case study analysis drawing on qualitative data, documentation, and insights from the respective nine engagement processes. Case study methods are well suited for situations involving complex events and processes, allowing the researcher to develop explanations regarding how outcomes are impacted by local conditions [54,55]. Case studies can be especially useful for researchers to understand complex phenomena in situations where multiple factors are potentially important and need to be considered [56].

3.1. Data Collection

The main data for our analysis constituted series of surveys carried out in 2019. These were done by national project partners in respective local MAPs on the basis of a common set of questions concerning the performance and functioning of the MAPs and aimed at harvesting lessons and best practices. The survey questions were tailored to the respective context of each MAP and used as part of an online survey or a structured interview. In some cases, follow-up interviews were also carried out. Respondents were active MAP members, in most cases, farmers, farmers' organizations, farm advisors, and government officials from local to regional level, while some also included representatives from waterworks, drinking water companies, and water catchment associations. This exercise was the basis for a qualitative (nonstatistical) analysis, identifying key patterns in an inductive fashion. A presentation of findings and a preliminary analysis of these data topics as synergies, trust, shared goals, and available resources (adapted framework from Warner and Verhallen [33]) can be found in Sundnes et al. [57]. Achievements gained are listed and further elaborated in the results. In total, there were 106 respondents across the cases, ranging from 5–29 per case.

An additional source of data was represented by "engagement plans" developed in all MAPs as part of the FAIRWAY project. These are important for understanding historical and contextual factors, description of relevant participants, and plans for the MAPs within the project timeframe. Particularly for the newly established MAPs, the plans provide important insights into the process of platform development. Project partners' interactions with MAP participants in meetings during the period from 2017/2018 to 2021 also generated important insights into the respective processes. For the more established engagement platforms with a longer history, we also drew on relevant documents and secondary literature pertaining to these particular MAPs.

3.2. Case Studies

Nine MAPs were set up to facilitate local and/or regional engagement processes to solve certain water quality challenges in the following countries: Denmark, England, Germany, the Netherlands, Northern Ireland, Norway, Portugal, and Slovenia (Table 1). The cases were selected to provide a range of experiences related to engagement processes in different contexts. Some of the MAPs were set up through the FAIRWAY project, while others have a longer history of engagement and were brought into the project according to their characteristics as engagement platforms. In all cases, a central coordinator was responsible for the running of the MAP. This coordinator also participated in the project's trainings, discussions, and evaluations of the engagement processes. The coauthors of this paper participated in respective MAPs as coordinators or participating researchers.

Although the engagement platforms vary according to the context and the kinds of actors they involve, they have clear commonalities. All the MAPs engaged with the local-/district-level government. Some also engage with regional and national authorities. In all the MAPs, farmers participated either as individuals or through farmers' associations, while, in some MAPs, agricultural advisors also participated. All MAPs engaged with relevant waterworks, drinking water companies, and/or water catchment associations/boards where applicable. All MAPs organized annual stakeholder meetings, while targeted activities, workshops, meetings, and field visits were facilitated according to the engagement plans of the respective platforms.

The MAPs also differed in several respects. The size of the case areas varied due to both institutional settings and water system characteristics, ranging from a few hundred km^2 to tens of thousands km^2. The nine areas covered different types of drinking water resources, pedoclimatic zones, types of farming, land use, legal frameworks, and governance approaches used. Hence, comparing these engagement processes offers a pan-European view on experiences with local governance arrangements for the protection of drinking water resources from agricultural pollution. Inspired by the framework developed by Sabatier et al. [35] for understanding a collaborative watershed initiative, Table 1 provides an overview of the cases, with details on pre-existing contextual factors and the history

of engagement for each case. While some cases addressed the quality of drinking water from surface water sources, others concerned groundwater. Some MAPs addressed issues pertaining to nitrates and/or phosphorus, while others dealt with pesticides or all of these issues. In some cases, there was a high level of conflict; in others, the tensions were less visible or absent. Some of the platforms had an official and formal mandate, while others were looser associations around more or less common challenges or problems. The characteristics of the respective MAPs and the development of the platforms are described in Section 4.

Table 1. Case area characteristics.

Country	Case Study Context	History of Engagement
Denmark, Aalborg municipality	Pressure: Drinking water comes from groundwaters, which are vulnerable to pollution from nitrate and pesticides. Measures are implemented by voluntary agreements with farmers since 1998 including compensation. Farmers are required to implement measures according to actions plans; expropriation can be used. Status: Drinking water quality is at risk.	A "groundwater board (Grundvandsradet)" including 20 members that represent agriculture, environment, nature, forest, groundwater, etc. has been maintained by the municipality since 2011. This water cooperation is responsible for negotiation of agreements with farmers.
England, Anglian region	Pressure: Pesticide and molluscicide use lead to contamination of surface water, along with a lack of water treatment options. Measures include a knowledge exchange campaign. In a vulnerable catchment, there is also a campaign on product substitution, including financial incentives. Status: Drinking water quality is at risk.	Since 2015, the Anglian Water (private water supply company) catchment adviser has adopted a catchment-based approach through knowledge transfer/exchange to farmers and the wider industry, as well as product substitution. Farmers rely on advisers and government campaigns, as "catchment-sensitive farming".
Germany, Lower Saxony federal state	Pressure: There is farm manure surplus in a region within the state. Drinking water is mainly sourced from groundwater wells. Measures include fertilization law, farm manure application techniques, discussions on inter-regional manure transport, and manure treatment. Status: Water quality is at risk in manure surplus regions.	Round table discussions initiated by municipalities on nutrient management and water protection have been organized in districts since 2017. Chairpersons are farmer representatives; participants are both agricultural and environmental representatives and local and regional authorities.
Netherlands, Overijssel province	Pressure: Dairy farming causes nitrate and pesticide leaching toward groundwaters. Drinking water is sourced from groundwater wells. Measures include reducing nitrate and pesticide by better nutrient management and targeted pesticide use. Status: Shallow groundwater nitrate standards are not met.	The province and the water company Vitens initiated the "Farmers for Drinking Water" project in 2011; as part of this, farmers have been invited to regional meetings to facilitate implementation of measures. The water company contributes with agricultural advice, agricultural accounting, regional rural development, etc.
Netherlands, Noord-Brabant	Pressure: Pesticides from agriculture and urban areas threaten the groundwater in several areas. Measures include the prevention of pesticides in rural and urban areas, and water purification measures. Status: Drinking water quality is at risk.	The province, water company, and the water boards initiated an engagement project in 2012. The agricultural organization contributes by facilitating communication to their members and links to agricultural education.
Northern Ireland, Derg catchment	Pressure: There is runoff from agriculture and forestry, with a focus on pesticide use and impact on drinking water quality. Drinking water is sourced from surface water. Measures include a water utility-led land incentive scheme to improve drinking water. Status: A final tranche of measures were implemented, and monitoring is continuing. Drinking water quality is at risk.	The national-level Water Catchment Partnership has involved the national government and NGOs with an interest in water management existed since 2013. A "Source to Tap" project in the Derg catchment was led by NI Water (Northern Irish water utilities) working with stakeholders to deliver a land incentive scheme to improve drinking water quality.

Table 1. *Cont.*

Country	Case Study Context	History of Engagement
Norway, Vansjø/Morsa catchment	Pressure: Nutrients from agriculture and sewage from dispersed settlement posed a high risk to surface water quality in early 2000. Lake Vansjø is a drinking water source. Measures include intensive monitoring, with a focus on all contributors, as well as tailored agreements with individual farmers for environmental practices. Status: Water quality has improved but is still at risk in certain areas.	There has been a long history of actor collaboration in the area since the 1970s. The Morsa project was established in 1999 to improve poor water quality, engaging local and national politicians. Forms of collaboration among inhabitants, farmers, and local, regional, and sectoral authorities have been ongoing, although collaboration has primarily been between authorities at different levels and municipalities.
Portugal, Baixo Mondego	Pressure: There is an excess of nutrients caused by fertilizers such as manure and wastewater sludge. Drinking water is sourced from groundwater. Measures include national legislation and policy. Status: Some drinking water sources exceed nitrate standards and other limits of pollutants coming from agriculture.	There has been previous engagement with individual farmers in projects. There has been no previous multi-actor engagement platform in the catchment involving authorities, water company, and farmers.
Slovenia, Dravsko Polje	Pressure: Agriculture impacts water quality. Drinking water is sourced from groundwater. Measures include a water protection zone, while water companies mix water from shallow and deep wells to reach an acceptable quality. Status: Abstracted water in the lower parts of a shallow aquifer is polluted with nitrate (>50 mg/L).	There has been previous engagement with individual farmers in projects. There has been no previous multi-actor engagement platform in the catchment involving authorities, water company, and farmers.

4. Results

Considering the case context and engagement history of the different MAPs (Table 1), we present the nine cases in three categories related to stages of MAP development: MAPs at an initial stage of establishment in areas with no previous multi-actor engagement, MAPs representing ongoing multi-actor engagements, and MAPs referring to engagement platforms established more than 10 years ago. Furthermore, for each of the nine MAPs, the following elements are presented with information about MAP establishment and development: (i) the aim of the MAP, (ii) participants' understanding of the problem and objectives, (iii) participants' perceptions of synergies or added value associated with engaging in the MAP, (iv) achievements, and (v) risks challenging long-term continuation of the MAP (Table 2).

Table 2. MAP characteristics and developments Country, case study.

	MAP Characteristics					MAP Development: Strategy, Achievements, Learning Points, and Risks Challenging Long Term Engagement
	MAP Establishment and Stakeholders	**Aim and MAP Mandate**	**Shared Understanding of the Problem**	**Synergies Associated with MAP**	**Economic Resources Available for MAP**	
Denmark, Aalborg municipality	MAP initiated in 2017 including the water works, the municipality, farmers, farmer advisory org., Agri-Nord, SEGES. Facilitation: The waterworks, municipality.	Aim: Improve collaboration and contribute to common understanding of the pressures and processes. Mandate: Project supported by the municipality and the waterworks.	No shared understanding of the need for additional groundwater protection between the farmers and the Water Collaboration Aalborg.	Low level of synergies associated with the MAP. Farmers received some economic compensation from implementing measures.	Economic resources available for compensating farmers when they implement measures.	Strategy: Separate meetings were conducted with farmers and other actors to understand perspectives and to find a common space for dialogue. Achievements: Common platform for communication enabled in 2021. Learning points: Agronomic advice being individual and free of charge for farmers; transparent approach; compensation should be indemnified and fair. Risk: Conflicts.
England, Anglian region	MAPs initiated in 2017 with Anglian Water (AW), ADAS, Environment agency, farmers, agronomists, agricultural industry. Facilitation: Univ. of Lincoln, AW, catchment advisor.	Aim: Develop bottom-up approaches to farmer engagement to meet their and the water company's needs. Mandate: MAP to be facilitated by the AW catchment adviser for continued engagement.	Initially different understanding of what is the problem of focus, the farmers focus on their problem with weeds, while the water company focus on water quality.	A focus on solutions affecting farmers, AW was able to develop a greater presence in the catchment. This created farm trials and projects of high synergy to both parties as they had been co-developed.	External funding was generated to develop MAP activities. In kind provided by AW, otherwise no resources. Continuation will be through AW catchment advisor.	Strategy: Focus on farmers' challenges. Field demonstrations; expertise in both farming and environmental protection. Achievements: Common knowledge-base, shared understanding, networks for continued engagement. Learning points: Understand farmers' issues for meaningful engagement; priorities of water companies may differ from farmers' – work to solve farmers' issues first to gain trust. Risk: Lack of funds for long-term continuation.
Germany, Lower Saxony	MAP initiated in 2017–including representatives of district authorities for water and agriculture and local advisory services. Facilitation: A farmer representative is the chairperson.	Aim: Discuss viable compromise how farm manure surplus in the northwest by transfer to the southeast could work. Mandate: Support by municipalities and the federal state, no mandate to formally agree on measures.	Shared understanding on the need to reduce diffuse nitrate pollution from agriculture. Not all actors agree on inter-regional manure transport to reduce environmental pressure in the northwest.	High synergy level as all actors are very interested in the topic.	No formal legitimization of the MAP - hence there is no continuous external funding.	Strategy: Trust-building factors, official and informal meetings. Achievements: Varying perception of the success -some see the MAP as an information source, but not solving the actual issues. Learning points: Transfer of knowledge is ranked as the most important trust-building factor; increased farmer participation give legitimacy to the MAPs being achievements; need to tailor to particularities in the different districts. Risks: Weak mandate and lack of funds.

