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

FAIRWAY REPORT series

Evaluation report on barriers and issues in providing integrated scientific support for EU policy

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LIST OF ABREVIATIONS

AEM - Agri-Environmental Measures
AES - Agri-Environmental Schemes
BCA - Biocontrol Agents
BD - Birds Directive
CAP - Common Agricultural Policy
CBA - Cost Benefit Analysis
CEA - Cost Effective Analysis
CIS - Common Implementation Strategy
COST - European Cooperation in Science and Technology
DG - Directorate General
DG AGRI - Directorate General for Agriculture and Rural Development
DG ENVI - Directorate General for Environment
DG R&I - Directorate General for Research and Innovation
DSUP - Directive on Sustainable use of Pesticides
DWD - Drinking Water Directive
EEA - European Environment Agency
EIONET - European Environment Information and Observation Network
EIP - European Innovation Partnership
EIP AGRI - European Innovation Partnership on agricultural productivity and sustainability
EIP WATER - The European Innovation Partnership on Water
EIT - European Institute of Innovation and Technology
ERA-NET - European Research Area Net
ERC - European Research Council
GWD - Groundwater Directive
JRC - Joint Research Centre
MS - Member States
ND - Nitrates Directive
PoMS - Programmes of Measures
PPPR - Plant Protection Products Regulation
RBMP - River Basin Management Planning
RDP - Rural Development Plan
REA - Research Executive Agency
RTD - European policy for research and technological development
SPI - Science Policy Interface
WFD - Water Framework Directive
WISE - Water Information System for Europe
WssTP - Water Supply and Sanitation Technology Platform

SUMMARY

Throughout the European Union (EU), high concentrations of nitrates and pesticides are among the major polluting components of drinking water and have potential long-term impacts on the environment and human health. Many research projects co-funded by the European Commission have been carried out, but the results often do not influence policy making and implementation to the extent that is duly justified. This paper assesses several issues and barriers that weaken the role of science in EU policy making and EU policy implementation in the case of agricultural impacts on drinking water quality. It then proposes improvements and solutions to strengthen the role of science in this process. The analysis is conceptual but supported empirically by a desk study, a workshop, and complementary individual interviews, mostly with representatives of organizations working at the EU level. The results indicate that perceived barriers are mostly observed on the national or regional level and are connected with a lack of political will, scarce instruction on the legislation implementation process, and a lack of funding opportunities for science to be included in policy making and further EU policy implementation. In response to that, we suggest translating scientific knowledge on technological, practical or environmental changes and using dissemination techniques for specific audiences and in local languages. Further, the relationship between data, information and decision making needs to change by implementing monitoring in real-time, which will allow for the quick adaptation of strategies. In addition, we suggest project clustering (science, policy, stakeholders, and citizens) to make science and research more connected to current policy challenges and stakeholder needs along with citizen involvement with an aim of establishing sustainable long-term relationships and communication flows.

The objective of this study is to analyse and discuss the role of science in EU policy making and implementation processes concerning the agricultural impact on drinking water quality. This concerns, broadly speaking, the WFD, DWD, GWD, ND, and DSUP[1]. Specifically, we want to identify barriers that hinder the science and research sector from having effective dialogue and cooperating in knowledge sharing from policy making to actual EU policies implementation on the member state or regional level. We argue that the science/research sector's role in policy making and implementation is vague and dispersed across different stages of the process. It also has different roles in the process, as an initiator of policy, a follower of policy or political strategies, or a participant in the public discussion. Our societal aim of this analysis is to suggest possible long-term system improvements and to encourage scientists and policymakers to develop new solutions for improving communication flow. The study, while conceptual, is based on empirical data collected by a desk study, a workshop with different stakeholders, and individual interviews with EU-level stakeholders.

A desk study was carried out as a basis for the workshop and interviews. The desk study focused on the following topics: (i) agriculture and water in the EU, (ii) evidence-based policy making in the EU, and (iii) implementation of the Water Framework Directive. A non-systematic review of relevant scientific literature was carried out using scientific databases such as Scopus, Web of Science, Science

[1] WFD - Water Framework Directive; DWG - Drinking Water Directive; GWD - Groundwater Directive; ND - Nitrates Directive; DSUP - Sustainable Use of Pesticides.

Direct and Google Scholar. Other information was obtained from websites of the EU and the internet.

A workshop on the "Evaluation of the issues and barriers around providing integrated scientific support for EU policy" was held in Brussels, Belgium, on 6 December, 2017. The workshop was led by a FAIRWAY project partner, the University of Ljubljana. The workshop method was based on a World Café workshop type with a duration of 3h. The primary objective of the workshop was to discuss with representative EU-level actor organizations the role of the science and research sector in EU policy making and EU policies implementation related to drinking water resource protection against diffuse pollution of nitrates and pesticides originating from agriculture.

The participants were asked about:

- the main issues on the EU level related to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture in the EU,
- the main barriers,
- the Relationship between Science and Policy and its Reflection in EU Policy,
- Improvements and possible Solutions for Enhancing the Role of Integrated Scientific Support in EU Policy Decission Making.

The participants highlighted the following main issues (*Figure 1*):

- Lack of knowledge about agricultural impacts on water quality;
- Harmonization of legislation needed at the EU level, with water protection currently a very local issue;
- Lack of coherence between policies;
- Synergies and trade-offs between goals and pathways of pollution;
- Lack of balance between targets and objectives of EU policies;
- A time lag between taking measures and changes in water quality;
- Fragmented and not easily available data;
- Financial questions about available budgets and allocation of the costs.

Interviewees highlighted especially two main issues related to drinking water resource protection in the EU: (i) There is a general lack of knowledge about the relationship between agriculture and water quality, which calls for a stronger contribution from science, and (ii) drinking water protection is a local issue with local characteristics. They also indicated that a lack of communication between water authorities, people responsible for RBMPs, the farming community, and agricultural departments is an issue. All agreed that more bottom-up, inclusive processes should be stimulated in the field of water resource protection.

The main barriers that interviewees mentioned are the following (*Figure 1*):

- Lack of political will to impose costs on farmers, and limited financial means needed to apply specific measures;
- Lack of awareness of the required actions by farmers to achieve water quality targets and a need for capacity in advisory services;
- Lack of communication or synchronization of languages between scientists and policy makers;
- Site-specific aspects in taking effective measures, e.g., differences between member states and regions;
- A time lag between taking measures and subsequent changes in water quality;
- Not enough farmers involved.

In relation to the question on how the relationship between science and policy is reflected in EU legislation three statements were highlighted (*Figure 1*): 1) public participation could be dangerous because if something is scientifically correct, we cannot discuss it and change it to suit the popular sense (populism, nationalism, corporatism); 2) the formal relationship between science and policy in the EU directives is to be defined in the national transposition, but the policy text does not specify how this should be done. This is a decision of the member states. There is a clear link between science and policy in, for example, the ND and the WFD; 3) there should be more opportunities to enhance the role of scientific expertise in policy making.

Figure 1: Key points for Questions 1, 2, 3 and 4 on the role of science in EU policy making and implementation related to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture in the EU.

Based on study results, we argue that establishing project clusters (science, policy, stakeholders, and citizens) for up-to-date policy challenges and stakeholder needs and with citizen involvement is a viable solution to enhance the role of science in the EU integrated policy making process. The aim is to establish longer-term relationships and communication flows between scientists and policy makers, which will contribute to achieving more sustainable management of ecosystem (water, food) services.

1. INTRODUCTION TO THE DELIVERABLE D7.1

In FAIRWAY we aim to evaluate the barriers and issues associated with providing integrated scientific support for European Union policies, related to drinking water quality including agriculture (WFD, DWD, GWD, ND, DSUP). Moreover, it identifies obstacles for effective dialogue, cooperation and knowledge sharing, between the research, sector and policy-making worlds. There are many contextual, structural (e.g. inherent working methodologies) and cultural (e.g. relationship between researchers, sectoral representatives and policy makers) differences between research and policy-making. Literature states that existing practises which attempt to bridge the gap between research and policy-making do not provide efficient solutions [12, 14, 17, 19, 48]. Therefore, the EU emphasises the importance of strengthening the dialogue between policy-makers and researchers. This is the key for maximising the impact of science projects on policy-making.

FAIRWAY work package 7 will evaluate the barriers/issues in providing integrated scientific support for EU policy and establish an iterative process of knowledge and practice exchange with policy during the FAIRWAY project, resulting in an integrated scientific support for relevant EU-policies.

2. METHODOLOGICAL APPROACH

The deliverable 7.1 is based on the desk study research with the fulfilment of the workshop and individual interviews results, on barriers and issues in providing integrated scientific support for EU policy.

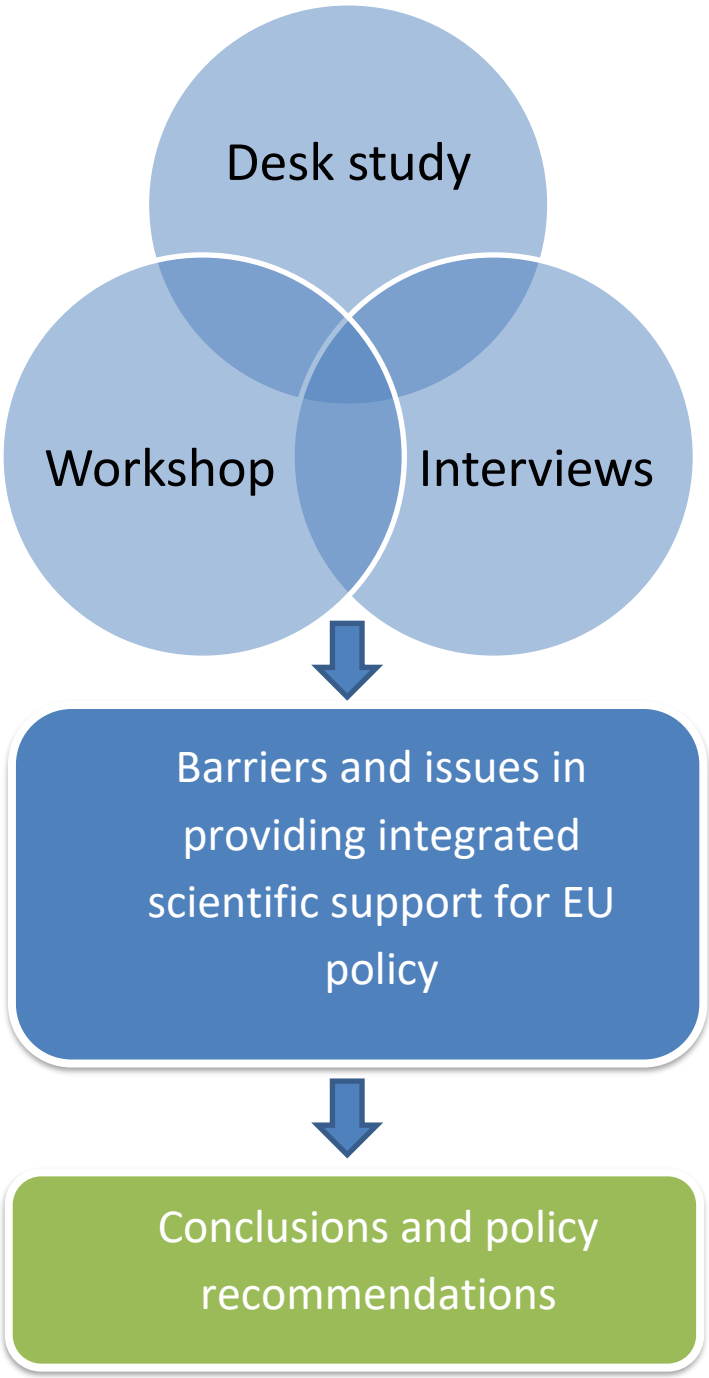

Figure 2: Methodological approach of the research

2.1 Desk study research

A desk study was carried out as a basis for the workshop and interviews. The desk study focused on the following topics: (i) agriculture and water in the EU, (ii) evidence-based policy making in the EU, and (iii) implementation of the Water Framework Directive. A nonsystematic review of relevant scientific literature was carried out using scientific databases such as Scopus, Web of Science, Science Direct and Google Scholar. Other information was obtained from websites of the EU and the internet.