Table 2. *Cont.*

	MAP Characteristics					MAP Development: Strategy, Achievements, Learning Points, and Risks Challenging Long Term Engagement
	MAP Establishment and Stakeholders	**Aim and MAP Mandate**	**Shared Understanding of the Problem**	**Synergies Associated with MAP**	**Economic Resources Available for MAP**	
Netherlands, Overijssel province	MAP initiated in 2011. Farmers, agricultural contractors, municipalities, water company. Facilitation: The province and the water company Vitens.	Aim: Platform to discuss current situation, agree on measures and evaluate the implementation of these measures. Mandate: Provided by province and water company.	Broad consensus on the need to improve groundwater quality (lower nitrate levels) by improving the efficiency of the use of nutrients through a mutual gain approach.	MAP represents a network of people; Farmers use MAP to also discuss other issues and potential solutions such as the drought-issue.	Funds for the MAP and associated activities are provided on a continuous basis by the province and the water company.	Strategy: Creating a network for knowledge exchange. Individual advise on farm management in combination with economic impact. Achievements: Exchange of knowledge; new insights by actors; a trust-building platform between farmers, the province and the water company; Learning points: voluntary approach and measures may not be enough to meet the water quality standards. Risk: Continuity dependent on budget provided by actors.
Netherlands, Noord-Brabant province	Ongoing MAP initiated in 2011 includes: water boards, water company, agricultural org., local and regional authorities, farmers. Facilitation: Water company and agricultural organization.	Aim: Reduce pesticide in surface and ground waters. Mandate: Provided by the water company, provincial authorities and water boards to discuss measures and solutions.	Common understanding on the need to reduce pesticide use, and/or use pesticides "responsibly" to improve drinking water quality.	Access to advice and demonstration of new measures; insights into the complexity of pesticide regulations.	Funds have been available by means of a joint collaboration between water boards and the water company; agricultural organization contributes with in-kind resources.	Strategy: Building trust over time, collaboration to find solutions, include a variety of relevant local actors. Achievements: Reduced pesticide use possible for certain crops; MAP serves as basis for sharing perspectives and decision-making. Learning points: visualization of environmental impact important; trust-building involves mutual understanding among actors. Risk: Continuity of MAP depends on available resources and voluntary engagement.
Northern Ireland, Derg catchment	MAP initiated in 2017 builds on the Source to Tap project team and the Water Catchment Partnership, AFBI, Irish water, Northern Irish Water, Ulster University, Rivers Trust, East border regions.	Aim: Protection of drinking water by addressing pesticide use; comply with regulations on pesticide use. Mandate: By national, regional, local authorities, associated with requirements of the WFD, the ND and DWD.	Shared understanding of need to protect drinking water by reducing pesticide use. Also emphasized need for awareness raising at the national level and at the local level - communicate impact on their drinking water.	Access to information on best practice on sustainable land management or nutrients management and the MAP contribute to community engagement/involvement and raise awareness.	Resources available through projects Source to Tap, SCAMP and through NIWater. Insufficient funds for measures, slow implementation.	Strategy: Build relationships between partners; monitoring and evaluation of a farmer incentive scheme. Achievements: Increased knowledge and awareness, understanding of farmer's perspectives, relationship between water company and landowners, reduced pesticide levels. Learning points: Patience needed to see results, building trust takes time, information need to be targeted. Risks: Possible lack of funding, changing national policies; change of staff to less dedicated staff.

Table 2. *Cont.*

	MAP Characteristics					MAP Development: Strategy, Achievements, Learning Points, and Risks Challenging Long Term Engagement
	MAP Establishment and Stakeholders	**Aim and MAP Mandate**	**Shared Understanding of the Problem**	**Synergies Associated with MAP**	**Economic Resources Available for MAP**	
Norway, Vansjø/Morsa	The MAP established in 1999, incl. municipalities, political representation, a secretariat, water company, working groups, representatives from NGOs incl. farmers. Facilitation: Secretariat.	Aim: Improve the water quality and environment of the catchment. Mandate: By catchment municipalities, national authorities. Associated with implementation of the WFD.	A common understanding and awareness of problems achieved in the MAP – associated with monitoring efforts over decades. Some differences in political priorities at different governance levels.	Knowledge exchange and possibility to influence discussions.	Financial resources available from municipalities, from national and regional authorities for organization. ASlso for measures since 1999.	Strategy: Involvement by means of four thematic working groups (sewage, agriculture, environmental monitoring and the coastal area). Achievements: Proven and efficient measures that show results. Learning points: Political representation, a secretariat and thematic groups are cited as key elements to achievements. Risk: Few risks challenging long term engagement.
Portugal, Baixo Mondego	MAP established in 2018 including national, basin and regional authorities, farmers' associations and farmers. Facilitation: Researchers familiar with actors in the region.	Aim: Platform for exchange of information between farmers and the public, for dissemination and transfer of knowledge. Mandate: Informal, by national, regional authorities, farmer association.	Shared understanding that aquifers have too much nitrate. Varying perspectives of purpose of MAP, some on practices for improved water quality, others on economic performance of agriculture.	Synergies in learning, but otherwise low levels –experienced as a concern for continued activity. Limited extent able to influence the priorities of the map.	Increased knowledge of farm management and current agricultural practices in the area.	Strategy: Contribute with increased knowledge-base, solving differences by means of open dialogue and informal meetings. Achievements: More interaction between actors; better understanding of other points of view - only partly regarding agriculture practices. Learning points: Changing practices takes time and depend on technology, funding, increased knowledge. Risk: Lack of funding and common goal a challenge for MAP continuation.
Slovenia, Dravsko Polje	MAP established in 2018 with ministries, drinking water company, agricultural comp., agri. advisors, municipalities, farmers. Facilitation: Project researchers and local agriculture advisory service.	Aim: Solve problems of farming in the water protection buffer zones. Mandate: Given by the presence of authorities, but no real mandate to implement changes.	The actors reflect different goals: farmers/agri. comp./advisers – proper financial support or new land; water companies – less emissions, trust with farmers; municipalities - clean drinking water; Ministries – measures agreed with farmers, trust.	Outside of the MAP - low level of synergy about MAP future. The MAP reported contributing to improved synergy. Synergies could be improved if ministries would recognize local MAP as partner in communicating local issues.	Increased knowledge of farm management and current agricultural practices, regarding measures and subsidies. The MAP could become part of agri. adviser public service paid by Ministry for agriculture.	Strategy: Meetings for knowledge exchange and to discuss focus and priority of MAP. Achievements: Better communication between stakeholders, address a common issue. Learning points: MAP discussions need to be considered by decision makers; formal meetings are taken more serious by actors. Risk: Politicized issues, poor cooperation between gov. agencies and ministries, insufficient emphasis on the need for solving the problem.

4.1. MAPs at an Initial Stage of Establishment

The MAPs in Portugal, Slovenia, and Denmark were established in the period between 2017 and 2018 in collaboration with local and regional actors, and water companies, facilitated by a research team. In Portugal and Slovenia, no previous platforms for engagement among farmers, water companies, and authorities existed, while, in the Danish case, a previous engagement platform with farmers and other actors had been ongoing since 1998. The MAPs in Portugal and Slovenia were established for exchange of information, to enable dialogue, and to better understand different perspectives of farmers and local authorities. The long-term objective of the MAPs is to help farmers change their agricultural practices for improved surface and groundwater quality. In both cases, MAP participants in general shared an understanding that runoff from agriculture to water resources is a problem that needs to improve for the benefit of groundwater and surface water quality. Some participants, however, indicated that there were different views on the problem situation and the objectives of the platform. This became apparent when discussing the need for changing farming practices. In both MAPs, improving the economic performance of agriculture was raised by some as a main objective, in addition to improved water quality. In the Portuguese MAP, this was addressed when discussing how to create conditions for developing the circular economy in the agricultural sector. Participants in this MAP further argued that changing practices is dependent on technology, funding, and increased knowledge.

In the Slovenian case, it was emphasized that "more initiative is needed from the government"; it was explained that, when funds are unavailable for new technology, farmers can only make a limited contribution to solve the issue. Regarding the strategy for establishment and development of the MAPs, both the Portuguese and the Slovenian MAPs highlight a strategy of open dialogue with many actors to identify agriculture–water-related topics that need to be discussed and solved in the coming years. Formal and informal meetings were organized to build trust and to improve interaction among actors. The MAP participants concluded that a rather limited number of actors in the platform, a maximum of 15 in the Slovenian case, was preferable. The Slovenian MAP participants emphasized that it was important to include all relevant stakeholders while still limiting the total number of participants to facilitate actual dialogue and a feeling of being heard. Synergies and added value of engaging expressed by the participants were increased learning and understanding of different perspectives, corresponding to the overall stated achievements of a better understanding of actors and communication between actors within the MAP. Regarding risks for long-term continuation of the engagement, participants in both these MAPs emphasized that the lack of funding and lack of common goals represent risks. It was also stated that acknowledgement and recognition by the government through formal meetings is important. In the Slovenian case, it was also mentioned that an important criterion for success is the extent to which their recommendations are considered by the decision-makers, and that politicized issues, change of government staff, and poor coordination among national-level authorities are risks for continuation.

The Denmark Aalborg MAP was established with the mandate from authorities to enable dialogue about groundwater protection in the Aalborg area. The strategy for establishing the MAP was, firstly, to gain a better understanding of the situation and the different actor perspectives by means of facilitating bilateral meetings and, secondly, to provide a forum for achieving a more mutual understanding of water quality pressures. The aim was to find common ground between the groundwater board and farmers on the need for additional groundwater protection. The Aalborg MAP was established after several years of farmer engagement as part of a governance system of voluntary agreements with compensation with farmers to reduce nutrient discharge from agriculture, organized by the municipality and the local waterworks. According to informants engaging in the MAP, however, the previous engagement process regarding the voluntary agreements was loaded with conflict. There was disagreement among actors on the process of how measures in agriculture were implemented to protect water quality, and farmers in the area felt discontent with the compensation levels in the voluntary agreements, as they saw

few or insufficient synergies for their benefit. This resulted in an initial distrust between actors, representing a barrier for establishing the MAP. While trust between actors was not achieved during the first years of engagement in the MAP, currently, after several bilateral meetings and workshops, partners are again interacting. Some key lessons were learned through interviews with actors in this case. Agricultural advisory services that are individual and free of charge were highlighted, as well as the need for a larger "toolbox" of measures to be implemented. Lastly, it was emphasized that land consolidation, sufficient farmer compensation, and information to farmers and other stakeholders are key for a successful engagement process.

4.2. MAPs Representing Ongoing Multi-Actor Engagements

Platforms for engagement among farmers, waterworks, and authorities already existed in the cases of England, Northern Ireland, and Germany as part of pre-existing government initiatives for improved water quality. In the cases of England and Northern Ireland, MAP meetings were organized and facilitated by researchers in collaboration with water companies and local/regional authorities. In Germany, the farmers representatives chaired the meetings with administrative help of the agricultural Chamber of Agriculture, a hybrid organization for farm advisory and discharging tasks of public administration.

The MAP in England was established by researchers supported by the Anglian Water (AW) catchment adviser and consultancy ADAS. It is associated with a knowledge transfer program initiated by AW and local authorities in 2017, including incentives to reduce the use of pesticides for slug control. Initially, actors did not share an understanding of the problem, and their needs and priorities did not match. Farmers focused on the blackgrass weed problem, while the water company and authorities focused on pesticides causing poor water quality. The MAP aimed to develop a farmer engagement process to improve pesticide management through a "bottom-up approach". Central to this strategy were interactive events that included field demonstrations for practical learning, discussions, and experiments. MAP participants stated that benefits of engaging were access to agronomic knowledge and practical advice on best practice from farming industry actors. Several new partnerships and collaborations, such as field demonstrations, trials, and a collaborative stewardship project were developed after the events, extending the network of the MAP. Continued engagement was facilitated by the catchment adviser. Achievements of the MAP are associated with trust-building, strengthening relationships, and communication, knowledge, exchange, and gained credibility by working with the farmers to address their issues for future long-term co-beneficial collaboration. Lack of external funds, possible reliance on individuals, and a time-demanding process were emphasized as risks for long-term continuation of the MAP.

The Northern Irish MAP was established in 2017, seeking to raise user awareness of the risks associated with pesticide contamination of surface water through educational events, as well as financial incentives encouraging the adoption of best practices. The MAP consists of scientists, local water utilities, and organizations with an interest in developing community-based solutions to surface water quality challenges and engages with the local farming community. The MAP participants are all aware of the problem of pesticide contamination, but views on the problem and potential solutions vary according to their individual experiences. One strategy to encourage engagement in the MAP and build trust between participants was sharing water quality monitoring data gathered in the catchment and linking this to information on pesticide persistence and mobility in the environment. Stakeholders observed that this allowed them to understand that "mitigation schemes do not fix the problem immediately" and that building trust within a multi-actor platform takes time. Other achievements noted by participants were that the MAP encouraged behavioral change reducing pesticide use, and that engagement improved between water companies and landowners. Uncertain financial funding for impact assessments, to assist farmers in adopting new measures and for dedicated facilitation of the MAP, is considered

a risk to its long-term continuation. Another challenge to getting the right stakeholders involved is the lack of legal compulsion for organizations to engage with the MAP.

The MAP in Germany involves "roundtable" discussions on nutrient management and water protection", being practiced in the area since 2017 by local and regional authorities, advisors, and farmers. The MAP has a mandate from federal state- and local-level authorities to address surplus organic manure in one region by improving inter-regional manure transport while also reducing nitrate pollution from agriculture within predefined conditions. Yet, the mandate was limited as the MAP was not able to influence the development of regulations targeting fertilization practices. The MAP participants in general had a mutual understanding of the problem as there was agreement on the overall aim of reducing diffuse pollution. However, disagreement occurred when discussing what could be done to enable inter-regional transport. The MAP strategy has been to organize mostly formal meetings with room for informal talks in breaks and after the meetings, sometimes followed up by bilateral meetings. The aim is to understand perspectives and build trust in combination with knowledge transfer to find viable compromises by identifying the potential and limits to the measure of transferring surplus farm manure from the northwest to the southeast. Added value and synergies from the engagement being expressed included getting information on manure processing and increased knowledge of regional nutrient management and on suitable measures. The main achievement was enabling a common understanding of the situation. The farmers' representatives expressed appreciation for the opportunity to raise agricultural issues in front of the authorities. The lack of a strong mandate and funding to implement measures was a barrier for further achievements. Risks for long-term continuation were the lack of clear legitimization of the MAP and, as a consequence, no funding to implement concrete measures.

4.3. MAPs with a Long History of Engagement

The multi-actor engagement in Norway, Netherlands Overijssel, and Netherlands Noord-Brabant (hereafter Netherlands O and Netherlands N-B) were established more than a decade ago. The first engagement platform preceding the current MAP in Norway was established in 1999 by eight municipalities in response to drinking water quality concerns. The engagement platform represented a continuation of different engagement processes by municipalities and regional authorities since 1977 [58,59]. The current MAP, established in 1999, includes a board of majors and other user interests, as well as a secretariat including an employed manager, and it is structured by thematic working groups. Funding for a general manager responsible for coordination of the MAP is based on a shared contribution by the municipalities, as well as some national support. Initially, during the early 2000s, there were relatively high conflict levels among actors about the causes for declining water quality in Lake Vansjø [58]. The initial strategy associated with the engagement platform at this time was to build trust among actors in the MAP by making available scientific and knowledge-based information about the situation in the lake. Furthermore, a high frequency of both formal and informal meetings with different actors within and outside of the platform, also involving the local media, was part of the strategy. National government attention to the problem was ensured, with subsequent funds for research projects and a monitoring program. The MAP primarily consists of local and some county and state regional authorities, with representation from stakeholders such as the farmer organization and the water company. Achievements in improved water quality conditions are closely related to political anchoring, an active secretariat, and effective policy mechanisms. The risk that the MAP will not continue in the long term is low, as the engagement platform is embedded in the Norwegian governance approach to WFD.

The MAPs in Netherlands O and N-B were both established in 2011 for improved drinking water quality, through initiatives by the water company and with contributions from the provinces and the agricultural organizations. The focus in Netherlands O is on nitrate and pesticide leaching toward groundwater in the recharge areas of vulnerable abstraction sites, while the Netherlands N-B case is specifically focused on reducing pesticide

use considering national and European regulations and laws. Actors in both MAPs express a broad consensus on the central problem: improving surface and groundwater quality by improving the efficiency of the use of nutrients and by reducing the impact of pesticides (Netherlands N-B) through a mutual gain approach. The strategy of the engagement in both MAPs represents a variety of different types of activities, including knowledge exchange and individual farm management advice on practical issues associated with, for example, catch crops and lower nitrogen levels in manure. MAP participants point to benefits of knowledge sharing, gaining relevant insights and a feeling of being heard, including an opportunity to also discuss other related issues, such as drought. Achievements mentioned include increased awareness of nutrients in farm and soil management and enhanced communication between farmers and the water company. Farmers in Netherlands O are increasingly using the project to discuss other related issues. Risks identified for long-term continuation of the MAPs were a lack of structural measures, such a clear mandate and anchoring in the governance structure, as well as a lack of financial incentives.

5. Discussion

Meaningful Engagement Strategies and Social Network Factors Promoting Long-Term Multi-Actor Engagement

In all the MAPs, it is evident that the participants through the engagement processes have reached some degree of mutual understanding of the problem. However, the emphasis on and priority in attending to water quality problems vary within and among the MAPs. The varied perception of pressure for change among informal and formal sectors in the cases has implications for the likelihood for continuous long-term engagement. National government and local actors' concern for water quality and pressure for change seem to be important conditions for establishing meaningful multi-actor engagement [44,60] when such concerns translate into a clear mandate of the MAP. In line with Fraser et al. [61], Reed [1], and Reed et al. [6], the case studies presented in this paper show that top-down anchoring links discussions in engagement platforms to national and regional policy developments. Such anchoring is important, as it is the government that has the authority to initiate collaborative planning between formal and informal sectors and to acknowledge collaborative planning results [46]. Furthermore, when the government initiates collaborative planning between actors, funds for organizing and coordinating the engagement platform may follow.

In Portugal and Slovenia, where the MAPs represented new platform initiatives for policy discussions among water works, authorities, and farmers, MAP participants emphasized in interviews and surveys a need for increased involvement by the national government for stronger formal support. While formal support and top-down anchoring is needed, the German MAP illustrates that only when top-down anchoring reflects a strong mandate can long-term meaningful engagement be expected. A perceived weak and limited mandate, as was the case for the German MAP, challenges meaningful engagement, since the possibility to impact decision making is often equally limited [59]. Initiatives to establish MAPs for communication and collaborative efforts represent only a first step for enabling negotiation and problem solving among governmental and nongovernmental stakeholders for improved water quality status. Indeed, in line with results by Vitálišová et al. [62], the MAP in Norway illustrates that, when there is a clear mandate supported by financial resources, in this case, provided by a formal governance structure and the water management cycle of the WFD, long-term engagement is facilitated. In this MAP, political anchoring and vertical coordination occur by means of representation from national governance levels in regional and local multi-actor platforms or networks important for communication and transfer of knowledge [41,46].

The level of concern was in some MAPs influenced by diverging understandings of the problem situation among actors and/or by other pressing issues, such as the blackgrass weed in the English case. To promote engagement in a situation where pressure for change varies among actors, the case studies show that there is a need to address local actors' concerns, e.g., weeds harming agricultural yields in the English MAP or economic performance

of agriculture being a prioritized objective in the MAPs in Portugal and Slovenia to enable synergies and added value of engagement. Furthermore, Kochskämper et al. [39] showed in their paper the importance of local participation, as this provides added outcomes of the engagement on learning and enhanced understanding.

In the Danish MAP, farmers' lack of concern for the pollution situation was not due to not wanting better water quality, but due to a disagreement regarding the understanding of the problem. The farmers disagreed with the water works and the authorities that it is the farmers' responsibility alone to address the problem. The strategy of the MAP to improve the engagement process was to increase the understanding of the different actors' perspectives and to improve trust and confidence among the participants. Improving confidence among actors about the situation can also be achieved by communicating monitoring results to actors, a strategy exemplified in the Northern Irish MAP and in the Norwegian MAP. An efficient monitoring program also provides information on other diffuse pollution sources [59]. In general, the increased acknowledgment of different perspectives on the water–agriculture complex was flagged as an important achievement of the MAP processes, being an important contribution toward creating an enabling context for collaboration and engagement. In accordance with Sabatier et al.'s view [35] that successful collaborative approaches require varied strategies for meaningful engagement, these cases illustrate the use of techniques such as identifying win–win solutions, acknowledging farmer's problems, and knowledge-based and collaborative learning. Prutzer et al. [63] argued that, to meet the multitude of obstacles to collaboration and trust, in processes with social learning ambitions, a supportive context is key. In accordance with this argument are the studies that show that active and visible platform coordinators and making use of a diversity of strategies are important for the development of trust and for supportive engagement approaches [1,46,64]. Yet, building confidence and trust in a conflict situation requires extensive efforts over time and approaches for enabling a mutual understanding of the problem situation.

The degree to which the MAPs have been able to establish relationships and networks with other institutions such as water companies, agricultural and environmental authorities, farmers, and civil society organizations seems to influence the possibility for long-term meaningful engagement. The MAP itself can be described as a network since participants may be institutions and/or organizations at different governance levels [46]. Typically, however, long-term MAPs as represented by the Norway Vansjø and Netherlands Overijssel and Noord-Brabant MAPs have been able to establish relations with other institutions and actors that provide access to policy information and economic resources. These networks were established over several years as part of developing trust among MAP participants, and between MAP coordinators and other external actors at higher governance levels, as well as end-users. In accordance with other authors, development of such networks with high cohesions requires skills, time, and resources [46,64,65]. In contrast, for the MAPs in the other case countries, most typically for the MAPs in Portugal and Slovenia that are rather recent establishments, time did not allow for the development of such network links. Regarding the MAPs representing ongoing multi-actor engagement, i.e., the cases in England, Northern Ireland, and Germany, some network connections were established. However, the challenge of enabling long-term funds for coordination of the MAPs was not solved. Across MAPs, participants identified uncertainty and a lack of funds for coordination of the MAP, as well as not being considered by policymakers as risks challenging long-term engagement. Hence, obstacles to engagement for the development of trust and collaboration can also be of an external organizational, financial, and administrative nature [66]. In line with Koontz and Newig [38] and Emerson et al. [67], an important criterion for long-term meaningful engagement is for collaborative efforts such as MAPs to reside within a broader governmental regime.

6. Conclusions

The paper discussed the conditions and factors promoting long-term engagement by drawing on experiences from nine MAPs across Europe. Participants in these MAPs highlighted synergies and added value from contributing, and they identified challenges for developing long-term engagement platforms. It can be expected that actors will not participate unless participation is experienced as being meaningful by the different types of stakeholders, defined by Pirk et al. [43] and others as the right to be heard and the possibility to contribute to setting objectives. We argue that a meaningful engagement platform is furthermore dependent on both top-down and bottom-up pressure for change for improved water quality. Pressure for change is, however, dependent upon a common understanding of the problem situation among actors. Bottom-up engagement needs to involve end-users to identify local concerns, while dialogue and sharing experiences contribute to trust and to increased understanding of different perspectives. It can be expected that, for engagement platforms to be meaningful, actors' concerns, such as farm management practices, drinking water quality, and legal and administrative requirements, need to be acknowledged and addressed. Furthermore, strategies for meaningful engagement need to involve top-down anchoring and a clear mandate that provides possibilities to have an impact on policy discussions.

While stakeholder participation has been established as a norm in governance frameworks and by global institutions, normative rules for participation processes, such as the need for engagement at different levels of governance, still remain to be included in European legislation. As the WFD is the only directive that refers to participation as essential for its successful implementation, this directive takes a special role among directives in regulating the involvement of end-users to identify tailored and relevant measures to meet water quality objectives. The current engagement status in Member States shows varied levels in terms of the function and impact of engagement with stakeholders. While the discretion perspective of the WFD is important for national adaptation, this perspective will not be violated by specifying the need for engagement processes that involve local end-users, as well as the need for financial, and administrative support from higher governance levels.

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water

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Article

Effectiveness of Voluntary Measures to Reduce Agricultural Impact on Groundwater as a Source for Drinking Water: Lessons Learned from Cases in the Dutch Provinces Overijssel and Noord-Brabant

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Abstract: Agricultural practices cause diffuse water pollution issues, which is a policy concern across the globe. This paper addresses the reduction in agricultural impact on groundwater as source for drinking water with a governance approach based on a mutual gains approach (MGA) using voluntary measures only. We performed case studies in Overijssel and in Noord-Brabant, both located in the Netherlands, to study the effectiveness of the governance approach on nutrients and pesticides, respectively. The effectiveness was studied by analyzing the engagement process qualitatively and by analyzing the impact of measures at farm scale as quantitative indicators. For nutrients, the effectiveness is expressed in the N-surplus at farm scale and the realization of groundwater quality objectives in groundwater protection areas (GWPA). For pesticides, the effectiveness is expressed in environmental impact points (EIP) at farm scale and the level of groundwater protection areas (GWPA). The results indicate that the engagement process based on voluntariness creates a platform for meaningful engagement, adds to the economics of the farm and reduces the agricultural impact on groundwater quality. However, the nitrate objectives of the Water Framework Directive (WFD) are not met at the level of GWPAs in Overijssel. Due to the voluntariness of the approach, the participation rate relies on the farmers' expectation of the costs and benefits of the process, and diminishing economic returns prevent the further improvement of efficient nutrient use. Although an enforceable objective and strict deadline for pesticides is missing, the objective has been met at the level of GWPAs using voluntary measures only in Noord-Brabant. An important driver for this effectiveness is the fact that these results can be obtained without incurring economic losses, which may tie into the high participation rate of farmers.

Keywords: non-point source pollution; nutrient management; pesticide management; groundwater quality; water governance; voluntary measures

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1. Introduction

1.1. Agricultural Impact on Groundwater Quality

Diffuse water pollution from agriculture and its governance is a policy concern across the globe. Groundwater is an important resource for drinking water and the functioning of ecosystems. Groundwater provides two-thirds of the drinking and industrial water required in the Netherlands. The two provinces included in this study, Overijssel and Noord-Brabant (referred to as Brabant hereafter), are entirely dependent on groundwater as a resource for drinking water. Groundwater bodies are dynamic systems with water coming into infiltration areas and leaving the system in seepage areas or by abstraction.