2.2 Workshop (World Café Method)

A workshop on the "Evaluation of the issues and barriers around providing integrated scientific support for EU policy" was held in Brussels, Belgium, on 6 December, 2017. The workshop was led by a FAIRWAY project partner, the University of Ljubljana. The workshop method was based on a World Café workshop type with duration of 3h. The primary objective of the workshop was to discuss with representative EU-level actor organizations the role of the science and research sector in EU policy making and EU policies implementation related to drinking water resource protection against diffuse pollution of nitrates and pesticides originating from agriculture.

There were 4 main questions at the workshop. All of them are related to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture.

Each question was hosted by a table host, who led the discussion. There were 15 minutes rounds per question. Participants were divided into two groups, coloured red and orange. Orange group consisted of 6 participants and red with 4. At the beginning of each round, table hosts briefly shared key insights from the prior conversation, so the new group could link and build using ideas from previous rounds, if they wanted to. At minute 10-13 table hosts started collecting/forming short summaries of opinions of each group (*see underlined key discussion points presented in the main discussion*) and wrote them on post-it notes, used later on for the main discussion.

2.3 Interviews

Interviews with individuals were used to collect views on barriers and issues in providing integrated scientific support for EU policy. Invitations to participate in the interview were sent in three rounds. We sent the first invitations in December 2017 and the repeated invitations in January and February 2018. Altogether we managed to perform and complete 5 interviews. Interviews were conducted on the basis of telephone conversation of the average length of 20 minutes. The same questions as in the workshop were used to achieve a more in depth insight on the topic of issues/barriers around providing integrated scientific support for EU policy.

3. RESULTS

3.1 Desk study results

A desk study was carried out as a basis for the workshop and interviews. The desk study focused on the following topics: (i) agriculture and water in the EU, (ii) evidence-based policy making in the EU, and (iii) implementation of the Water Framework Directive. A non-systematic review of relevant scientific literature was carried out using scientific databases such as Scopus, Web of Science, Science Direct and Google Scholar. Other information was obtained from websites of the EU and the internet.

3.1.2 The Evaluation of Barriers and Issues in providing Integrated Scientific Support for EU Policy

Safe drinking water is vital for public welfare and an important driver of a healthy economy. Throughout the EU, nitrate and pesticides are currently among the major sources of drinking water pollution. High concentrations of nitrates and pesticides in groundwater with a long-term impact on groundwater quality have human (drinking water) and environmental (eutrophication of groundwater-dependent ecosystems) health consequences [44, 58]. In order to deal with this drinking water pollution, and sometimes for complementary reasons, the EU has developed an extensive set of directives, guidelines and policies over the last decades. The requirements of the Drinking Water Directive (DWD) set an overall minimum quality for drinking water within the EU. The Water Framework Directive (WFD), the Groundwater Directive (GWD), the Nitrate Directive (ND) and the Directive on the Sustainable Use of Pesticides (DSUP) require Member States (MS) to protect drinking water resources against pollution in order to ensure production of safe drinking water.

One of the key points in discussions among scientists, policy-makers and actors in the last decade is the need to develop a conceptual framework for a science-policy interface related to water and especially water security, in order to enable various initiatives and knowledge to support policy [1). One of the conclusions from the European Commission report on scientific evidence for policy making is that decision makers in policy and practice typically can gain from more use of the research-based knowledge available, yet researchers should produce more knowledge that is directly or easily usable [4]. It could be argued that limitations at the science-policy interface will be overcome when its complexity and heterogeneity will be successfully integrated within policy measures [2]. Moving towards more evidenced-based policy making within the EU necessitates a better integration and collaboration (co-creation and co-design) at the science/policy interface [3]. A number of contextual, structural, and cultural factors are inhibiting better collaboration, such as a lack of opportunities to work together, inherent working methodologies used in decision making process, and missing effective communication channels between nations [4]. To properly address drinking water security, better integration of science and policy is required [5].

3.1.3 Evidence based Policy Making

“Evidence-based policy” is a concept developed in the 1970s that received renewed strength in the late 1990s [6]. It promotes a rigorous analysis of policy and program options, for providing useful inputs for policy makers in their ongoing consideration of policy development and program improvement. Policies could be described as science-based programs for action that guide decision-

making in service to the effective achievement of clearly designated outcomes [7]. Evidence-informed decision making processes, relying on transparent use of sound evidence and appropriate consultation processes, are seen as contributing to balanced policies and legitimate governance, however, the processing of expert knowledge is problematic and highly variable across policy making organizations. The potential for close linkage between good information and “good policy making” is routinely undermined by two important mechanisms: political and organizational, both concerned about legitimacy of policy-making processes and civic trust in decision makers [6].

The Lisbon Strategy, adopted by the EU member states in 2000, moved science into a central position for the development of a European knowledge-based economy and society and increased involvement of scientists in science policy making [16]. After that European science organisations and eminent scientists, initiated common movement which lead to the creation of the European Research Council (ERC) to support basic research of the highest quality. For the first time, the scientific community acted collectively and across disciplinary or national boundaries as a political actor for the sake of a better science policy for Europe [16]. This connection is supported by different financial instruments like the European Union's Research and Innovation funding programme (e.g. H2020) or for example with the Joint Programming Initiative Water challenges for a changing world (Water JPI), launched in 2010 for water sector.

In 2007 European Commission identified the connectivity of the European research area with European research policy and European society as an important EU challenge [8]. Besides the pursuit of scientific excellence, European research should support knowledge advancement and dissemination and underpin policies for sustainable development in fields of major public concern such as health, energy and climate change [8]. In 2008, the EU Directorate General for Research and Innovation (DG R&I) of the European Commission undertook an intensive process of in-depth interviews and surveys of European policy makers, senior advisors and knowledge transfer specialists with emphasis on scientific evidence-based policy-making and how to bridge the gap between science and policy, not as technical issue but rather as political, economic, social and cultural issue [4]. The central message was that *status quo* is unsatisfactory and recommendations were given: (1) DG R&I has a key role to play in ensuring that project results are disseminated across the European Commission for that it should ensure that supported project groups fully understand the importance of producing material which is useful, accessible and meaningful to policy-makers; (2) Project coordinators should be encouraged to put the policy-usefulness of their scientific research findings to the forefront of their objectives and actively include partners from the world of policy-making (European Commission) to ensure that the scope of the research, respond to defined policy-making priority areas [4].

Even after decades of intensive discussion on this topic, there are still major gaps in knowledge about what happens inside government agencies in relation to producing, assessing, and incorporating research-based evidence into their policy advice, service delivery, regulatory, and program evaluation activities [6]. It was demonstrated that decision makers’ behaviour in processing information varies across policy areas and that differences in the vocabularies, a lack of understanding of the counterpart's “modes of operation” and lack of interactions between decision makers and researchers my produce information that does not meet the needs of decision makers (forming ‘relevance gaps’) and is thus less useful, although scientifically valid and reliable [5, 9-11]. The practice of bringing research findings into the policy and practice arenas by publishing in peer

reviewed journals is deeply embedded in the science system and in incentive structures. Though often relevant for practitioners, findings are rarely presented in a way that they can easily be used and applied by decision makers, who primary use governmental and internal institutional information sources [5].

Progress toward a more evidence informed policy and administrative system requires sustained investment and commitment across several focus levels—individual leaders and managers, organizational units, and cross-organizational relationships [6]. Despite advances in analytical tools and capacity for assembling performance information and scientific evidence, it has become increasingly clear that we are still far from a consensus—intellectually or politically—regarding what should count as evidence, how it should be produced and validated, and how it should be used to influence policy making [6]. Report of European Parliament and European University Institute on evidence and analysis in EU policy-making concluded that institutional systems have a tendency to resist change where one of the key problems of evidence-based policy-making is bureaucratic inertia, which limits the potential for accepting new developments and ideas [12]. They also highlighted the need for elaborating neutral assessment tools to inform evidence-based policy-making in a comprehensive way while avoiding oversimplification and distortion of reality when reducing complexity to inform politics and the wider public.

The European Union made a substantial investment in research and innovation in the past decades through its Framework Programmes for Research and Technological Development, including the current programme, Horizon 2020, which started in 2014, in order to respond and provide solid scientific evidence for the numerous policies at the Union level [13]. At the same time EC DGs opens calls for tenders (service contracts) with special focus on underpinning of implementation of policies, its monitoring and evaluation. Improvements are observed as exploitation and dissemination activities are under contractual grant agreement obligations for the researchers participating in EU projects [13].

Science-policy dialogue in EU projects has many forms [13, 14, 15]:

- policy-makers invited to meetings;
- conferences or events organised by projects or the European Commission;
- project participants are members of EU or national scientific advisory committees;
- ministries or other national regulatory bodies or policy-makers are directly involved as beneficiaries in a project;
- projects seek inputs from regulatory stakeholders through surveys and inform them regularly through policy briefs;
- representatives from policy-making bodies participations in the (Scientific) Advisory Body of a project;
- projects involve professional scientific societies, stakeholder associations or civil society organisations;
- Commission assist projects to ensure and facilitate uptake of scientific results into policies trough providing responses to the Members of the European Parliament who often enquire for outcomes of projects;
- Open access publications and data, so that stakeholders, including policy-makers can get the maximum benefit from EU-funded projects.

3.1.4 EU Water Framework Directive (WFD) -Where Water Policy and Water Science meet

The Water Framework Directive (WFD) is the most important water related EU directive with respect to demand for knowledge support towards its tangible water policy and research objective to achieve good water status in an integrated and sustainable manner by 2015 [17-21]. The knowledge support is facilitated through a system of participatory River Basin Management Planning (RBMP) and implemented through water quality and ecosystem assessments, extensive monitoring and with inter- or multidisciplinary, participatory and pragmatic research [22, 23]. This Directive represents a shift in approach from the traditional unilateral focus upon sources of pollution and disturbance, to the new combined approach. The combined approach has focus upon emission limits from sources which must match with quality targets, objectives or standards for water bodies' environment. It also requires the collaborative production of new scientific knowledge that is effectively adopted and communicated between policy-making, policy implementation, and the research base informing policy work [23, 26].

Within the WFD Common Implementation Strategy (CIS), non-binding guidance documents on sharing good practices, operational since 2001, have been recognised for presenting and communicating results of research and demonstration projects in an easily usable form to policy-makers (regional, national level) in order show ways how to integrate the latest research developments into legislation [1, 22]. Some even propose a professional agent capable of adapting knowledge for policy and who can span both epistemologies [26]. The WFD has been a major milestone in raising awareness to the need of restoring Europe's rivers, but its application during the first management cycle was limited [20, 27]. The deadline for all rivers being in good ecological state failed due to a lack of efficiency in policies and timescale of resilience for hydrosystems, especially groundwater systems [21, 28]. To tackle this problem, the WFD requires Member States to design and implement cost-effective programs of measures to achieve the 'good status' objective by 2027 at the latest [28, 29]. However, WFD ultimately allows for economic considerations to override objectives of attaining good ecological status when all possible programmes of measures (PoMS) have been put in place [30, 105]. Derogations can be granted for an extension of the deadline for reaching good ecological status (financial ability to meet goals). This is the case too for setting a lower target (costs of implemented measures are higher than the benefits of good ecological status) - only on the basis of scientific socio-economic analysis (cost-benefit (CBA) or cost-effective (CEA)) - as an important part of the WFD evaluation [18, 31].

Many scientists, who work in large integrated projects aiming to support policy WFD developments and implementation, highlight a large gap between science and policy [1, 5, 32, 33]. This is still perceivable amongst the results of recent studies finished after the first cycle in 2015 [14, 20, 21, 34, 35]. At least partly this is due to problems of communicating in an appropriate manner about the key research results that would be of use to policy-relevant strategies [5, 33, 36]. Research or policy communities in itself encompasses multiple smaller subsectors (e.g. surface waters, groundwater, irrigation, energy, drinking water, waste water, transport, environment protection, land use planning, tourism) grouped around separate disciplines with its own practice and language, which frustrates integration and weakens communication [18, 32, 37]. A collaborative process approach with clear coordination and transfer mechanism is needed to come to a common understanding of the societal relevance of results of the scientific work, and vice versa to validate this scientific knowledge with the local and lay knowledge of the stakeholders [3, 19, 21, 26, 32]. At the same time

policy and decision-making arenas will require a willingness and confidence from one part of the water sector to engage with actors from other sectors which is essential for making progress on water challenges [14, 38].

Although WFD is well established as the key river basin management instrument across Europe, lack of cross-sectoral cooperation is still a problem. EC and member states policy institutions continually addressed this problem with goal for wider integration of conclusions from water-relevant projects into future policies [33, 35]. It is important to consider that science that can play multiple roles in policy process, can contribute to each stage of the process, and particularly to: problem identification; strategy formulation; selection of policy options; policy implementation; setting of regulatory standards; monitoring and evaluation [9, 19]. In Ireland intensive financial and personnel involvement of national policy makers demonstrated in up to 62% of the projects a high level of policy impact [20]. Results for other countries are not available.

Directives, legislation and management programmes are often implemented in a cyclical fashion and reviewed on a regular basis which provides a window of opportunity for researchers and policy-makers to draw together new evidence and approaches [21, 39]. The WFD integrated water resources management is developing through 6-years river basin management planning cycles, with possible revisions of technical requirements at the end of each cycle. This means that in principle recent scientific and technical progress in the design of the actions should be taken into account in the next river basin management plan of the WFD [27]. Similar to WFD Nitrates Directive has cycles of action programmes of four year's duration.

The Science-Policy Interface (SPI) for water activity was launched in 2010, led by Directorate-General R&I and ONEMA (the French national agency for water and aquatic ecosystems), which provide an interactive forum to ensure a cooperative interface between water research and water policy makers, managers and stakeholders at both EU and national level [1, 5, 27, 40, 41]. Strategic use of the SPI, with specific policy milestones and effective mechanism, should facilitate the development of innovative solutions to achieve policy goals (e.g. WFD, DWD, GWD, DSUP) and create conditions necessary for transformative change towards exchange platform enabling both scientists and policy makers to discuss the corresponding research and policy agendas [1, 34]. SPI activities (i.e. WISE - Water Information System for Europe) also demonstrated that although networks/lobby organisations (IAH, EGS, IGRAC, EUREAU, Eurometaux, EEB, etc.)[2] already exist, they need stronger involvement, if possible permanent [40]. An effective SPI requires: (1) compelling water narrative; (2) cross-sectoral collaboration; (3) co-production of knowledge; (4) experiential evidence-based learning; (5) strategic use of trusted scientists; (6) fostering networks; and (7) generating business from science-based innovation [34]. Many current water-related Research and Technology Development (RTD) projects have established operational links with practitioners as research scientists, which allow the needs of policy makers to be taken into account [20, 21, 35, 42]. SPI can be evaluated by post-processing and analysis of the links between the RTD projects results, the policy implementation tasks, guidance's, experiences and tools [25].

[2] International Association of Hydrogeologists (IAH), Geological Surveys of Europe (EGS), International Groundwater Resources Assessment Centre (IGRAC), European federation of national associations of water services (EUREAU), European Association of Non-ferrous Metals Producers and Recyclers (Eurometaux), European Environmental Bureau (EEB)

3.1.5 Ensuring water quality while developing the agriculture sector: primary policy and directives

The challenge of the Water -Agriculture Nexus is defined in the Commission Staff Working Document [103]. This acknowledges the delicate balance between agriculture and water-related objectives. To achieve these objectives, European policy is defined in different directives, like the EU Water Framework Directive (WFD), the Nitrates Directive, the Pesticides Directive and the Drinking Water Directive. The Working Document ascertains that less progress has been made than expected. Not all River Basin Management Plan (RBMP) programmes are on track, because the programmes of measures (set by national regulators) are insufficient to reach the required good water status. The European Commission (EC) wants to overcome this problem by helping the member states (MS) in their quest for efficient measures. The approach focuses on (1) optimising the effectiveness of the EU water and agriculture policies, (2) reviewing possibilities for supporting investments and (3) supporting knowledge and innovation transfer.

3.1.5.1 Agriculture

Agriculture accounts for almost half of the total EU land area and is a primary source of diffuse pollution of nutrients and pesticides, significantly affecting most of the EU river basins [43, 103]. Rapid changes in farming systems in the post-war decades allowed an increase in agricultural productivity and caused considerable impacts (physical and chemical) on freshwater resources [28, 43-45]. WFD requires that directives and regulations, tackling point sources and diffuse pollution, are first implemented correctly (i.e. ND, GWD, DUSP, Urban Waste Water Treatment Directive; Industrial Emissions Directive) before other policies are used [21, 46]. Data shows that 63% of river basin districts reported, that implementation of the ND is not enough to tackle diffuse pollution to the level needed to secure WFD objectives [46]. According to the communication from the Commission to the European Parliament and the Council, diffuse pollution of nitrate significantly affects 90% of river basin districts, 50% of surface water bodies and 33% of groundwater bodies across the EU [29, 46, 104]. In spite of important progress in relation to declining mineral fertilisers' consumption, there are still many gaps in the basic measures put in place by Member States to address agricultural pressures, including a lack of measures to control phosphate and nitrates emissions outside nitrate vulnerable zones, established under the ND [46] and in and outside of the drinking water protection areas. Supplementary measures reported in agriculture are largely voluntary, including advice schemes and agri-environment measures of the Common Agriculture Policy (CAP), such as farm extensification and organic agriculture. Research and restoration efforts have been developed to recover ecosystem functions and services [46].

The European Common Agricultural Policy (CAP) primary goal is to produce quality food at affordable prices and a decent socio-economic standard for farmers. The EU CAP is, in fifty years of existence, constantly adapting to the changing needs of society and the new challenges (i.e. environment, nature and biodiversity in rural areas) [47]. The CAP budget has decreased over time and agri-environmental payments are gaining importance in budgetary size and the proportion of participating farmers and farmland [48]. The application of agri-environmental measures (AEM) under Rural Development Programme (RDP) is compulsory at the Member State or Regional level, but optional at the farmer’s level. The agri-environment policy has ND embedded in its mandatory part (i.e. cross-compliance, codes of good practice, nitrate vulnerable zones) (Statutory Management Requirement - SMRs), which is an important building block of the wider European environmental and

nature conservation policy, as it is directly connected to the WFD and the Habitats (HD) and Birds Directives (BD) [48, 106]. Although the new phase of the Rural Development Programme (RDP, 2014–2020), strongly pushes towards integration and synergy between different sector policies, the need for policy instruments specifically targeted to pursue the objectives of preservation of water quality and quantity still remains [43, 49]. However, the institutional arrangements for the agriculture and water sectors are complex and multi-dimensional, and integration requires collaborative approach to science, policy and governance [50, 51].

Understanding and mitigating diffuse pollution from agriculture continues to pose demanding challenges [50]. Some AEMs are already accepted as standard farm practice and widely adopted whilst others are implemented less widely [52]. Science and policy from agricultural and environmental sector need to embrace that development of agricultural environmental regulation that could achieve meaningful improvements in freshwater resources is difficult, as farmers are often sceptic of conflicting policy, science and public media messages, unaware of existing regulation or simply choose not to comply with regulation [53, 54]. When farmers accept their role in preventing water diffuse pollution, they are often faced with several barriers related to costs of application and impacts on revenue, to bureaucracy or a lack of guidance on how effectively apply measures [21]. With this kind of attitude, the impact of polices is questionable. Impacts of production support payments and rural development payments on the quality of groundwater have rarely been estimated [47]. In the case of direct payments in Slovenia, coupled subsidies and investment grants (2004-2014) raised the pesticide concentration in groundwater, but did not have any statistically significant impact on the concentration of nitrates in groundwater. Agri-environmental payments did not have any statistically significant impact on nitrate concentration decrease in groundwater, but were effective in reducing pesticides in groundwater, although only to a limited extent. These results imply a problem of insufficient targeting of agri-environmental measures policy acts and suggest that greening of direct payments, a major innovation brought in under the 2013 CAP reform, is a way toward higher impact of CAP on water quality improvements (diversifying crops, maintaining permanent grassland, dedicating 5% of arable land to 'ecologically beneficial elements', 'ecological focus areas') [47]. For better results of agri-environmental payments, it is important that science, policy and management address the farmers as members of a heterogeneous group and agriculture as a heterogeneous activity which may involve many different practices. In addition, it should try to communicate measures with each particular stakeholder group also with the help of advisory services for farmers [21, 43, 52, 53].

3.1.5.2 Nitrate Directive

Groundwater constitutes the largest reservoir of freshwater in the world, accounting for over 97% of all freshwaters available on earth (excluding glaciers and ice caps). Focus on groundwater mainly concerns its use as drinking water, as about 75% of EU inhabitants depend on groundwater for their water supply [55]. Implementation of the ND decreased nutrient surpluses and improved groundwater quality by 16% in 2008 [56]. However, there is more than 30% of groundwater bodies in Europe considered to be at risk of not achieving the ND targets and 45% are in doubt of doing so in near future [29]. Reasons could be in the fact that Member States have the opportunity to apply for derogation within ND (i.e. manure application rate higher than 170 kg N per ha under certain conditions) or in interpretation of nitrogen application limit (i.e. adding gaseous losses of nitrogen ‘on top’ to the general limit) [57]. It is expected that the ND will result in a further decrease in N

emissions in EU, because the implementation of the measures is expected to become stricter. However, the nitrate target of 50 mg/l is still exceeded in shallow and sandy groundwater's with intensive agriculture [59].