Groundwater flows very slow, which causes residence times of groundwater in the subsoil, ranging anywhere between decades and thousands of years. Therefore, it may take that same amount of time before adverse effects of human activities on groundwater quality are noticeable. In line with that, remedial measures may take equally long to be effective. As a result of the very long recovery times and the sometimes large spatial scales of the impact of human activities, groundwater is considered to be extremely vulnerable to human influences [1]. Land use in the Netherlands is intensive. Furthermore, due to the high population density, different types of land use occur in relatively close proximity to each other. As a result, groundwater conflicts between the various land uses frequently occur. For example, the productivity of Dutch agriculture has strongly increased since World War II [2,3]. Simultaneously, the use of nutrients and pesticides increased. Especially in the vulnerable sandy areas in the eastern Pleistocene part of the Netherlands [4], emissions of nutrients and pesticides into the abstractions of groundwater for public water supply have caused serious concerns [5].

1.2. Groundwater Governance as a Complex Environmental Problem

The impact of agricultural activities on groundwater quality has been visible since the 1990s, and the stepwise reduction in nutrient and pesticide application has been implemented to reduce this impact [6,7]. The first stage of this reduction was initiated by the national authorities and was dominated by technical experts who evaluate quantitatively, within the context of an accepted scientific paradigm [8]. The extent of this reduction reflected the power balance behind governance at a national level [9].

Since 2000, the Water Framework Directive (WFD) has provided the overall framework and time-bound objectives for groundwater quality [10]. During this period, Dutch environmental policymaking has increasingly moved from national to regional and local authorities. This decentralization also shifted power to the local and regional level, where authorities moved to a new spatial management system that is based on water basins [11]. At the same time, environmental policy has become embedded in the social and economic processes of parties other than governmental organizations, such as businesses, non-governmental organizations and citizens [12]. In addition, there is a growing consensus within the policy community itself that expert-driven approaches do not suffice when dealing with problems related to environmental risks [13,14]. As a consequence, many regional processes in the Netherlands are now organized as bottom-up processes, in which the stakeholders negotiate with each other in a network structure, instead of top-down processes with the government as the dominant party [15–17]. In such bottom-up processes, it is important that the stakeholders are provided with the knowledge and information they need to actively take part in the process. Complex environmental problems are a particular challenge because they are 'quasi-scientific'. This means that more than scientific knowledge alone needs to be considered during problem-solving processes [18]. Groundwater protection is an important example of a complex environmental problem where policies impact peoples' practice, work and economic situation, as is the case for farmers in agricultural areas. Current research indicates that a broader and more inclusive risk analysis approach is needed. A key part of this broader approach is the inclusion of members of affected communities in order to combine expert science with local knowledge, beliefs and values during problem-solving processes. This helps to avoid inefficient policies, protests and conflict [18–21].

The development of the Drinking Water Protection Files (DWPF) has helped combining risk analysis and expert science with local knowledge and societal values as an instrument in the governance of Drinking Water Protection Areas (DWPA) in the Netherlands [5]. The compilation of the DWPF is a process-oriented approach in which a risk analysis is carried out for each individual drinking water abstraction with local and regional stakeholders, in order to meet the WFD objectives [10]. As a result, various drinking water abstractions proved to be vulnerable to agricultural risks [22–26]. Ideally, by involving a broad set of stakeholders, the DWPF approach enlarges the knowledge base of the

processes, increasing both the legitimacy of the outcomes and the experienced ownership influence over them [27].

1.3. Groundwater Quality Governance by Voluntary Measures

Although legal frameworks such as the monitoring and control and enforcement of regulations are seen as fundamental components of groundwater governance [28], DWPAs are conventionally managed through one or more of the following policy instruments in the Netherlands [29,30]. First, they may involve command and control regulation, such as nationally dictated limits for applied nitrogen per hectare. Second, they may concern voluntary adoption of the best management practices, resulting in improvements in environmental and farm management. Third, they may involve market-based incentives, such as fertilizer taxes, 'cap-and-trade' schemes for nutrients or permission for agro-chemical use in a given area. Finally, they may use payments for ecosystem service (PES) compensation for production and income foregone [31,32]. None of these policies are likely to be sufficient and cost effective if used in isolation, from a policy perspective [32] or from a groundwater quality perspective [33,34]. In addition, the current political and socio-economic context in the Netherlands is unfavorable towards additional tightening of regulations and restrictions to the agricultural sector. For example, the Dutch parliament decided that WFD implementation should not lead to additional costs for the agricultural sector [35]. This implies that the WFD objectives must be met using voluntary measures only.

Voluntary adoption of the best management practices encouraged by farm advisory systems can help detect opportunities to protect the environment, whilst also saving on farm production and labor costs [32]. Examples include soil testing, precise application of fertilizers and effective manure management. High rates of adoption may be difficult to achieve without a complementary 'stick' provided by (a threat of) regulation. In addition, if actual change is hampered by farm income or availability of capital for investment, a complementary 'carrot' provided through subsidies and other forms of financial support may be necessary [32].

The Dutch regional governments have initiated participatory projects to engage with agricultural stakeholders in achieving environmental goals. In this study we analyze engagement processes of two Dutch projects: Farmers for Drinking Water Overijssel in the province of Overijssel and Clean Water for Brabant in Brabant. These were set up in 2011 and 2001, respectively, to help reduce the input of agricultural pollutants in the groundwater system in order to protect drinking water abstractions (The cases presented in this paper are part of the EU FAIRWAY (Farm systems that produce good water quality for drinking water supplies) project (727984) as multi-actor platforms. The overall objective of the FAIRWAY project is to review current approaches and measures for the protection of drinking water resources against pollution caused by pesticides and nitrate from agriculture [36]). In these projects, farmers are supported by agricultural advisors through a "mutual gains approach"; the projects focus on a more efficient use of nutrients and a reduction in pesticide impact on groundwater. This, in turn, reduces leaching to the groundwater and results in economic benefits for the farmer. In the projects, knowledge and experience is additionally exchanged between farmers and professionals during group meetings with the aim of creating self-improving agricultural management regarding the use of nutrients and pesticides. The main question addressed in this paper is how effective of voluntary measures are in reducing agricultural impact on groundwater as source for drinking water. We reflect on this question qualitatively by analyzing the engagement processes, quantitatively by looking into measures at a farm level and through the realization of groundwater quality objectives in GWPAs.

2. Case Studies and Methods

2.1. Description of the Cases

2.1.1. Overijssel

From 2011 onwards a consortium has carried out the project. Royal HaskoningDHV (RHDHV) is responsible for the overall management, groundwater quality and WFD issues. Wageningen University and Research (WUR) is responsible for agricultural advice, prototyping farm management. Countus is responsible for agricultural accountancy. Stimuland is responsible for communication. The province is the regional authority regarding the protection of groundwater as source for drinking water. The drinking water company is responsible for the production of clean and reliable drinking water.

The project in Overijssel started in the recharge areas of 5 vulnerable drinking water abstractions in the province (Archemerberg, Herikerberg, Wierden, Hoge Hexel and Espelose Broek) and consists of 7 areas today. They are Archemerberg, Holten, Herikerberg, Wierden, Hoge Hexel, Manderveen and Espelose Broek. Farmers who owned parcels in recharge areas of the initial 5 vulnerable abstractions were invited to participate in the project. The platform in which farmers, agricultural advisors and accountants, communication and groundwater quality experts, authorities and water companies discuss and work together is referred to as a multi-actor platform (MAP)

Other farmers (neighbors, et cetera) as well as agricultural contractors, municipalities and the regional press were invited to facilitate the implementation of measures which are believed to be relevant for both the farmer and the groundwater quality, but less relevant for the groundwater quality in the vulnerable GWPA. Since 2017, the pilot Farmers for Drinking Water has been part of a larger regional project (Fertile Cycle Overijssel—Vruchtbare Kringloop Overijssel—VKO). In this project, additional financing stakeholders are involved: water authorities (water authority Drents Overijsselse Delta, water authority Vechtstromen and water authority Rijn and IJssel), farmers lobby organization LTO, cattle feed companies (Agrifirm and ForFarmers) and financial institutions such as the most common agricultural bank (Rabobank). These regional stakeholders of VKO are not particularly active in the pilot Overijssel. They can, however assist in implementing the measures, knowledge and experiences from the pilot Overijssel in the bigger regional project because all relevant stakeholders and the project structure are available. Currently, 26 dairy farmers participate in the project.

The soil is mostly sandy with groundwater tables typically at 2–4 m-sl, indicating that changes in nitrate concentration of water leaching from the root zone might be detectable in 2–4 years in the shallow phreatic groundwater, considering an infiltration rate of approximately 1 m per year [4]. Land use consists of agricultural land use (mainly dairy farming with 80% grass and 20% maize), nature and some urban areas. The measures to be implemented are focused on reduction in the nitrate and pesticide leaching towards groundwater in the recharge areas of vulnerable abstraction sites in Overijssel, while improving the operational result of the farm through better nutrient management and more specific use of pesticides.

Typical nitrate concentrations in the upper phreatic groundwater at the start of the pilot were, on average, 92–161 mgNO_3/L in maize and 64–86 mgNO_3/L in grassland. All groundwater abstractions show hardness of the water has increased due to manure application in the past. In individual abstraction wells, the nitrate standard is exceeded in Herikerberg/Goor, Wierden and Archemerberg [5]. Nickel concentration in Hoge Hexel exceeds the standard of 15 µg/L due to pyrite oxidation from nitrate-containing groundwater [5].

In addition to the province and water company having an interest in groundwater meeting the WFD objectives, MAP participants have mentioned various reasons to join the MAP. Farmers have mentioned that they have been invited to participate or that they prefer to look for common ways to solve the issue rather than being confronted with new and additional rules and regulations. Groundwater quality experts mention the input of knowledge and the fact that Farmers for Drinking Water is a measure/project following the

assessment of the risks of the individual drinking water abstraction sites in Overijssel. The agricultural advisors and accountants mention their position as a connecting link between farmers and policy.

2.1.2. Brabant

Clean Water for Brabant has been initiated and funded by the province of Brabant, the water company Brabant Water and the water authorities (water authority Brabantse Delta, water authority Aa en Maas, water authority De Dommel and water authority Rivierenland) since 2001. The province is the regional authority regarding the protection of groundwater as source for drinking water. The water authorities are the regional authorities for the surface water quality. The drinking water company is responsible for the production of clean and reliable drinking water. The agricultural organization (ZLTO) contributes to the project in-kind by facilitating communication between their members and offering links to agricultural education.

From 2001 onwards a consortium carried out the project. Within this consortium, Research and Advice (CLM) is responsible for the overall management and communication, Delphy gives agricultural advice and EcoConsult provides advice to greenkeepers and gardeners. This consortium selected and invited farmers and contractors if they had parcels of land in recharge areas of 1 of 11 vulnerable groundwater abstractions. From 2012 onwards, growers (of potatoes, strawberries, leek, green beans, ornamentals) and contractors from the whole of Brabant were invited to participate in the project. This was driven by the desire of the water boards to broaden the focus towards both ground and surface water and by the desire of ZLTO to make 'mutual gain' measures more widely available to growers.

Clean Water for Brabant currently consists of 11 GWPAs and 750 growers on more than 60,000 ha in the south of the Netherlands, in the province of Brabant. This province has an area of 4919 km^2 and it is populated by 2.48 million inhabitants. The northern border follows the Meuse (Maas) river westward to its mouth in the Hollands Diep strait, part of the Rhine–Meuse–Scheldt delta. Drinking water is abstracted from groundwater at 39 locations in the province, with an annual production of 180 million m^3. In addition, Brabant is part of the catchment area of the river Meuse. The surface water of the Meuse is a source for drinking water for 3 million people in the western part of the Netherlands. The abstraction sites for drinking water in Brabant vary in depth and vulnerability. The shallow and most vulnerable sites are surrounded by GWPAs. The case study Brabant focuses on is pesticide reduction in current and future drinking water resources, considering the national and European regulations and laws. The monitoring program carried out by Brabant Water and the provincial authorities shows that the use of pesticides is a threat to the groundwater in 11 of the 39 abstraction areas. The strategy to produce high-quality tap water revolves around prevention but, if necessary, also includes water purification. In Brabant, pesticide concentrations in ground and surface water are measured every four years at a large scale [34], confirming the concern that pesticides may leach out of the root zone and eventually reach phreatic and deeper groundwater.

A MAP was put in place to facilitate communication between farmers, the province and water company. Among other things, this contributed to shared goals and insight in dilemmas and provided a platform to exchange ideas and concerns.

2.2. Data Collection

The data collection has been organized along two tracks. These tracks are (i) the engagement process in which qualitative information is collected about the functioning of the MAP and (ii) quantitative data on agricultural management from the Annual Nutrient Cycle Assessment (ANCA) for nitrogen [3,37,38] and the Environmental Yardstick for pesticides [26,39,40]. In addition, the nitrate concentration is measured in the upper phreatic groundwater in the GWPAs in Overijssel to provide the farmers with feedback concerning the impact of agricultural management and measures to change this impact [41].

2.2.1. Engagement Process

Meaningful engagement and a well-functioning MAP is important when the governance approach consists of voluntary measures only. A key element for the engagement process is that agricultural advisors approach the farmers, their farms and their agricultural management with a genuine interest, looking for a mutual gain rather than individual benefit [42].