One of the possible solutions is, that Member States design and implement new cost-effective programs of measures under Agri-Environmental Schemes (AES) to achieve ND objective, or WFD 'good status' objectives (chemical and ecological) for the affected water bodies by 2027 at the latest. With policies currently in place, the general protection goals of the Directives will not be met, thus achieving 'good status' would demand a substantial change in the design of AEMs, involving costs that may not be offset by benefits [28, 29]. For the selection of appropriate measures, models are useful for quantifying the expected impacts and the associated costs [60]. However, models show that new policy approaches are required, as for some water bodies (high productive agricultural areas) the Directives time frames within improvements are expected could be much longer [29, 59].

Several EU member states recognised that losses of N from agriculture reduced significantly, especially in nitrate vulnerable zones, but further reductions are required to comply with the EU WFD [59, 61-64]. As further general reduction in nutrients may affect farm economics a change of paradigm is therefore planned, with severe restrictions placed on applications to land vulnerable to nitrate leaching to the aquatic environment and a potential easing of restrictions in other areas [63]. The lesson is that general policy regulation can be usefully applied to control widespread excessive applications of N but that once this has been achieved, and if further reductions are necessary, a switch to more spatially or type of farming targeted measures is required [63]. Introduction of AEMs to policy can be fraught with difficulty in the form of delays and legal proceedings when the legal and regulatory complexity of adopting AEM at the national level to achieve site-specific environmental objectives is underestimated in a top-down political process [45]. On the other hand there is a growing acceptance among farmers of environmental benefits occurring from the regulation but scepticism remains around the validity of certain measures, especially if their observations are not supported by scientific evidences [65].

A combination of targeted mandatory and voluntary measures might be a suitable way forward, where a failure of achieving the site-specific targets in the voluntary scheme (the carrot), will lead to imposition of targeted mandatory requirements (the stick), however good scientific grounds and policy backup will be required in the process [45]. For the design of agro-environmental policies, appropriate and user-friendly tools are needed which should help water managers to evaluate the potential impacts of mitigation measures on water resources, more clearly define protected areas, and more efficiently distribute financial incentives to farmers who agree to implement alternative practices ([28]). At the end, science and policy should cooperate in checking efficiency of AEMs with delivery/impact metrics and appropriate standards for identifying trajectories associated with diffuse pollution transfer and ensuring that agri-environmental policies are given a fair and thorough evaluation and modification in the next management cycle [61].

3.1.5.3 Pesticides

The Plant Protection Products Regulation (PPPR) and the Directive on the Sustainable Use of Pesticides (DSUP) are essential elements of the Thematic Strategy on Pesticides of the EU. EU policy is directed towards significant reductions in pesticide use in the medium to long term [66, 67]. A main new element of the PPPR is, that it provides the possibility to reject active substances on the

basis of their intrinsic properties (including endocrine disruption) [68-70]. These regulations introduced a shift from risk to hazard assessment and are characterised by a peculiar combination of five principles for risk assessment and management: hazard identification, precaution, substitution, sustainability and mutual recognition [71, 72]. The challenge for regulating authorities is to ensure that any losses of active substances and/or products are only due to safety reasons and are not just because one product appears to be less safe than another, for that solid scientific knowledge grounds are needed [68, 73]. If additional science based concerns about public health and economic costs associated with removing pesticides from water are raised, the WFD and DWD directives have the potential to restrict pesticide use in short term [67].

Article 7 ('Waters used for the abstraction of drinking water') of the EU WFD promotes a prevention-led approach to European Drinking Water Directive (DWD) compliance for those parameters, that derive from anthropogenic influences on raw water quality [74]. In Europe, drinking water is produced, to standards defined in the DWD, using water abstracted from the environment, for that treatment to remove pollution and strategies to prevent pollution are used [74]. Agronomists can in general predict that the reduction of one active substance will lead to the increased use of others, creating a risk of pollution swapping. Therefore, water companies face considerable uncertainty when planning for pesticide management in the potable water supply [75]. To support the prevention-led approach to DWD compliance required by WFD Article 7, water suppliers and policy makers need to work closely with scientists to chart early pollution warning strategies as well as control strategies for the major weed, disease and pest problems [75].

EU stricter legislation on regulatory regime governing the registration of active substances and plant protection has led, for many common pesticides widely used, to a removal from market, but unexpected and unacceptable risks emerged, threatened environmental quality and human health [67, 69, 73, 76]. Pesticides producers argue, that cost of developing new and maintaining existing active substances is becoming prohibitive, as is expected to lead to increased costs of production, decreased yields and increased risk of pesticide resistance in target pest populations [66, 76]. Another optional policy for pesticide use reduction includes tax schemes that are based on standards for environmental and health quality to promote low-input cropping practices [77, 78]. It is estimated that taxation systems could decrease pesticide inputs up to 25%, while higher reduction in use (up to 50% decrease) are not expected to have a larger effect, as farmers would become less responsive to input price after low-input practices adoption [78]. As pesticides affect human beings and other organisms differently and have various environmental effects across countries, climatic conditions and species varieties, a classification according to toxic contents will be needed [77].

Development of efficient biocontrol agents (BCA) is inspiring because of their acknowledgement by consumers and civil society as well as opportunity to fulfil the requirements of conventional crop production, Integrated Pest Management (IPM) and the organic sector [69]. The BCA matrix includes micro- and macroorganisms as well as natural substances of mineral, animal and vegetal origin. As biotic plant strengtheners are ruled by PPPR, the basic substance category could allow a reduction of timeframe, costs and resources affected to phytopharmaceutical applications, together with an internal management opportunity [69].

Enforcement of the pesticide legislation shows, that delays in assessments and national derogations to EU decisions mitigate the radical character of the reformed regulatory regime [79]. Due to delays

in monitoring activities, it is difficult to evaluate policy outcomes on the ground. Science and EU policy are affected by divisions among Member States in comitology and the deficiencies in risk communication activities [79]. A clear example is the discussion about Glyphosate, the most frequently used herbicide in the EU and possible mutagen and endocrine disruptor. While EU civil initiative, part of the Member States and part of the science community support the ban of Glyphosate, the other part support renewal of approval for Glyphosate use in the next five to years [80]. EU member states agreed on November 27th 2017 on a five-year renewal period.

3.1.6 Current organisational structure of scientific support system for eu policies related to water quality

The organizational structure of the European Commission of scientific support consists of several levels. The highest is the Directorate General, which operates in 31 different departments. The Directorate General is closely connected with the Joint Research Centre and its 10 science work areas. Aiming at bringing together all relevant actors at EU, national and regional levels, the European Innovation Partnership (EIP) works with five challenge driven partnerships, formed under the EU2020 Innovation. The partnerships are supported with steering groups, who create different task forces and work platforms [90, 89, 91, 84, 85, 92-94, 101, 103, 104, 107].

3.1.6.1 Directorate General (DG)

DG is a branch of administration dedicated to a specific field of expertise. Based in Brussels, managed by Director General and the political authority of the Commissioner, it has 31 different departments/areas of work. Four of the departments are closely related to the topic of FAIRWAY project: Agriculture and Rural Development, Environment, and Research and Innovation.

Table 1: EU Directorates related to the FAIRWAY project topic

Directorate:	**Role:**	**Aim:**
Directorate General for Agriculture and Rural Development (DG-AGRI)	Deals with all aspects of the common agricultural policy (CAP).	Responsible for EU policy on agriculture and rural development.
Directorate General for Environment (DG ENVI)	Protects, preserves and improve the environment for present and future generations, proposing and implementing policies, that ensure a high level of environmental protection and preserve the quality of life of EU.	Responsible for EU policy on environment.
Directorate General for Research and Innovation (DG R&I)	To improve Europe's competitiveness, boost its growth, create jobs, and address the main current and future societal challenges.	Defines and implements European Research and Innovation policy with a view to achieving the goals of the Europe 2020 strategy, its work is guided by the 7th Environment Action Programme, the Circular Economy Action Plan and, more recently, the United Nations Sustainable Development Goals.

Directorate General for Health and Food Safety	To make Europe a healthier, safer place, where citizens can be confident that their interests are protected.	to protect and improve public health; ensure Europe's food is safe and wholesome; protect the health and welfare of farm animals; protect the health of crops and forests.

Each of the three DG`s uses different service contracts to buy services such as conference and publicity services, studies, technical assistance and training, consultancy, etc. The providers are selected via calls for tender. The Joint Research Centre is described in separate chapter.

3.1.6.2 Joint Research Centre (JRC)

Role: to address key societal challenges, while stimulating innovation and developing new methods, standards and tools.

Aim: to support European Union policies with independent evidence thorough the whole policy cycle.

Structural organization: The centre is spread over six sites (Brussels, Geel, Ispra, Karlsruhe, Petten and Seville) in five different European Union countries. It is under the responsibility of the Commissioner for Education, Culture, Youth and Sport. JRC is led by Director General and a board of Governors, which assist and advise.

Actors involved: JRC employs 3000 people all over the European Union (scientists, seconded national experts, trainees). The majority of them work on scientific projects, rest on administration and support activities.

Areas of work: 10 science areas: Agriculture and food security; Corporate; Economic and monetary Union; Energy and transport; Environment and climate change; Health and consumer protection; Information Society; Innovation and growth; Nuclear safety and security; Safety and security; Standards.

3.1.6.3 European Innovation Partnership (EIP)

Role: To bring together all relevant actors at EU, national and regional levels. It`s main roles are: (i) steps up research and development efforts; (ii) coordinates investments in demonstration and pilots; (iii) anticipate and fast-tracks any necessary regulation and standards; and (iv) mobilises 'demand', in particular through better coordinated public procurement, to ensure that any breakthroughs are quickly brought to market.

Aim: to design and implement the main roles in parallel to cut lead times. EIP are formed as new strategic orientations of the European Union. They act as tools to support "interactive networking" of various stakeholders for the formation and transfer of knowledge from research to specific fields of interest. Moreover, in EIP researchers, advisers, entrepreneurs and other actors should work together in solving individual development issues.

***Structural organization*:** there are five challenge-driven partnership, formed under the EU2020 Innovation Union; (i) Active and Healthy ageing; (ii) Agricultural Productivity and Sustainability; (iii)

Smart cities and Communities; (iv) Water and (v) Raw materials. They are launched in areas and consist only of activities, in which government intervention is clearly justified and where combining EU, national and regional efforts with aim to achieve the target quicker and more efficiently.

The European Innovation Partnership on agricultural productivity and sustainability (EIP - AGRI)

Role: To helps the agricultural and forestry sectors to become more sustainable, productive and capable of tackling current challenges such as climate change, stricter environmental rules, more volatile market prices and fiercer competition.

Aim: focuses on forming partnerships and linking people in the EIP-AGRI network.

Structural organization: EIP-AGRI network comprises of people from different professional backgrounds, organised in different types of activities, such as Operational Groups (groups at local level) and EIP-AGRI Focus Groups. A steering board leads the EIP-AGRI by providing strategic orientations for its implementation. A Standing Committee for Agricultural Research, composed of representatives from Member States and Candidate and Associated Countries, is coordinating agricultural research across the European Research Area.

Actors involved: Multi-stakeholder groups of representatives with relevant knowledge within innovation and agriculture -researchers, agribusinesses advisers, farmers, NGOs and other stakeholders.

Areas of work: Different areas of the agricultural sector network, such as Agroforestry, Genetic resources, Organic Farming, Protein crops, Circular horticulture, High Nature Value, etc.

The European Innovation Partnership on Water (EIP WATER)

Role: The partnership facilitates the development of innovative solutions to address major European and global water challenges.

Aim: to remove barriers by advancing and leveraging existing solutions. Promotes and initiates collaborative processes for change and innovation in the water sector across the public and private sector, non-governmental organizations and the general public.

Structural organization: led by a Steering Group consisting of high-level spanning both the demand and supply sides of the water sector. The Steering Group and EIP Water are supported by a Task Force.

Actors involved: Multi-stakeholder groups of representatives with relevant knowledge.

Areas of work: Eight priority areas that centre on challenges and opportunities in the water sector (water policy, planning and management, water utilities, water users, as well as the development of water-related solutions. Five thematic priorities have been selected: (i) Water reuse and recycling; (ii) Water and wastewater treatment, including recovery of resources; (iii) Water-energy nexus; (iv) Flood and drought risk management; (v) Ecosystem services.

3.1.6.4 European Environment Agency (EEA)

Role: to provide independent and sound information on the environment.

Aim: it works as an information source for those involved in developing, adopting, implementing and evaluating environmental policy, and also the general public. It helps the European Community, member states and cooperating countries to make decisions, informing about improving the environment, integrating environmental considerations into economic policies and moving towards sustainability.

Structural organization: established in 1993 by the European Union together with the European environment information and observation network (Eionet). The EEA management board and the Executive Director are assisted by the scientific committee in providing scientific advice and delivering professional opinion on any scientific matter in the areas of work undertaken by the Agency. The committee is composed of scientists from the EEA member-countries, covering a variety of environmental fields.

Actors involved: 33 member countries and six cooperating countries. The EEA works together with national focal points, typically national environment agencies or environment ministries. They are responsible for coordinating national networks involving many institutions.

Areas of work: all environment areas.

3.1.6.4.1 European Environment Information and Observation Network (EIONET)

Role: supporting the collection and organisation of data and the development and dissemination of information of the EEA.

Aim: to provide timely and quality-assured data, information and expertise for assessing the state of the environment in Europe and the pressures and driving forces acting upon it.

Structural organization: a partnership network of the EEA and its member and cooperating countries.

Actors involved: It consists of the EEA, six European Topic Centres (ETCs) and a network of around 1000 experts from 39 countries in up to 400 national bodies dealing with environmental information.

Areas of work: EIONET forms the basis of integrated environmental assessments and knowledge that is disseminated and made accessible through the EEA website. This information serves to support public participation at national, European and global level, environmental management processes and environmental policy making and assessment.

3.1.6.5 European Research Council (ERC)

Role: complementing funding activities in Europe such as those of the national research funding agencies. It is a flagship component of the European Union's Research Framework Programme for 2014 to 2020 and Horizon 2020.

Aim: to encourage the research in Europe, through competitive funding and to support investigator-driven frontier research across all fields.

Structural organization: it is a 'bottom-up', 'investigator-driven' research centre.

Actors involved: different researchers

Areas of work: ERC grants are awarded through open competition to projects in Europe. The sole criterion for selection is scientific excellence, the ERC expects that its grants will help to bring about new and unpredictable scientific and technological discoveries.

3.1.6.6 Research Executive Agency (REA)

Role: is a funding body for research and innovation. It manages EU research grants.

Aim: The Agency operates in a political framework created by the European Commission. It manages research proposals and funded projects under its portfolio and provides services to all activities funded under Horizon 2020.

Structural organization: is an autonomous body with its own legal entity. It is managed by a senior official seconded from the Commission, the Director, and by a governing board composed of parent DGs' representatives, the Steering Committee.

Areas of work: REA supports the DGs of the European Commission, which are in charge of all policy aspects of their respective research actions. IT manages the legacy of the FP7 actions from the previous mandate (SME actions, Marie Curie actions); manages a large share of the Horizon 2020 actions and provides services (expert management; validation services; logistical support for project evaluations and management of the Research Enquiry Service).

3.1.6.7 EUROSTAT

Role: the statistical office of the European Union.

Aim: to provide high quality statistics for Europe. The key task is to provide the European Union with statistics at European level, which enable comparisons between countries and regions.

Structural organization: is one of the Directorates-General of the European Commission, headed by a Director General and a Deputy Director General.

Actors involved: staff consists of more than 800 people, among them officials and temporary agents represent, contract agents and seconded national experts represent, trainees, employment agency staff and external service providers.

Areas of work: Eurostat is the statistical authority of the European Union. Eurostat co-ordinates statistical activities at Union level and more particularly inside the Commission.

3.1.6.8 Water Supply and Sanitation Technology Platform (WssTP)

Role: Fosters collaborative, innovative and integrated European Research and Technologies Development, provides global answers to global challenges for the next generations, addresses the challenges of an integrated and sustainable management of water resources and ensure the European growth and competitiveness of the water sector.

Aim: to make, by 2030, the European water sector a leading centre of expertise for providing safe, clean and affordable water services while protecting nature. WssTP represents a key mechanism to further coordinate pilot projects, demonstration and research in the water sector.

Structural organization: The Board of Directors is the decision making body, which implements the strategy of the platform, decided on by the General Assembly.

Actors involved: Working Groups that have different formats comparable with the current Task Forces. Representatives from different working groups compose the Steering Group that oversees all the work. WssTP consists of 178 members and a network of more than 700 individuals from research, technology providers, industry, policy makers and water users.

Areas of work: 16 working groups, such as Water and agri-food, Eco-system services, Green Infrastructure, Urban water pollution, etc.

3.1.7 The role of EU research for the EU policies related to quality of drinking water

In order to protect the quality of drinking water, the European Union along with it scientific support services, has developed an extensive set of directives, policies, guidelines, research projects, websites and literature.

The most important are the following directives that act on the quality of drinking water: Water Framework Directive, complemented by Drinking Water Directive, Ground Water Directive, Nitrates Directive and Directive on Sustainable Use of Pesticides.

Under the WFD, there are currently 34 guidance documents and technical reports in use, prepared by research bodies involved in the WFD. They are intended to provide overall methodology approach and to assist stakeholders in the implementation phase of the WFD [99]. Moreover, an internet-based platform called "CIRCABC" (Communication and Information Resource Centre for Administrations, Businesses and Citizens) is set up by the European Commission. It is used to create collaborative workspaces, where different stakeholders can work together and share information and resources.

The DWD has a three year cycle to be reported to the European Commission. The Commission assesses the results of water quality monitoring against the standards in the DWD with the help of research. After each reporting cycle, a synthesis report is produced, which summarizes the quality of drinking water and its improvement at European level. A Synthesis Report on the Quality of Drinking Water was adopted on 20 October 2016, examining the Member States' reports for the 2011-2013 period [87].

Within the GWD, a technical Working Group with different actors involved (researchers, agency representatives on Groundwater) was established. The group exchanges information and experience on groundwater issues related to the WFD (e.g. risk assessment, monitoring, chemical status, characterization of trends and programs of measures, etc.). Its aim is to implement the GWD and the groundwater elements of the WFD, in particular the monitoring and preparation of the first River Basin Management Plans [99, 88]. Working group members share information via different means, such as guidance documents, technical reports and workshops in which they gather participants' experience. There are currently five guidance documents and nine technical reports published, contributing to the implementation of EU water legislation [88].

The ND has a four year cycle, to be reported to the European Commission on the implementation of the Directive. DG Env also commissions studies on different aspects of the ND, in order to assist Member States in implementing the Directive, to extend scientific knowledge on best farming practices for protection of water quality and minimization of nitrogen losses from agriculture [96].

The DSUP, particularly in the form of compliance with the principles of integrated pest management, was excluded by the Commission from the Common Agricultural Policy (CAP). Unfortunately, very few Member States are taking its implementation seriously. In order to assist the implementation of DSUP, a Pesticides Action Network Europe, including different actors (researchers), was established. Its main role is to ensure that farmers start applying integrated pest management, that Member States engage and as a result that the DSUP becomes fully integrated into the CAP [97].

Created in 1962, CAP is one of the oldest polices of the European Union. Its main objectivities are to provide a stable, sustainably produced supply of safe food at affordable prices for Europeans and ensuring a decent standard of living for farmers and agricultural workers. The CAP contribution of the political priorities it's significant towards the delivery of the DG Agri objectives. The CAP implementation is assisted with instrument for pre-accession assistance in Rural Development. Following input from various stakeholders and scientific assessment, the DG initiates proposals for adoption by the Commission and consideration by the Council and the European Parliament. Once adopted, the DG works with Member States to ensure that the legislation is transposed and applied across the EU effectively, moreover DG also regularly evaluates the legislation and policies to ensure they are fit for purpose [96, 97].

As seen from the DG Agri annual report (2016), DG Agri acts through different types of interventions: (i) policy and economic analysis, evaluation and impact assessments of the overall policy conception and formulation of the CAP; (ii) contribution to the Instrument for pre-accession assistance for the part related to rural development; (iii) contribution to the negotiation of international agreements in areas of agricultural policy (food security, trade in agricultural products, quality policy, etc.); (iv) contributes to the implementation of such international agreements and manages the relations with third countries related to agriculture; (v) preparation of legislative proposals and negotiates them with other institutions and monitors their implementation to ensure a harmonized application [81]. Currently there are different service contracts for DG Agri, available through calls for tender. There are currently ongoing different evaluation studies of CAP (see example) and different pilot projects [105].

DG Environment represents the EU at a wide-range of environmental meetings in international fora such as the United Nations, in multilateral environmental agreements and in other international fora

when environment-related matters are discussed. The DG Environment makes funding available through two different programmes (LIFE fund and the Eco-Innovation and Competitiveness and Innovation Framework Programme) and trough operating grants to environmental non-governmental organisations (NGOs) [106].

All three programmes are financed through grants. The Commission also organises procurement tenders see examples). DG Envi sub-program for Environment finances scientific projects dedicated to promoting environmental protection, resource efficiency, nature and biodiversity conservation as well as governance and information in these priority areas within the EU [82].

The DG R&I contributes particularly to the Commission's priorities for Growth, Jobs and Investment, the Energy Union, the Digital Single Market and the EU as a global actor. This includes working with the Member States to improve the level and quality of public investment in research and innovation, through the European Semester, the Policy Support Facility and the development of the European Research Area. Thirteen Research and Innovation policy-related, country specific recommendations were issued in 2016, highlighting the need to boost innovation, enhance productivity and private investment, strengthen governance for research and innovation, etc. [83].

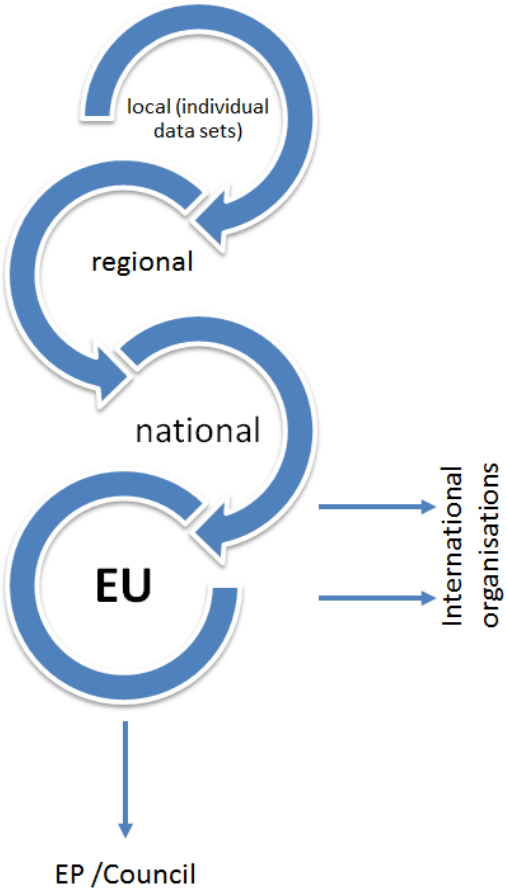

Figure 3: The data flow process for implementation of environmental legislation in EU [95].