Since the start of the projects in 2011 (in Overijssel) and 2001 (in Brabant), the authors have participated in farm visits and discussed the primary results of previous farm visits prior to the growing season to discuss management strategies and plan actions. Furthermore, a visit was organized at the end of the growing season to evaluate the experiences and results. Moreover, two meetings were annually organized for clusters of 6–10 participants to discuss technical issues. In the Overijssel case, these issues concerned farm nutrient management, grazing management, and optimizing the timing of fertilization and the distribution of parcels. In the Brabant case, these issues concerned crop protection management, the use of alternative pesticides and optimizing the application of pesticides and the precise use of pesticides. In addition, alternatives to pesticides, such as mechanical weeding, and management of point-source emission was part of the planned actions. An overview of these activities is listed in Table 1. These activities have been documented in activity logs as part of the FAIRWAY project.

Table 1. Overview of yearly engagement activities and meetings in the case studies of Overijssel and Brabant. The participation rate is in brackets.

	Farmers for Drinking Water Overijssel Since 2011	**Stakeholders**	**Clean Water for Brabant Since 2001**	**Stakeholders**
Individual farm management advice	2	Farmer and agricultural advisor	1	Farmer and agricultural advisor
Small group meeting	2–4 (6 out of 10 farmers)	Farmers and agricultural advisor/expert	1 (10–15 farmers)	Province, water company, water authority, farmers
Field demonstration	2–4	Province, water company, agricultural lobby organization, agricultural advisors, groundwater quality experts, farmers and regional stakeholders outside the GWPAs	3	Farmers, experts, province, water company, water boards
Crop groups (e.g., arable, tree nursery, asparagus)			1–2 indoor; 1–2 in the field (50% of the farmers, group size 10–15 of groups ranging from 15 to 150 farmers)	Farmers and agricultural advisor/expert
Annual meeting	1 (20 out of 26)	Province, water company, agricultural lobby organization, agricultural advisors, groundwater quality experts, farmers	1 (250–375 out of 750)	Province, water company, water authority, agricultural lobby organization, agricultural advisors, farmers

In addition, a survey was carried out in 2019 with a focus on multi-actor engagement and dimensions that are considered relevant for assessing strengths, weaknesses and opportunities for change with regards to engagement platforms. This survey was also part of the FAIRWAY project [43]. Attempts were made to enroll all relevant actors in the two

cases to the surveys. For Overijssel, this survey was answered by 10 respondents, among them farmers [4], agricultural advisers [5] and the agricultural lobby organization [1]. The province of Overijssel and the water company Vitens, the main stakeholders, did not respond. For Brabant, this survey was answered by 10 respondents, among them the main stakeholders: farmers, the water company, the water board, agricultural advisors and the province. In addition, feedback from the farmers about the project and vice versa was collected during annual evaluation meetings and through questionnaires.

2.2.2. Farm Scale Measures and Targets

Agricultural management is supported quantitatively by a farm management plan based on the ANCA and Environmental Yardstick which the farmer and advisor agree to. This plan contains an overview of possible measures in combination with an indication of whether the measure is relevant, already implemented, to be implemented next growing season or a possible option in a future year. The key element of this farm management plan was the quantitative analysis of the N-surplus by the ANCA (Overijssel) and the EIP (Brabant) by the Environmental Yardstick. The N-surplus and EIP serve as quantitative indicators for agricultural management.

An important aspect of agricultural management is setting targets directly related to the agricultural management of the farmer. For nutrients, the targets are set at 80–100 kgN/ha/year. For pesticides, the targets were set at 500 environmental impact points (EIP) for groundwater per year. The nutrient targets were derived directly from the ANCA, and the pesticide targets were derived directly from the Environmental Yardstick. The relation between the targets for farm management and the nitrate concentrations in shallow phreatic groundwater were based on empirical relations [44].

2.2.3. Groundwater Quality

A stratified monitoring design was used to enable the extrapolation of the measured nitrate concentrations from the entire agricultural area with respect to the occurring strata. The strata consist of soil type (#5), groundwater table (#3) and land use (#2), totaling 30 unique combinations [45]. The sampling procedure follows the procedure used for the Minerals Policy Monitoring Programme (LMM or 'Landelijk Meetnet effecten Mestbeleid') to monitor the impact of manure policy [46,47]. The density of sample locations was approx. 170 sample points per 201 hectares of agricultural area. The upper meter of the groundwater, occurring within three meters of the surface, was sampled. Water, sampled with a well screen and using a suction pump, was directly filtered using a 0.45 pm filter, then acidified and stored at 4 °C prior to chemical analysis [46,48]. If the phreatic groundwater level was deeper than 3 m-ss, a soil moisture sample was taken from a depth of 1.5–3.0 m-ss, in line with parameters proposed by De Goffau [48] and Fraters [49].

Groundwater quality for pesticides in Brabant is monitored by the National Groundwater Quality Monitoring Program (LMG) according to the method of van Duijvenboden [50]. Groundwater quality was measured in 350 sample points, 56 of which were in Brabant, taken at depths of 10, 15 and 25 m minus the soil surface. Additionally, Brabant had 66 sampling points for the Provincial Groundwater Quality Monitoring Program (PMG, or 'Provinciale Meetprogramma's Grondwaterkwaliteit'), which follows the same methodology as the LMG [34]. The yearly impact of pesticide use on groundwater in Brabant is also monitored using the Environmental Yardstick. All farmers register their pesticide use, and the environmental impact on groundwater is calculated using the EIP of each pesticide as function of the organic matter content of the soil. The pesticide impact is calculated per crop and for the total project [26].

2.3. Economic Analysis

An analysis of the economic impact of the measures was caried out to illustrate the benefit farmers may have from implementing measures as part of the MGA. The analysis was carried out quantitatively by an economic valuation of the ANCA indica-

tors for the Overijssel case. The economic valuation used in the pilot project is widely accepted in Dutch dairy farming. Here, the determination of the value of fodder is based on the fodder valuation method of Wageningen Livestock Research. Every four weeks, Wageningen Livestock Research calculates the actual prices of fodder in dairy farming (https://www.wur.nl/nl/Expertises-Dienstverlening/Onderzoeksinstituten/livestock-research/Producten/Voederwaardeprijzen-Rundvee.htm, accessed on 27 December 2020). For the Brabant case, the economic impact of measures was carried out by qualitatively evaluating costs savings and subsidies.

2.4. Case Studies

The cases in Overijssel and Brabant are independent. Both cases are a response to a socio-economic issue regarding agricultural impact on groundwater as a source for drinking water, and they were not designed to be a comparative study. However, in the Overijssel case, a kind of benchmark was provided by using comparative agricultural data from existing databases. In the Brabant case, this benchmark was not at hand because databases with actual pesticide use were not available or accessible. It is argued in literature that one cannot generalize from a case study, but according to Flyvbjerg [51], this statement is not true; case studies can serve as an example and can be valuable for scientific development. A case may be so important or interesting that it deserves study in its own right [52]. Thus, the intention of this research is not to draw general conclusions based on a case study, but rather to understand the case and its engagement process in its complexity and context. The insights provided contribute to effective cooperation between stakeholders and the successful implementation of strategies from the farm to the regional level that mitigate nitrate and pesticide pollution of vulnerable drinking water resources

3. Results

3.1. Overijssel Case

3.1.1. Engagement Process

At the start of Farmers for Drinking Water there was already a high level of awareness of the need to reduce the nitrate concentrations in the groundwater of the recharge areas concerned. The need to meet the nitrate objectives was clear for the participating farmers from the start, and some of them explicitly mentioned the focus of the project on economic aspects as important reason for participating. Farmer awareness and the information collected in Farmers for Drinking Water, such as the nitrate concentrations of the shallow phreatic groundwater and N-surpluses of participating farms, have increased the understanding that farming in general contributes to groundwater pollution but also increased insight into their own role. Farmers are aware of the changes that agricultural farm management can make to reduce groundwater pollution. Often, the measures are not completely new to them: "I (the farmer) read and hear about measures implemented by colleagues but only after discussing these measures in the context of my farm with my advisor I feel confident enough to implement these measures myself". As result of the discussions with the farmers about the increase in their awareness, the scope of their management broadened: "I (the farmer) was used to focus on feeding cows, but now I'm also focused on feeding the soil with a focus on the groundwater quality".

Communication in regional and national press regarding the concern about groundwater quality as resource for drinking water is a sensible topic for the farmers, especially with press releases from the water company: "We (the farmers) trust the representative of the water company in Farmers for Drinking Water and know that that representatives support our effort, but press releases from the water company about their concern regarding the groundwater quality without mentioning Farmers for Drinking water feel as a stab in the back". During annual evaluation meetings, farmers are very positive about their experiences of Farmers for Drinking Water and indicate that advisors provide them with relevant and trusted advice. A vast majority of over 80% of the farmers indicate that working with their advisor increased the priority they give to nutrient management

and—indirectly—groundwater pollution. Holding-specific, one-to-one advice based on genuine interest in the farmer and his farm management is most effective for building trust and confidence: "Together with the advisor, I (the farmer) selected a measure (i.e., application of manure to the maize in a row) which required a heavy vehicle. When it was time to apply the manure and sow the maize the soil was too wet. The advisor came to see and decided to cancel the measure". In addition, group interaction with other farmers at group events (peer group interaction) is important for developing farmers' confidence and skills, exchanging knowledge and experiences and establishing Farmers for Drinking Water as a good farming 'norm'. This way of trust building is also recognized by the farmers, as one of said: "In the MAP, you are talking with farmers rather than talking farmers". Furthermore, these peer group interactions have been used to invite well-selected experts to discuss a topic relevant for the group or suggested by the group.

The rule-of-thumb calculation of the economics of implemented measures strongly contributed to this attitude. although farmers also mention that "they haven't seen one single euro in the hand yet" referring to the fact that the province and water company do not pay for their effort, and the result of the measures becomes part of the nutrient efficiency at the farm level and is not settled financially measure by measure. At the same time, farmers also mention the future of the farm as reason to participate and improve their management to further reduce the impact on the groundwater: "in this catchment agriculture and drinking water are the main land use functions. When co-existence is not possible, I'm afraid that agriculture will have to move".

In annual meetings, we also asked the farmers how they would evaluate the project. Overall, farmers are very positive about their experiences of Farmers for Drinking Water, with the vast majority of over 80% agreeing (i) the project encouraged them to reduce water pollution, (ii) the advice received was relevant to their farm, (iii) they received enough information to enable them to introduce new ideas or changes on their farm and iv) they are satisfied with the help received. In addition, some of the front runners mentioned that the tool box of the advisors was getting empty over a period of 3–5 years, which was a reason for them to ask for subsidies or payment schemes to implement additional effective measures without any economic gain for the farmer or for extending the legal space for agricultural experiments.

Following a national agreement on an approach to reduce nitrate leaching in specific vulnerable GWPAs, also including the GWPAs of Farmers for Drinking Water Overijssel [53], the dynamics of the engagement process changed. Although the objectives and approach of the project did not change due to this agreement, the agreement did introduce a deadline for meeting the nitrate objective: the nitrate objective has to be met at the scale of the GWPA by 2025 at the latest (i.e., at the end of the 7th Nitrate Action Program). This deadline puts pressure on the engagement process. The concern of individual farmers of the Farmers for Drinking Water project about 'what will be next if we are not able to meet the groundwater quality standards' increased as result of this agreement, and they were openly questioning their participation more often than before.

3.1.2. Farm Scale Measures

Farm management changed significantly over time after the implementation of measures to reduce the N-surplus and nitrate leaching. The implementation process evidently covered a wide range of farm management. Measures relating to both cattle and feed on the one hand and soil and crop management on the other have the highest uptake rates. Those methods that relate to farm infrastructure, such as enlarging manure storage capacity and land use change, generally have the lowest. The mean implementation fraction increased from 0.4 to 0.6 during the total runtime of the project. The reduction in the crude protein content in the ration as compared to the energy content in ration was implemented the most frequently, followed by restricted grazing intensity and rotational grazing strategy. As a soil and crop management measure, the early harvest of maize directly followed by sowing catch crop and catch crops with high N-uptake capacity had a high implementation

fraction, whereas the supply of manure in the rows where maize seeds are placed was only implemented on some farms. Most of the implementation of advice occurs within one year, but in some cases it can take an extended period of time. As a result of the one-on-one advice and shared interpretation of the ANCA, farmers gained a better understanding of how specific measures reduce water pollution, and they were much more likely to implement that measure [54].

Because the implementation of the measures is voluntary, this implementation depends on specific conditions of the farm (soil and groundwater situation, farm infrastructure, spreading of parcels, preferences of the farmer, et cetera). When measures were evaluated as 'probably not suitable' prior to implementation, this was associated with one or more of the following factors in most cases. First, there is the complexity of the measure. Second, there may be a misfit between the measure and the conditions on the farm, for instance, big machinery that must be operated on parcels that are too small. The final factor relates to uncertainties concerning the effectiveness of the measure [54].