European policy for research and technological development (RTD) is also an important area of European legislation. It has been extended in the early 1980s with the establishment of a European framework programme for research. EU research funding has been now grouped into Horizon 2020 and the 8th EU Framework Programme for Research and Innovation covering the period 2014-2020 [98].

In 2002 The European Research Area Net (ERA-NET) was launched, to support the coordination and collaboration of national and regional research programmes. It sets up the coordination of programmes carried in the Member States and associated countries through networking and implementation of joint activities.

Horizon 2020 covers the operational costs for European Cooperation in Science and Technology (COST) designed to help to coordinate nationally funded research at European level. Furthermore, Horizon 2020 also coordinates its activities with the intergovernmental EUREKA initiative to promote international, market-oriented research and innovation. This helps research organisations and industries introducing new processes, services and products to market [98].

The European Commission is monitoring the implementation of EU legislation in the EU Member States, through reporting and monitoring. Based on their own internal monitoring, the EU Member States, are submitting information and data to the European Commission, which then analyses these national reports and presents its findings in various ways (implementation reports, indicators and scoreboards, other publications). The European Commission is often working in collaboration with Eurostat, the Joint Research Centre or other agencies depending on the legislation concerned. Environmental monitoring usually leads to data collection and reporting (Figure 1). It starts with the collection of individual data sets on a local scale and continues with the first level of spatial aggregation, on the regional scale. Second is the national level of spatial aggregation that reports to the third level, the European Union level. The data collected on this level is transmitted through different EEA and European Commission reports to the European Parliament or Council and the different international organizations, such as the United Nations [95].On the other hand, bottom up, European citizens can form a citizens' initiative. It works as an invitation to the European Commission to propose legislation on matters where the EU has competence to legislate. It has to be backed by at least one million EU citizens, coming from at least 7 out of the 28 member states. A citizens' initiative can be formed for any field where the Commission has the power to propose legislation, for example agriculture, environment or public health [102]. Moreover, the European Commission highlights the importance of national justice systems and the rule of law. Effective national justice systems are crucial for the implementation of EU law, for the strengthening of mutual trust and for upholding the values upon which the EU is founded. Effective justice systems are also key players in providing greater regulatory predictability, creating an investment friendly environment or restoring confidence and sustainable growth [108].

Since the establishment of the European Commission, there were 180 European projects with the word WATER in the Acronym Project and 75 with the word AGRI, under different founding systems (Framework founding, Horizon 2020, European Research Center, etc.) [86]. Moreover, inter-governmental joint programming initiatives are formed to tackle major societal challenges unable to be addressed by individual countries. This are contributions to the development of the European Research Area. In 2010, the joint programming initiative ‘Water challenges for a changing world’, the Water JPI was formed. It tackles the challenge of achieving sustainable water systems for a sustainable economy in Europe and abroad [100]. Knowledge and innovation communities bring together higher education, research, business and entrepreneurship in order to produce new innovations and new innovation models that can inspire others to follow. They are created by the European Institute of Innovation and Technology (EIT), founded in 2008 [100].

3.1.7.1 Assesment of Scientific Policy Types

There are reasons to believe, that certain policy support work better than other as some have a cleaner message for the final recipient. For example, Service contracts that address specific questions of DGs are more successful than big FP7 or H2020 projects, with high quality scientific output but often without clear messages for the final recipient.

3.2 Results of the Workshop: "Evaluation of the issues/barriers around providing integrated scientific support for EU policy"

3.2.1 Key Workshop Facts

The workshop on *Evaluation of the issues/ barriers around providing integrated scientific support for EU policy*" was held in Brussels, on December 6th, 2017. The workshop was led by Fairway Partner University of Ljubljana, as part of the work in Work Package 7, task 7.1.

Main objective: to discuss with representative EU-level actor organisations the EU regulations related to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture.

Workshop type: World café

Duration time: 3 hours (1.00 p.m. - 4.00 p.m.)

Venue: Vlaams-Europees Brussels (VLEVA), Belgium

Participant number: 10

Figure 4: Collage of differnet workshop activities (Foto by: Špela Železnikar)

3.2.2 Key Workshop Results and Discussion

The main purpose of the workshop was to get the answers on the following 4 questions:

1. What do you consider to be the main **issues** on the EU level related to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture in EU?

2. What do you consider to be the main **barriers** in solving the issues in the EU regulations related to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture in EU?

3. By your opinion how the **relationship between science and policy** in the EU regulations is reflected in EU legislation, with special attention to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture?

4. By your opinion how the system at EU level can be improved, i.e. what are the **possible solutions** for integrated scientific support for EU policy related to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture?

Table 2: Main discussion points on Question 1 (main issues)

Main discussion points of the Group 1	Main discussion points of the Group 2
• Balance between EU objectives can be conflictive. How to define balance? • Policy coherence: transition at member state / regional level • Synergise between different goals - cooperation • Apply the people-planet - profile principle	• Fragmented data and not easy available • More harmonisation of legislation • Financial question: Who is paying? • World motivation: Patience will help, development is already positive. Listen to experts

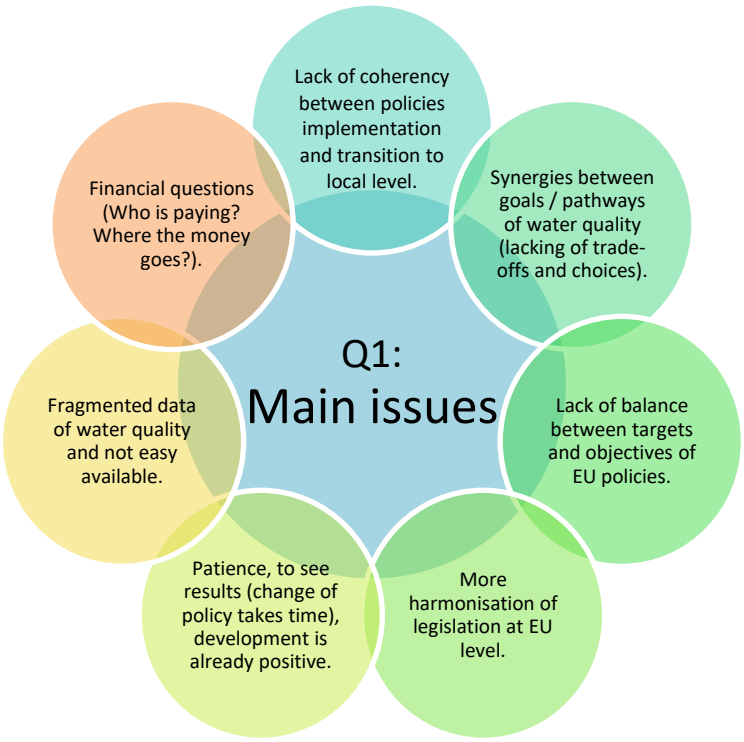

Figure 5: Key results points for question 1

The debate around the question of issues related to drinking water quality, first tackled the problem of nitrates. It evolved that nitrates are not necessarily bad since they are naturally occurring (but not those from mineral sources), but the topic of pesticides may be more complex than the topic of nitrate. The second point of debate was the share of EU funds over targets. Participants discussed over the topic, if there is more budged needed to achieve the targets or if the main issues related to drinking water are connected with the lack of funds for this topic / area of work.

The discussion on main barriers in solving the issues in the EU regulations related to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture in EU highlighted the following main barriers that are presented in Figure 6.

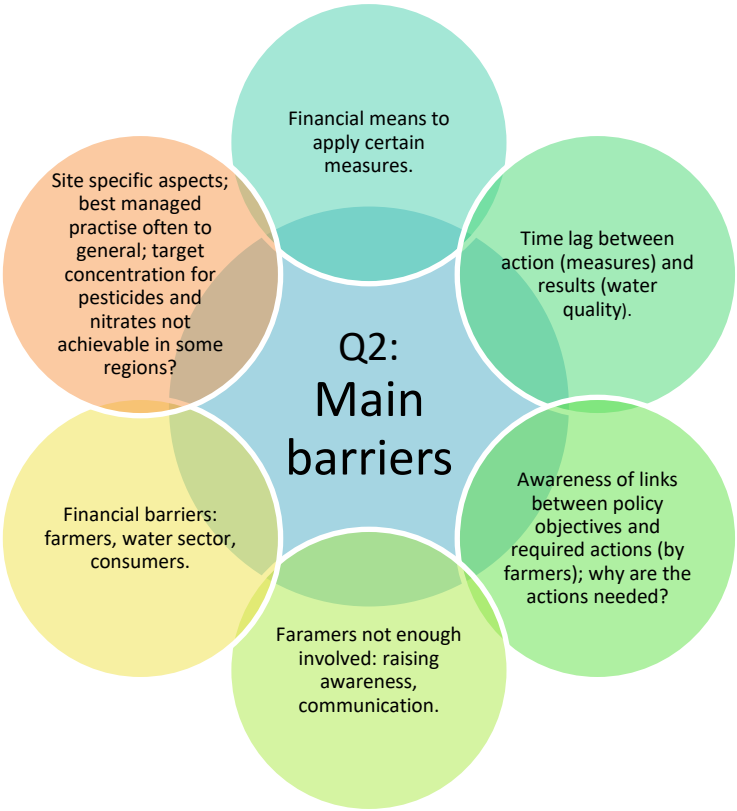

Figure 6: Key results points for question 2

Among the barriers exposed, the first was that we have to consider socio-cultural factors / differences between member states countries and other regions in Europe. Especially the perception of environmental education and barriers for implementation of policy is different member states countries. Moreover, also problems with translation and transposition of EU policies on local level were highlighted and also the topic of lack of funding for implementation of measures was omnipresent.

Table 3: Main discussion points on Question 3 (How relationship between science and policy is reflected in EU legislation?)

Main discussion points of the Group 1	Main discussion points of the Group 2
• Is there a relationship? • All directives are based on science based evidence: It could be improved. Is really all science? • Populistic decisions • Policy makers don't always understand the science. They should ask and listen to experts (political lack of knowledge) • More education for political science • Social awareness • Politics are not connected with practical world (nobody works in agriculture): weak connection in public eyes; farming ≠nature	• Water framework directive: Member states don't have substantial level of subsidy • Science -Policy should be implemented at local level, followed in regional and national level • It is difficult to find communication between member states • Science based policy yes, but do we really want this? • MAP is a way to engage stakeholders • Links are not strong enough (ex. Common agriculture Policy -European Innovation Partnership -agriculture) • Science -Policy interface: science ↔education↔ policy • Science and policy are not so different: allow public policy • More scientist tackle complexity of a problem • Maybe water is not a priority of EU -not enough science support

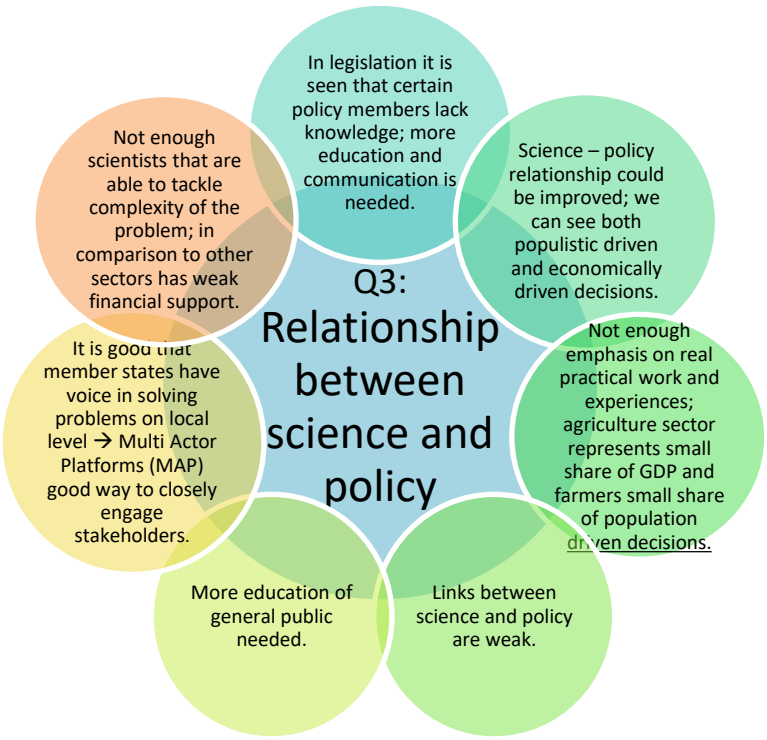

Figure 7: Key results points for question 3

At the question of evaluation on how the relationship between science and policy is reflected in EU legislation, the topic of public participation or "democracy" in science was highlighted. It can be dangerous, because if something is scientifically correct we cannot discuss it and change it to suit the popular sense. Participants debated around the fact that scientific work should be done independently, because it is a methodological process (while policy is a democratic process). Public could be involved in determining priorities about which issues are important to investigate and also as a part of science itself, (.e. effects of sociologic factors). When the research is finished, the topic should be presented to the public so that everyone interested knows what is going on and then the information can be used in democratic policy making processes.

Table 4: Main discussion points on Question 4 (Solutions for improvement of the system/the integrated scientific support for European level policy)

Main discussion points of the Group 1	Main discussion points of the Group 2
• Nitrates and pesticides have to be dealt separately • Communication should be strengthen (case studies and best practise) • Multiactors approach should help	• Multipurpose data (management, use and share of data) • Trust building • More research into OG`s (more interactions) • Better time alignment • RIA and policy • Strengthen the science policy relation with different actors

Figure 8: Key results points for question 4

The main debate around question four - solutions for improvement, evolved by highlighting some policy actions hints / solutions for: use language that is easy for policy makers; really make clear what are the aspects of the project, meet in live with other project participants and stakeholders involved.

3.3 Interviews results

3.3.1 Question 1:

What do you consider to be the main issues on the EU level related to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture in EU?

Interviewees highlighted **two main issues** related to drinking water resource protection. **Lack of field knowledge and that drinking water protection is local issue with local characteristics.** There are also governance issues, where there is a **question of communication** between water authorities, people who draw up river basin management plans, the farming community and agriculture departments. Moreover they all agreed that, **more bottom up inclusive processes have to be stimulated in the field of water resource protection**. Furthermore, the issue of pollution from overstocking was mentioned, especially in Northern Europe areas, but also in other places in Europe. We have to be aware that many of the pollution issues come from farms that don't actually have land. On the farms that don't have land, the CAP doesn't have that sort of leverage that people imagine. Also, one of the interviewees noted the problem on farms for arable crops, where there are problems of non-application or inconsistent application of nutrient management planning, that leads to overuse and also sometimes, to nutrient depletion.

Hereinafter we can divide the answers into two parts, **nitrates and pesticides issues**. One of the issues that were mentioned about the nitrates is that ND does not send an end point by which certain results have to be achieved, unlike the WFD. Also, the ND takes a very long time in delivering results. There is a wide, different interpretation about what role the ND should play in the WFD in addressing the nitrate pollution issues. This is linked again on if, the WFD interplay should be mandatory uncompensated or voluntary compensated. There is also a big variation on how MS have addressed this issue. The predominant approach so far has been that MS do as little they can to get away with under the ND (those are the measures that become mandatory for farmers). Then the approach is that they include voluntary measures as part of WFD implementation. When it comes to pollution with nitrates another issue can be the costs related to the investments that are needed for compliance. Example: for small farmers it can be difficult to comply with manure storage requirements. Also, when the norms are already enforced for some time now, EU money can no longer support investments for compliance. There is also the problem of the overuse of manure and mineral fertilisers in many regions of EU. These are the well-known regions with intensive livestock farming systems, such as the regions in Germany, Flanders in Belgium, Netherlands, Brittany, Catalonia and regions with intensively managed cropping systems, such as vegetables, which can be found in most EU countries. In these regions, the nitrogen inputs are much higher than the crop uptake and the surplus of nitrogen is lost to the environment, including leaching as nitrate to groundwater and surface water. Very few MS has set out a comprehensive approach that works out what, is the load reduction that we need to achieve objective and therefore what should be done under the ND and WFD to meet a defined target goal.

The main issue of pesticides on the EU level is the implementation of the sustainable use of pesticides directive (SUPD). The implementation of this has been delayed in MS, also the reports on the implementation on this are 2 years delayed. There is a huge increase in pesticides so the adoption of integrated pest management across Europe should be pushed forward. The main reason for the delay is political, these issues used to be dealt by DG ENVI, but they were moved and decided

that they are a no on a priority list. This report should be the main toll in helping address the issue of pesticides on all areas, not just drinking water.

There is quite a lot of legislation "under the implementation", but generally the legislation does not need to be changed, **it just needs to be implemented by MS**. The main issue at EU level is political, not a science issue. The process of water resource protection is mainly limited by politicians that don't want to impose costs on farmers. All of the tools are here, if only there was a political will to actually achieve the outcome of water resource protection against diffuse pollution.

3.3.2 Question 2:

What do you consider to be the main barriers in solving the issues in the EU regulations related to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture in EU?

There were three main barriers exposed by our respondents. **One of them is again political; there is a lack of political will to impose regulations and costs onto farmers.** It also costs a lot to provide good advisory services and regulatory bodies to check, whether what is happening on a farm is what should be happening. This all costs money, so this has to be a political priority.

The second barrier highlighted was that there needs to be capacity in advisory services and on regulatory bodies. More is needed than guidelines, i.e. engagement and (auto)control of local actors. There also needs to be willingness to address these issues. The nature of diffuse pollution is much more difficult to manage than it is point source pollution. For example, it is very difficult to control thousands of farmers who have taken individual actions. **Their lack of knowledge on environmental issues in relation to farming practices (and EU policies) and economic reasons is a big barrier too. Farmers are often not aware of the objectives of EU policies (e.g. the need to decrease nitrate leaching, because of drinking water protection) and which measures can be taken to decrease leaching.** In addition, **manure and fertiliser are often cheap and from an economic perspective farmers want to apply more than sufficient amounts of nitrogen to avoid risk of low yields.** In regions with intensive livestock, manures are often seen as waste and are applied (disposed) to soils in the surroundings of the livestock farm, because transport of manure to other regions is expensive. Also, when farmers need investments, they don't comply in time and then they can't have the benefits of EU or national funding for compliance with existing norms, in order to carry out these investments.

On the other hand, **we also have good, positive examples in Europe**. **In Scotland they have a targeted approach to identify catchments of higher priority (for drinking water or high value fisheries).** They are putting their resources into these areas, map all of the problems and then go back repeatedly to farmers and give them advice. They also give them money to resolve the issues, and then if they haven't resolved it after the third time, there is a fine. This is really a clear, targeted strategy to deliver results. This example stands out, as a real targeted approach to achieve results in a given area. But unfortunately, if this was not a political priority, all this efforts would never be put in.

The third, highlighted barrier is the lack of communication or the different timing between different instruments. The common agriculture planning is different from the WFD reporting. It happens that when national rural development programme is prepared, river basin management

plans are not yet approved etc. Also where agriculture is a very profitable business there is a question of balancing societal interests between maintaining the economic benefit at supporting decisive measures for addressing the pressure on the environment.

3.3.3 Question 3:

By your opinion how the relationship between science and policy in the EU regulations is reflected in EU legislation, with special attention to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture?

The link is there - in the legislations, but it doesn't specify how this should be done, this is MS decision. **There is a big difference between the science- policy links that has been made at MS level**. There is a clear link between science and policy in for example the ND and WFD. The nitrates action plan, which has to be established every 4 years should be based on monitoring and the results from the previous plan. If there is a feedback mechanism, we can understand what a previous plan has achieved and we can design our next set of measures based on that.

Also the WFD has articles on different classifications and then you need to draw up a plan that includes the programs of measures that will address the problem. **There is a link established between: you know what the situation is - you know what you did before - you know where you need to get to - and then you should make the most cost effective measures to achieve this.** A very **good example can be seen in Ireland on agriculture catchments program**, where they trial in different catchments lots of different measures to address diffuse pollution. **The measures that work best are the ones that then make it to the ND action programme and are included in the rural development program to be funded. Like a laboratory, to demonstrate certain measures, show farmers the work so they can understand them and then this gets incorporated into the national programmes.** This is best practice, not visible in other MS. Behind this agriculture catchments programme in Ireland, there was of course the political will to address this issue. **The link is very clearly established, there is good work in relationship between the environment department, the agriculture department, the agriculture advisory services and the science together.** This often does not work in many MS, there isn't even a common agreement between the agriculture and the environment side on what should be done.

There should be more opportunities for scientific expertise to be included in policy making. The policy making cycle is sometimes so fast you don't have enough time/space to include moments where you should ask independent scientific advice that is not the most available one but the most valuable one. Moreover, **in the EU research projects, the dissemination is not really followed trough.** The dissemination is very formal and birocratic, they don't really look if they had use the maximum way to make impact with their findings. Sometimes the way the commission uses the results of these projects is not straight forward, it's not clear. The CORDIS web platform is not always helpful; **it looks like the EU is only funding the project and not really using the information the projects give.** The EU is putting a lot of money into these projects, so they could put a little bit of money into making sure the most is made out of the results. An idea could be to have a functional system of disseminating summaries, by topic, to civil servants that could actually use the information.

Moreover, there are service contracts for DG Environment implementation of the Nitrates Directive ongoing and available. Studies include the assessments of nitrate action plans (with measures) of

member states and general studies about aspect related to nitrate leaching. The Commission uses the results of these studies in the discussion with the member states. This means that **there is a clear role of science in supporting the implementation of the Nitrates Directive.** The Commission has similar Service Contracts for other environmental directives, so in general the commission uses scientific information in their regulations from specific Service Contracts. However, **it is doubtful if this information is really used by the member states and farmers.** It is also not clear how the results of other, and often more general, projects, and especially the H2020 projects, are used by the Commission. One of the most relevant factors is the resource availability at the European Commission, where within the European institutions the highest levels of technical knowledge and assessment are located. There is not enough staff available to deal with all EC key tasks, so complementary ones like science-to-policy cannot be addressed.