3.1.3. N-Surplus

The N-surpluses were reduced in a period of 3–5 years (Figure 1). The average N-surplus of the participating farms shows a significant decline from 154 kg N per ha per year (kg N per hectare per year (2020). This decrease of almost 12 kg N per year until 2017 and—except for 2018—the constant level after, is a significant decrease considering that there were no additional general measures or policies implemented during this period. The fluctuations between years illustrate the dependence of the N-surplus on climatic conditions, especially drought, which strongly impacts plant growth and the uptake of nutrients. This is most explicitly shown by the drought of 2018. As result of this drought, which was severe in the high sandy areas in the Netherlands and even more severe in the recharge areas in these high sandy areas, plant growth was retarded, resulting in an increased N-surplus.

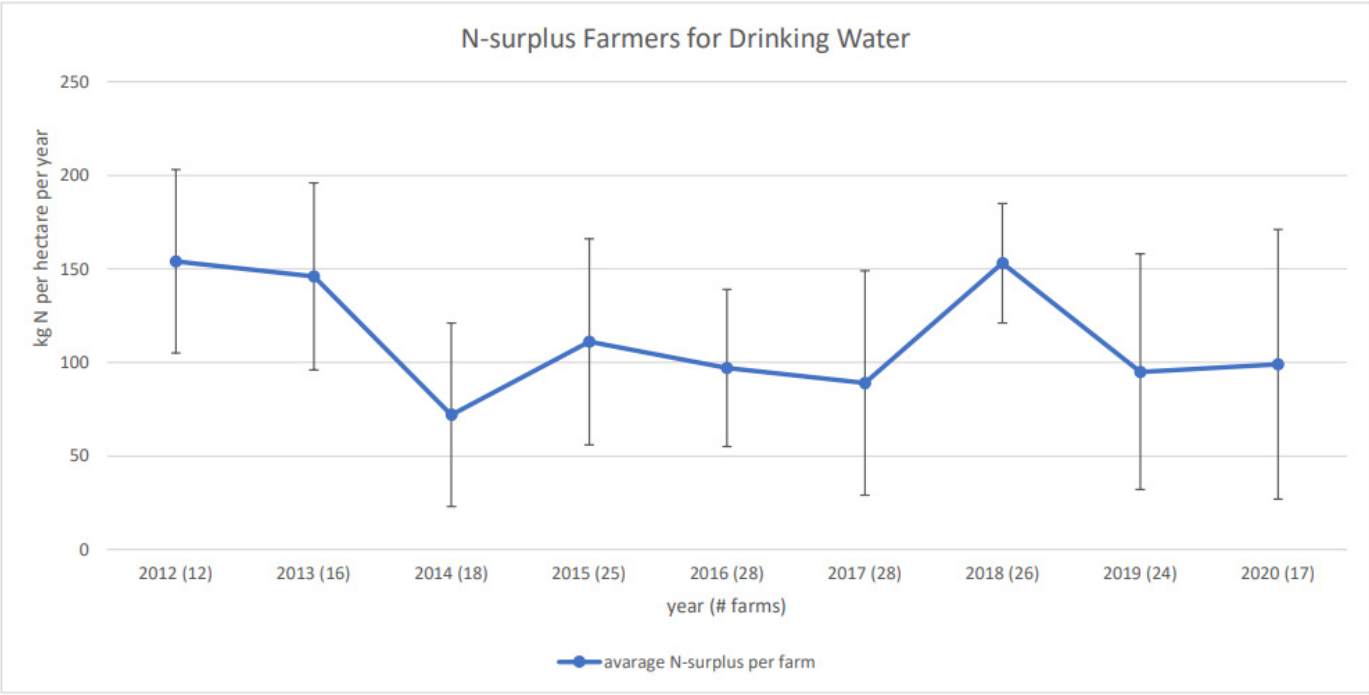


Figure 1. Dynamics of the N-surplus on the whole farm soil balance, average for all pilot farms per year.

The impact of implementing measures on reducing the N-surpluses is high during the first 3–5 years. After that period, the N-surpluses stabilize, indicating that the measures which are effective in reducing the N-surplus and have a business economic-gain (BE-gain)

are implemented. An additional improvement is possible in the craftsmanship of executing the measures, but the implementation of new measures is hampered by a lack of BE-gain; additional measures cannot be motivated from economic perspective.

However, although the structure of improving agricultural management is evident in a theoretical sense (analysis of the ANCA to identify the most significant N-losses; selection of measures; analysis of ANCA to evaluate measures—and identify the newest most significant N-losses) farmers did not become autonomous in continuous improvement of farm management during the scope of the project. This is in part due to the fact that analysis of the ANCA requires more expert knowledge than most farmers have. A more economic reason might be that nutrients are cheap, indicating that nutrient efficiency is important from the groundwater quality perspective but not a necessity from BE perspective. Cost savings associated with lower fertilizer inputs are not considered by the farmers to prevent the risk of yield reduction, so continuous attention and challenging points of view from an advisor are required to maintain nutrient awareness.

3.1.4. Economic Impact of Measures

In the first years of the project, the implementation of measures had an economic gain of tens to hundreds of euros per hectare [54]. Self-improving agricultural management economically supported by more efficient use of nutrients seems feasible; farmers see the (economic) impact of measures improving nutrient efficiency and are increasingly eager to implement and carry out various measures. For newly introduced and implemented measures, the business economic gain could be calculated per individual measure per farm. The average BE-gain per farm is EUR 4200, for soil and crop management measures (with a range of approx. EUR 2100–6800) and EUR 2600, for cattle and feed management measures (with a range of approx. EUR 0–9600). This BE-gain, alongside lecturing and discussing this valuation method during (peer) group sessions, strongly increased commitment to improve cattle and nutrient management.

After implementing the measures in farm management and improving this management in one or several years after discussing this with the advisor, it was more difficult to relate the BE-gain to a specific measure. Therefore, the calculation of the BE-gain changed to the economics of 'nutrient efficiency at farm scale' [54]. With parameters from the ANCA, nutrient efficiency is expressed as the fodder production with own production means: the more efficient the nutrient management, the more fodder is produced with own production means (Table 2).

Table 2. Fodder profitability of dairy farmers from Farmers for Drinking Water compared to benchmark farmers.

	Farm Efficiency in Fodder Production	
	Farmers for Drinking Water 2016/2018 (#26)	**Reference Dairy Farms 2016/2018 (#500)**
(€ per hectare)	3.835	4.132
Reference fodder production (€ per hectare)	3.878	4.132
Deviation (€/hectare)	−43	0

Table 2 shows that the nutrient efficiency over the period 2016–2018 is slightly less than 500 reference dairy farms in the region, while the N-surpluses of the participating farmers are significantly reduced. The main reason for this discrepancy is the drought of 2018. As previously mentioned, this drought retarded plant growth in that year.

The calculation of the BE-gain also revealed diminishing economic returns of the efforts of the farmers to further reduce agricultural impact; agricultural management has improved in such a way that additional measures cannot be motivated from an economic perspective alone. However, some improvement is possible in the craftsmanship with

which the measures are executed. Voluntariness hampers the implementation of measures needed to further reduce the impact of agricultural activities which cannot be economically motivated. In discussions, farmers indicate that the measures implemented—given the sense of urgency they feel related to the 'license to produce'—may not be enough for optimal groundwater-friendly agricultural management. To move towards even more groundwater-friendly management, they expect the government to either provide payment schemes or legal space for more experimental measures benefitting both farmer and groundwater. An example of this would be to add more compost to the soil.

3.1.5. Groundwater Quality

The nitrate concentrations decreased in maize land but remained more or less constant in grass land areas [54]. The average nitrate concentration in agricultural areas, however, remained more or less constant within the agricultural area or showed only a small decrease. During the first 3–5 years, farmers and advisors were convinced the measures implemented would make a difference in the quality of the upper phreatic groundwater in their recharge area, because the ANCA showed decreasing N-surpluses in the first 3–5 years (Figure 1), and the travel time from soil surface towards the upper phreatic groundwater is approximately 3 years. During and after this period, however, no trend or decrease could be detected in the nitrate concentrations in the groundwater [54], which gave rise to concern. Although farmers consider the project to be successful in reducing the N-surpluses, they are also concerned about future developments and the tenability of voluntariness. Especially when measures show a diminishing economic return on their efforts. In other words, agricultural management has improved in such a way that additional measures cannot be motivated from an economic perspective alone.

3.2. Brabant Case

3.2.1. Engagement Process

From the year 2000 onwards the drinking water company in Brabant became increasingly concerned about the pesticides found in the groundwater used for drinking water. The national regulation (based on the EU regulations) to protect the groundwater did not prevent the leaching of pesticides. Subsequently, in 2001 the drinking water company started a project—together with the province of Brabant—to stimulate the users of pesticides to reduce use and emission of pesticides in two of the most vulnerable GWPAs.

Accustomed to cooperating with other stakeholders, they adapted to the new challenge. Some of them had already switched to organic farming in the years before. In the other areas, Budel, farmers were initially suspicious, especially since the regional government warned the farmers that a ban on certain crops with high pesticide use might be implemented.

In the GWPAs, farmers receive free one-to-one advice from an independent farm advisor. The advisor helps them to implement sustainable crop protection, to understand the impact of their current use and the possibilities to reduce their emissions. Additionally, farmers have access to group meetings, field visits and demonstrations of new techniques with their advisor. Farmers consider this very useful. As one farmer explained: "It always teaches you something new. In the past we would see each other at auctions, but that doesn't happen anymore. The number of study groups has also decreased". For farmers outside GWPAs in Brabant, no one-to-one advice is available, but all participating farmers do have access to all group meetings.

The farmers set their suspicions aside after reassurance from the regional government that a ban would be reconsidered if they joined the Clean Water project. In the period between 2001 and 2009, the number of vulnerable GWPAs joining the project increased from 2 to 11. All landowners in the GWPAs were contacted with a request to join the project. This resulted in more than 85% of the area covered. A potato farmer explains why he joined: "Of course we have a wish to produce sustainably; my 400-year-old farm should

still be in action 400 years from now. I'm also very interested in technical solutions, like my self-built biofilter".

There are annual meetings between the MAP members in varying compositions. The water authorities join group meetings to discuss measurements from the previous year. The water authorities will join meetings when there are new groundwater studies available to discuss successes and future challenges. Guiljo van Nuland from Brabant Water indicated in one of these meetings that "We still find pesticides in the water. Often a heritage of the past, but also pesticides which are still used. We are optimistic about what we can achieve by working together in this project (Clean Water for Brabant)". The meetings allow farmers to ask questions and discuss any constraints, such as the lack of alternatives to specific pesticides. The government agencies can then help solve the constraints, for example, by funding research and field experiments of alternative measures.

To stimulate the movement towards reducing emissions, the Clean Water project has an innovation budget of EUR 25,000 per year. Farmers with innovative ideas to reduce pesticide emissions in water can apply for the budget to co-finance investments. This can be an existing technical solution, such as a new low-drift sprayer or mechanical weeder, a self-developed solution, such as a weed burner. Alternatively, it can be a research budget to set up a trial plot with an advisor. The results or techniques are shared with the other project participants through a newsletter, mailings and group demonstrations. This way, the innovations are presented to farmers in Brabant.

3.2.2. Farm Scale Measures

The farm scale measures for the Clean Water approach can be categorized into four groups: (i) choice of pesticides, (ii) reduction in emissions, (iii) non-chemical alternatives and (iv) decision support tool. The choice of pesticides is facilitated by the Environmental Yardstick. This instrument is used to create environmental impact sheets, which summarize crop-specific information on the pesticides admitted, recommended doses and corresponding environmental impact. A green–yellow–red color system is used as a visual aid to distinguish pesticides with high and low environmental impact. The sheets are distributed and discussed with the farmers during group meetings before the growing season. The reduction in emissions is realized by the reduction in spray drift. There are several techniques available to reduce these routes, such as nozzle choice, low-drift sprayers and lower boom height. To avoid pesticide use altogether, several mechanical alternatives are available. Some techniques are readily available, such as mechanical hoeing, but a group of growers are also developing new techniques for their own specific needs. Autonomous systems are currently being investigated, as most mechanical weeding systems are time consuming. Finally, a decision support tool is used to choose the best moment of application and/or the weather conditions for optimal performance. One crop group has their own weather station to better predict their local conditions and pesticide needs.

The most important measures were bundled in the leaflet "Win-win measurements for clean water" [55]. The leaflet, which was distributed to farmers and is available online, gives an indication of the pros and cons, as well as costs and benefits, of the measures. New measures are constantly being researched and developed, either by farmers or the advisors. When a new constraint arises or a technique is deemed interesting, a farmer or a group of farmers will work on solutions. This often happens with aid through the innovation budget or directly with a government agency. It is then used for demonstration purposes. A good example of this is a group of nurserymen who were interested in mechanical weeding systems. As there were none available at the time, they started developing their own systems. Their solutions are demonstrated at meetings regularly.

An important feature in the Clean Water project is the collection of pesticide use data from all farmers within the protection areas and 30% of farmers from the rest of Brabant. These data allow farmers to receive specific feedback about their progress compared to their peers. The information is discussed in one-on-one advice sessions, where the advisor helps find alternatives to the higher scoring pesticides. Additionally, group data is discussed in

group meetings. Farmers receive their personal score and will have a group discussion on constraints and solutions. The independent advisor present can ask specific farmers why they chose alternative measures and how they worked. This direct feedback from peers is very useful in opening farmers up to new ideas.

3.2.3. Environmental Impact Points

The environmental impact points for groundwater in the GWPAs decreased from an average of 1601 EIP/ha in 2001 to 370 EIP/ha in 2020 for all crops combined (Figure 2). This is a reduction of more than 75% [56]. The most significant decrease occurred in the first four years, after which the EIP remained relatively stable and low (<500 EIP). This is a good result, considering the large increase in participating farmers, crop area and the number of crops with high disease and pest pressure. The number of participating farms increased from 23 to 170 in the GWPAs, with an increase in surface of 160 ha in 2001 to about 4000 in 2019 (85% of the total area).

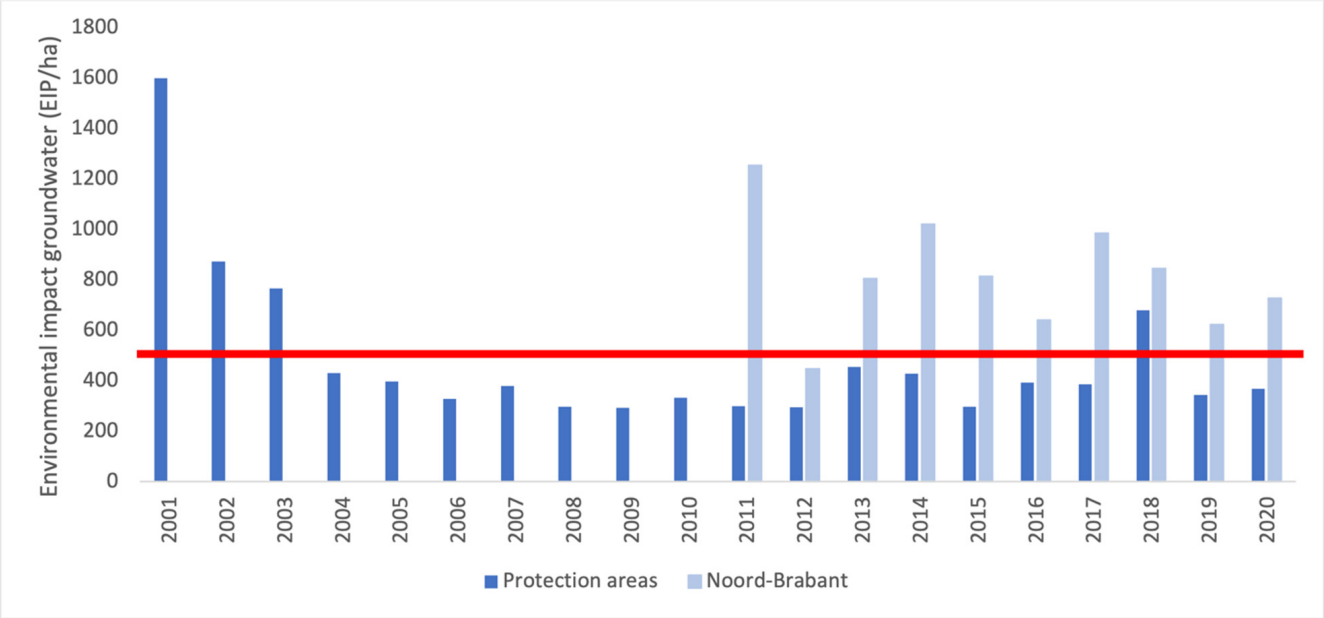


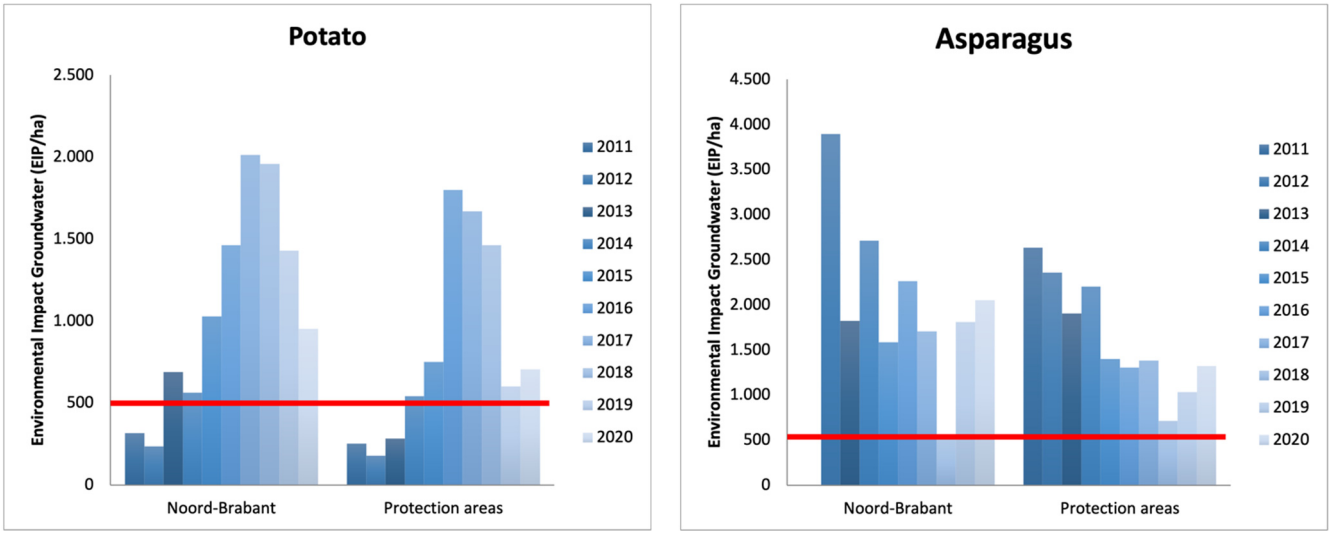
Figure 2. Environmental impact points (EIP/ha) within GWPAs and in the rest of Brabant between 2001 and 2020 for all crops. The red line indicates the target value of 500 EIP/ha.

For the farmers outside of the GWPAs, the reduction in EIP was about 50% from 2011 to 2019. This is still significant, as these farmers do not have access to individual meetings with an advisor, and their main goal is the reduction in surface water EIP, not groundwater EIP. For the whole of Brabant, farmer numbers increased from 70 to 370 and the participating area increased from an estimated 20,000 ha in 2011 to an estimated 60,000 ha in 2019.

An important note is that the reduction on a regional level depends on the crops grown. Some crops, such as grass and maize, can be grown.

For other crops, such as potato and asparagus, the reduction is difficult and is very dependent on climatic conditions. Disease and pest pressure are also high in these crops. In addition, the availability of "green" pesticides is limited, making it a challenge to reduce environmental impact to the groundwater. While improvements have been achieved over the years (Figure 3), changes in the scientific review of the leaching potential of three main pesticides have made advising the farmers in a consistent way difficult. Initially, these three pesticides were avoided by farmers due to the supposed leaching risk. Eventually, this led to a decrease in environmental impact. After a review of the leaching risk, the trend in environmental impact in potato farming has partly reversed between 2011 and

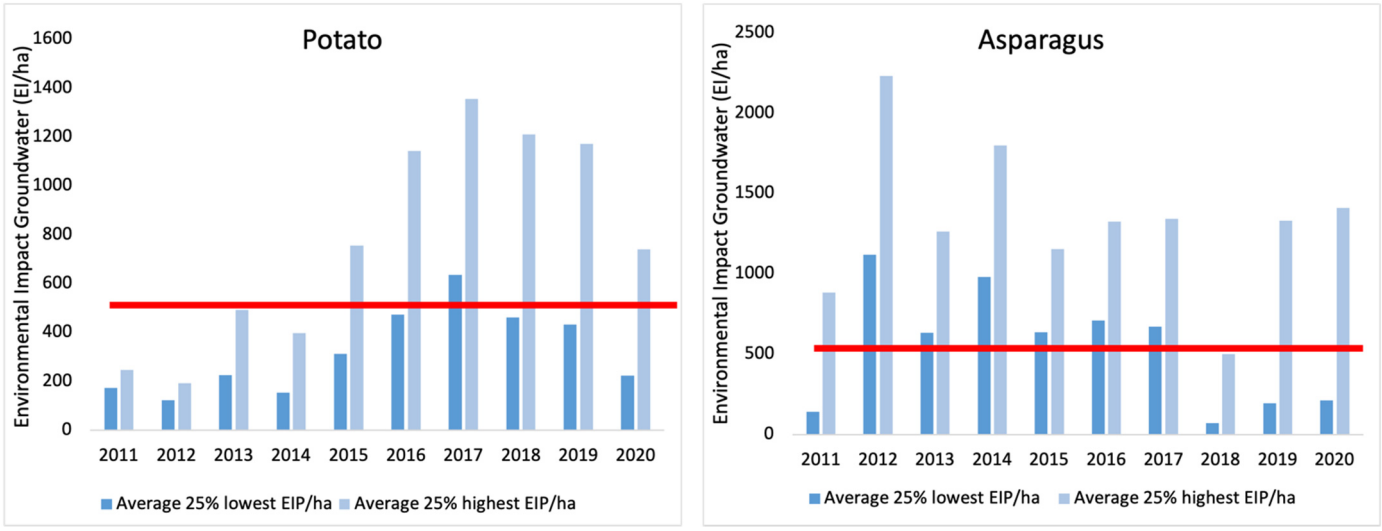
2019. Still, for all crops, the environmental impact to groundwater is lower in the GWPAs compared to the rest of Brabant.



(**a**) (**b**)

Figure 3. Environmental impact points (EIP/ha) within GWPAs and in the rest of Brabant between 2011 and 2020 for (**a**) potato and (**b**) asparagus. The red line indicates the target value of 500 EIP/ha.

While it is relatively difficult for potato or asparagus growers to reduce their environmental impact to below the target value of 500 EIP/ha as a group, there are signs that it is not impossible to reach the target. When analyzed individually, the 25% of growers with the lowest environmental impact show that they can collectively stay below the 500 EIP/ha (Figure 4). Most of the growers in the <500 EIP/ha group are from the GWPAs, showing that the voluntary measures can work with regular advice, even for the most challenging of crops.



(**a**) (**b**)

Figure 4. Environmental impact points (EIP/ha) for the 25% highest scoring farmers and 25% lowest scoring farmers for (**a**) potato and (**b**) asparagus. Figures include farmers in and out of the protection areas. The red line indicates the target value of 500 EIP/ha.

An important difference between GWPAs and the rest of Brabant is the possibility of receiving individual advice from independent advisors. Farmers growing crops such as

asparagus and potato receive free annual visits from an expert. For other crops, a decision is based on the results of the previous year. The growers with the highest impact also receive an individual visit. During these visits the crop protection bottlenecks of the previous year are discussed, as well as solutions for the coming season. Individual advice increases the trust farmers have in measures proposed (such as choosing a less impactful pesticide or delaying the moment of application), although it is expensive compared to group advice.

A second distinction is that farmers in GWPAs do not have access to the same pesticides as farmers outside the protection areas. A number of pesticides with high leaching potential are banned in Dutch GWPAs, resulting in a smaller package of active substances. This makes full control of all pests, weeds and/or diseases in these areas a challenge. Research on limitations and solutions for crop protection in the areas is currently ongoing.

3.2.4. Economic Impact of Measures

While the cost of some new measures can be high, the objective of the project is to reduce costs in the long term. Often, the costs of investment are reduced over time by savings in pesticides, while yields stay the same. An example of this is an emission reducing technique, such as the Wingssprayer or air support. These techniques require a lower dose of pesticides, with reductions up to 30%. They also allow the farmer to spray under more varying weather conditions and give better coverage than conventional spraying methods. This way, the farmers often have lower labor and pesticide costs while maintaining crop quality. Other examples include reducing pesticide use by decision support tools and mechanical weeding systems.

Some measures have no economic benefits. Examples of this include techniques to reduce spot emissions from washing and filling spray equipment, such as biofilters and phytobacs. These measures have no direct economic benefit for the farmer, while there are costs to setting them up. In these situations, subsidies have been used as an incentive. There have also been campaigns where the water in the farm well was analyzed to raise awareness. While this is effective with some farmers, not all are willing to spend money without some form of compensation.

4. Discussion

4.1. Engagement Process

Within the Overijssel and Brabant projects there is broad consensus that the engagement process enlarges the knowledge base of the processes and increases the legitimacy of the outcomes and the experienced ownership influence over them. The process also fits in the paradigm shift described by [11] by providing more power to local and regional authorities, moving to a new management level at a regional scale. The mutual gains approach, together with a genuine focus on improving the efficient use of nutrients and pesticides—and therefore improving the economics of the farm—helped to build trust and reduced the impact of agricultural pollutions. This is valuable for understanding the other viewpoints, creating a shared understanding of the issue to be solved and forming a common foundation from which to solve issues. Farmers value not only this platform, but also the equality of stakeholders in this platform. They feel free to discuss issues with the authorities (province) and water company from an equal standing.

However, as the time-bound objectives of the WFD remain out of reach, all stakeholders realize what has been mentioned by Wiering and colleagues [57]: that advancing scientific knowledge alone cannot resolve the problems of controversy and delay in advancing policies to address diffuse agricultural sources. The MAP analysis carried out as part of the FAIRWAY project [43] and the annual meetings of Farmers for Drinking water showed that the arena of issues and conflicts between drinking water sources and agriculture is complex and results in pressure on the trust when groundwater standards remain out of reach despite common effort and achievements, as is the situation in the Overijssel case. In addition, the front runners of the farmers experience the limitations of the approach when

they realize that additional effort in improving the nutrient efficiency will not result in a proportional improvement of the economic result.

Overall, the farmers consider the engagement meaningful and the project successful, even realizing that the groundwater quality objectives are still out of reach. However, despite the awareness of the farmers and shared notion on the objectives of the project, they keep asking for financial incentives as compensation for their efforts. In addition, as the groundwater objectives remain out of sight and the deadline of 2025 is approaching, the effort of the farmers and the groundwater objectives are becoming two separate entities: "We (the farmers) are putting a lot more effort in our management to meet your groundwater quality objectives. What is in it for us?".

For pesticides the situation is different. Due to the possibility of shifting to less harmful products or mechanical solutions, the groundwater quality objectives (<500 EIP) can be met at the scale of GWPA. However, the skills and commitment of the farmers to meet these objectives require continuous effort in engaging and supporting farmers to maintain their focus on groundwater quality.

The effort to keep pesticide emissions below the threshold takes place in a competitive arena with companies that provide free advice in exchange for being the preferred pesticide seller. Although they are generally good advisors, including measures to avoid point source emissions, their primary focus is to protect the crop and yield, more so than the groundwater. These companies often have long-term relations with the farmers and regularly check on the progress regarding pest and weed control. Additionally, new pests and diseases develop, fueling the need for continuous research and advice. Without regular and personal advice from an independent advising party with a focus on groundwater-friendly techniques or use of pesticides, farmers are not updated on new low-environmental-impact pesticides or techniques and gradually lose their focus.

4.2. Effectiveness of Farm Scale Measures

The effectiveness of the project Farmers for Drinking Water (Overijssel) expressed as reduction in nutrient losses is significant (approx. 40%). More specifically, 154 kgN/ha minus 89 kgN/ha over the period between 2012 and 2017—and—except for 2018—more or less stable thereafter. This reduction is far greater than the 4.3% nutrient loss, as reported by a comparable initiative in the UK—Catchment Sensitive Farming (CSF) [58]. The reduction in the N-surpluses was not reflected in an improved groundwater quality. In that respect, the choice of a nitrate-monitoring network at the GWPA level, rather than the at farm level, increased the problem of indirect feedback of agricultural management by groundwater quality data. Contrary to CSF, the reduction in the N-surpluses flattens after 3–5 years, while CSF reports a clear relationship between the amount of time CSF has been targeted in a specific area and the resulting pollutant reduction, due to one-on-one advice and capital grants [58].

Despite the fact that Farmers for Drinking Water is unable to use capital grants, the effectiveness is at least similar to the CSF. This might be due to the focus on the BE-gain by implementing nutrient efficient measures combined with lecturing the economics of these measures in (peer) group meetings. On the other hand, the implementation of new measures and intrinsic improvement by analysis of the ANCA by individual farmers was hampered when implementation could not be motivated economically. The interest of 'clean groundwater', as such, is not economically strong enough and requires continuous investment—at least as advice. Advice can also be promoted effectively in a practical farm setting where farmers learn from each other's experiences and visualize benefits in a tangible way [59]. Such peer group interactions allow confidence and skills to be developed and help establish groundwater-friendly farming as a good farming 'norm'. A mix of one-to-one and group events, as practiced by Farmers for Drinking Water, can therefore be seen as optimal for effective delivery.

The effectiveness of the Clean Water project (Brabant), expressed as reduction in EIP, is significant. The main features have been a 75% reduction since 2001 and meeting the ob-

jective of <500 EIP in GWPAs since 2004. As the project entails over 85% of the agricultural land in the GWPAs, the reduction is likely to have an effect on future groundwater quality. An important basis for this effectiveness is the fact that these results can be obtained without BE-loss for individual farmers, and they boast a high participation rate at the GWPA level. This participation enables the leveling of the impact of crops that have a high need for pesticides (e.g., potatoes and asparagus) with crops that have a low need, such as grass and maize. However, a visible trend shows farmers moving from low-impact crops, such as maize and grass, towards high-impact crops, such as potato, asparagus or sugar beet. This trend puts pressure on groundwater quality in the long term. Furthermore, new diseases put pressure on the balanced use of pesticides and techniques because it takes some time to find the new balance in applying the right amount of pesticide at the right moment in combination with mechanical measures (e.g., drift reduction and mechanical weeding).

The results of the Clean Water project are under pressure by free advice from pesticide-selling companies, climate change and changes in cropping system. Free advice given by companies linked to pesticide dealers is often given with the best interest of the farmer in mind, but it is more conservative than advice given by independent advisors, especially when the advice is financed by a project with emission reduction as its goal. Farmers have long-term relationships with their advisor and receive regular communications about the latest information on pests and diseases found in their area (with related pesticide advice). However, this information generally does not include advice regarding reducing or delaying pesticide use, or alternative pesticides with a lower impact on the groundwater. Advice is given purely to keep the crops clean of pests, diseases and herbs.

Climate change increases the appearances of new pests and diseases. With pests becoming more specific, new pesticides need to be developed for these new issues. However, these pesticides are not always low impact, as admission criteria do not always block high-impact pesticides. Additionally, extreme weather conditions such as heavy rain or drought cause stress in the crops, which in turn increases their sensitivity to pests and diseases.

Change in cropping systems may affect the use of pesticides. Crops such as potato and asparagus give good return on investment and as such, are important to the financial stability of the farmers. However, as high-impact crops, they are a risk to groundwater quality. The total area of these crops in Brabant has slowly increased over the years. For instance, potato crops grew from 15,000 to 22,500 ha between 2005 and 2019, and asparagus crops grew from 850 to 1300 ha between 2005 and 2019 [60].

4.3. Effectiveness of the Voluntary-Based Governance Approach

Although it is difficult to relate governance approaches to water quality improvements, Wuijts et al. [61] provided a framework to assess the effectiveness of water quality governance from the ecological, legal and social-economic perspectives. From their study, it appeared that potentially conflicting characteristics are (i) the difficulty of setting objectives (involving many unknowns) and adequate measures from the ecological perspective, (ii) the limited adaptive capacity of the legal framework once set in place and (iii) the focus on decision-making processes rather than water quality improvement from the social-economic perspective. In the case of nitrate and pesticides, objectives are set by the WFD. However, the limited adaptive capacity of the governance and legal framework and the balanced trade-off with other interests, such as maintaining the level playing field for agriculture, particularly hamper realization of the groundwater quality objectives.

The adaptive capacity of the legal and governance framework are limiting factors for long-term sustainability of the engagement process. Continuous investments in groundwater-friendly approaches and measures by all partners in the water chain are necessary to form a counterbalance within this arena. The forementioned initiative CSF does have capital grants, and they concluded that 'Cost is the most significant barrier to implementation of measures, but capital grants (initially available through CSF and now through Countryside Stewardship) are a strong enabler and driver of action' [62].

The economic analysis revealed diminishing economic returns on the effort of farmers, and it was concluded that additional measures could not be motivated from an economic perspective alone. However, even though farmers are asking for capital grants in almost every meeting, the current framework will not change in that direction in the near future. This was illustrated during a national webinar about the future of agriculture organized by the ministry of Agriculture, Nature and Food Quality on 13 October 2020, which was attended by over 400 policy makers, experts, agricultural advisors, agricultural lobby organizations, water companies, water boards, provinces and farmers. When asked 'how to improve (ground)water quality', 29% voted for the need for more (ground)water quality data, 37% voted for the need for more knowledge about effective measures and only 11% voted for the need for financial arrangements or payment schemes. Note that these percentages are estimates because not all participants answered all questions.

The result of the balanced trade-off of WFD objectives with interests such as agricultural interests is illustrated by the Dutch parliament, which decided that WFD implementation should not lead to additional costs for the agricultural sector [36]. This implies that the WFD objectives must be met using voluntary measures only. Consequently, WFD objectives may not be reached, as the voluntary approach is organized as a collaborative process with no clear end point rather than a mandatory process in which additional rules, regulations and enforcement guarantee these objectives are met. The downside is that there is no political support for any payment scheme or subsidies if concentrations still do not meet the standards, either for planning instruments such as rezoning, or for land retirement. This observation is in line with the increasing evidence that the WFD has difficulties with directly intervening in agricultural policies, especially when source-based measures are involved. These obviously interfere more with the 'business model' of farmers, and effect-based measures provide more flexibility and options for differentiation [58]. On the other hand, Wuijts et al. [61] state that governance approaches such as voluntary-based measures, with the involvement of multiple actors at multiple levels, are often more effective in dealing with complex water issues than conventional legal frameworks with centrally organized top-down mechanisms [62–64]. In this context, governance is defined as a process of interaction between public and/or private actors, ultimately aiming to realize collective goals [65]. The engagement processes of both Overijssel and Brabant reflect the effectiveness of voluntary-based measures in terms of the involvement of multiple actors at multiple levels and improvement of agricultural management, but the constraining factors—especially the lack of source-based measures—inhibit the realization of the WFD objectives in the Overijssel case, while they are met in the Brabant case.

The concern of individual farmers of the Farmers for Drinking Water project about 'what will be next if we are not able to meet the groundwater quality standards' increased during the scope of the project, especially when they realized that protection of the drinking water abstraction is not just an objective of the regional authority or drinking water company, but that meeting these standards in the entire recharge area had also been confirmed by a national agreement on nitrate leaching in specific vulnerable GWPAs [53], with the agricultural lobby organization as a co-subscriber. This concern is realistic, given the fact that farmers participating in the project do not meet the nitrate objective, and that the current participation rate is still only 53% of the agricultural area in the GWPAs as of 2021. The engagement process, as a well-functioning platform of collaboration, may serve as a vehicle for the required transition of agriculture within the vulnerable GWPAs, in which additional measures will have to be selected. The objective of this transition will be 'economically feasible agriculture meeting environmental standards even in very vulnerable GWPAs'.

The situation for the Clean Water for Brabant project is different from the situation of Farmers for Drinking Water Overijssel for two reasons. First, the EIP objective is not a formal standard following from an EU directive or national agreement and does not have a strict deadline. Second, Clean Water for Brabant shows that the drinking water limit of <500 EIP (or 0.5 μg/ha for all pesticides) can be met at the level of the GWPAs without BE

losses for the farmers. The fact that an enforceable objective connected with a deadline is missing, contributes to a more equal power balance in which the emphasis lies on characteristics for meaningful engagement such as building trust, exchanging knowledge and sharing dilemmas, rather than a growing uncertainty regarding the next step of the national and regional authorities and drinking water company to meet the objectives in time. The fact that the objective of <500 EIP can be met without BE losses opens the opportunity for farmers to profile themselves—and not just as a groundwater-friendly farmer. Several farmers profile their farm as sustainable, fit for the future and producing healthy products for their customers.

However, despite these examples, keeping farmers focused on groundwater-friendly techniques and pesticide use in a competitive arena requires continuous engagement efforts when participation and measures can only be based on voluntariness. A reduction in participation or measures may well lead to a discussion on whether obligatory measures will be needed soon.

5. Conclusions

The governance approach process based on voluntariness creates a platform for meaningful engagement and helps to build trust and equity, facilitating the exchange of ideas, knowledge and experience. The approach applied in the case studies in Overijssel and Brabant improves agricultural management, adds to the economics of the farm, reduces the agricultural impact on groundwater quality through the reduction in N-surpluses and environmental impact points and creates a well-functioning collaboration.

Despite the improvement of agricultural management of the participating farmers in the Overijssel case, the nitrate objectives are not met at the level of the GWPAs. The voluntariness of the approach plays an important role. Due to this approach, the participation rate relies on the farmers' expectations regarding the costs and profits of the process, negatively affecting the participation rate of farmers in the GWPAs and therefore also affecting the potential effectiveness of the approach. Voluntariness also hampers the implementation of additional measures needed to meet the objectives of nitrate in the groundwater which do not contribute to the economics of the farm. In addition, diminishing economic returns prevent the further improvement of efficient use of nutrients. The fact that enforceable groundwater objectives with a strict deadline remain out of reach puts pressure on the engagement process and trust between stakeholders.

Although an enforceable objective and strict deadline is missing for EIP in the Brabant case, the objective of <500 EIP/ha is met at the level of GWPAs using voluntary measures and techniques only. An important driver for this effectiveness is the fact that these results can be obtained without BE losses for individual farmers and a high participation rate at the level of the GWPAs. The trend of farmers moving from low-impact crops such as maize and grass towards high-impact crops such as potato, asparagus or sugar beet, puts pressure on the effectiveness of the approach and engagement process, because this trend moves soil use away from the objectives. Keeping farmers focused on groundwater-friendly techniques and pesticide use in a competitive arena therefore requires continuous engagement efforts for as long as participation and measures can only be based on voluntariness.

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