3.3.4 Question 4:

By your opinion how the system at EU level can be improved, i.e. what are the possible solutions for integrated scientific support for EU policy related to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture?

Much of this is a **national implementation issue**. **What can be addressed and done primarily at EU level is the reform of the CAP.** Another area is to make sure that, there are **clearly defined indicators in the monitoring and evaluation of the CAP**. Article VII.[3] of the WFD requires measures to be put in place at catchments level, this reduces the need for water companies to reduce the pollution. This should be a measure that is also reflected into the agricultural legislation, to make sure that the costs are picked up by the CAP budged and not on drinking water providers. In the water legislation, the WFD has to be reviewed in 2019 and there should be a possibility to explicitly strengthen the science-policy interface. This, does not only apply to EU policy related to water, but also at the attitude of policy makers and administrators towards what is going on or needs to be or it's going to change, because of technological change.

Now, **policy is made based on indicators, data that are sometimes inconsistent, sometimes even outdated.** With the digital revolution, with machine learning and data mining, **we could/should have a real time picture of what is going on** (for example in water use in Europe). **Many of the current instruments and mechanisms need to be adapted.** We can no longer use a type of measure that is implemented unchangingly for 6 years, but **we have to be able to monitor in real time and adapt to make more value per public money spent. The whole relationship between data, information and decision making needs to change because of these new mechanisms and instruments.**

One of the solutions for EU decision makers and locals would be to equip themselves, to make use of these changes and new technologies. To use data platforms, use data mining. Use it in the "feedback loop" way, you do something and have feedback, you can adjust it, you can use the information from other fields and departments (the EU is actively pushing for data re-use and open data). Now we have data bases which we use for a single purpose of subsidy payments to farmers. With the approach mentioned above, **we could use the same data for different purposes**. A win-win solution could be improve the way we do agriculture, be mindful of what the public or tax payers expect from farmers and the farming community, why they support the CAP, and be ready for

[3] Article VII. of the WFD promotes impacts on diffuse pesticide pollution, potable water decision making and catchment management strategy.

change in order to deliver these results. **Another improvement that is needed is that the policy makers of member states (national and local level) and farmers and other stakeholders can use the results of the ongoing projects.** This demands for specific dissemination techniques for specific audience and in the local language. The scientific knowledge is mostly available and **we should translate this knowledge into information that farmers and stakeholders at the local level can use in practice.**

Besides the Service Contracts mentioned in question 3, we could also have the involvement of civil servants of Commission in the projects, such as H2020 projects, so they can be improved. This can be done by giving the civil servants of the Commission a clear role in the project (example by presentations, active role in workshop, interviews etc.). Furthermore, some projects just focus on "their business" disregard whether the topic is on the political agenda of the EC or not, with the aim to "tick boxes" fulfilling the Grant Agreement obligations. One trend to make this more "digestible" for all is via the establishment of project clusters, aiming for longer-term approaches/teams and the use of gatekeepers in the relationships/communication flows.

4. POSSIBLE SOLUTIONS TO SOME OF THE IDENTIFIED PROBLEMS IN POLICY MAKING

In different parts of the research (desk study, workshop, interviews) different problems and barriers that arise in the process related to drinking water resource protection against diffuse pollution of nitrates and pesticides from agriculture in EU and in the relationship between science and policy, have been identified. In the following, we tried to find possible alternative solutions for the identified problems and some possible policy design solutions.

We followed policy cycle framework, which we had to adjust slightly for our case and our needs.

The policy cycle framework originates from the idea of organizing and ordering the complexity of policymaking. It is a heuristic tool through which different stages of the ongoing and never-ending dynamics of policy processes can be segmented and then analysed. It was originally proposed by Lasswell in 1956, the founder of modern policy analysis and public policy, and is still considered one of the essentials in the conceptual toolbox of policy scholars. The policy cycle - also called the "stages approaches to policy process" - does not have any explanatory relevance and is thus not at the theoretical core of public policy (where there is a richness of different theoretical frameworks). However, it is a powerful conceptual tool to simplify and make "workable" the complexity of policymaking. The cycle is usually divided into five stages: agenda setting, formulation, decision-making, implementation, and evaluation [110].

There are many ways to represent the policy cycle. As highlighted by Young and Quinn (2002), "*it is important to emphasise that policy processes are never as linear, or cyclical, as implied in the model. But, looking at the policy process in terms of these stages or functional elements can help us to understand how this process does (or should) work.*"

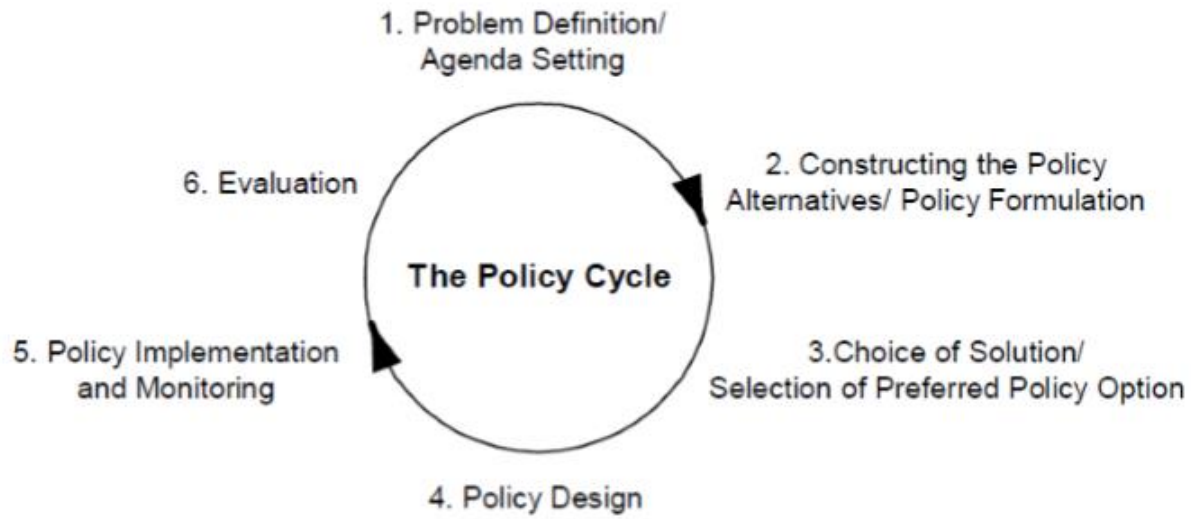

Figure 9: The Policy Cycle [111]

PROBLEM 1

IDENTIFICATION OF POLICY ISSUES

(broad policy objectives)

Lack of coherency between policies implementation and transition to the local level in individual states.

AGENDA ON ALTERNATIVES

ASSESSMENT OF CURRENT POLICIES

(side effects, what is already meet, cost-benefit, needed adjustments/new policies and monitoring of measures)

Policy implementation and transition to the local level has a clear and unified set of rules, not just recommendations and a set of examples.

The bottom-up, inclusive processes should be stimulated in the field of water resource protection.

Farmers should be more involved in the process of awareness-raising and communication about practical outcomes of policies.

Take into account socio-cultural differences when thinking about implementation.

Involve science to improve knowledge of stakeholders on good agricultural and environmental conditions in relation to cross-compliance of farming practices. Improve knowledge on EU policies and reasons for implementation (environmental and economic).

FORMULATION OF PREFERRED OPTION

SET DESIRABLE FEATURE OF NEW POLICY

(specify precise characteristics/options of the new policy, adjustments of stakeholders)

Strengthen the science and policy interface.

All policy decision should have science-based study. However, we cannot avoid populistic driven and economically driven decisions.

Involve the public in determining prioritizing issues that will be investigated by science. Science presents results to the public on the current status. Information's are used in the democratic policy-making process.

Set clear objectives by which specific results have to be achieved. More binding rules with a list of compulsory measures to limit various interpretations.

IMPLEMENTATION PROCESS

POLICY DESIGN SOLUTIONS

(in practice optimized process)

States have to improve the national system and introduce solutions for enhancing scientific support in the policy-making interface.

Relevant scientific knowledge must be available translated into information's and languages that stakeholders at the local level can use in practice.

Strengthen trust among concerned actors, inter alliance, thought non-concerned databases on various levels (easily accessible).

PROBLEM 2

IDENTIFICATION OF POLICY ISSUES

(broad policy objectives)

Lack of synergies between goals and pathways to achieve good water quality (lacking trade-offs and choices).

AGENDA ON ALTERNATIVES

ASSESSMENT OF CURRENT POLICIES

(side effects, what is already meet, cost-benefit, needed adjustments/new policies and monitoring of measures)

Support proper implementation of directives in member states. Avoid prioritizing policy measures by political line.

Build awareness (science)of links between policy objectives and required actions by farmers.

The agricultural sector should directly participate in setting goals and pathways of policies by giving choices of future farm development.

Science should be involved in supporting policy makers by knowledge sharing.

FORMULATION OF PREFERRED OPTION

SET DESIRABLE FEATURE OF NEW POLICY

(specify precise characteristics/options of the new policy, adjustments of stakeholders)

Design goal-oriented clusters consisting of expert representatives from different sectors qualified to design optimal pathways and reach a compromise.

All policies should have action plans and a policy evaluation process. This will help us understand previous accomplishments and serve as a base for the design of the next plan.
Science and research should take a central role in this process.
Prepare program on improvement of education and communication skills of policy members.

This will improve the relationship between science and policy and buffer populistic and economically driven decisions.

IMPLEMENTATION PROCESS

POLICY DESIGN SOLUTIONS

(in practice optimized process)

Regular reviews of WFD of CAP RDP are processes that allow the opportunity to enhance the role of science in policy making and set a new attitude for policy makers and administrators regarding the current status, needs, or upcoming changes due to technological, practical or environmental changes in all connected sectors.

Establish project clusters (science, policy, stakeholders, and citizens) aimed at longer-term approaches/teams and the use of gatekeepers in the relationship/communication flows.

Separate Pesticides and Nitrates in communications as these are two different expert field and environmental impact.

PROBLEM 3

IDENTIFICATION OF POLICY ISSUES

(broad policy objectives)

Lack of balance and harmonization between targets and objectives of the EU policies.

AGENDA ON ALTERNATIVES

ASSESSMENT OF CURRENT POLICIES

(side effects, what is already meet, cost-benefit, needed adjustments/new policies and monitoring of measures)

Synchronization of different instruments planning cycles. The WFD RBMP and CAP RDP are out of sync. One ends when the other starts.

Interpretation of roles of a specific directive in relation to another should be addressed at the EU level.

All directives should specify the objective by which specific results have to be achieved.

Awareness of links between policy objectives and required actions (by farmers).

Work on communication and synchronization of languages between scientists and policy makers

FORMULATION OF PREFERRED OPTION

SET DESIRABLE FEATURE OF NEW POLICY

(specify precise characteristics/options of the new policy, adjustments of stakeholders)

Increase the number of the workforce at EC institution to lower staff workload to increase science-policy interactions.

Improve communication between staff at different DG (DG Environment, DG Agriculture) on designing policies at harmonized time frames of implementation, monitoring and evaluation.

Engage scientist with broad knowledge on integrated river basin management, designing policy objectives, and on roles, certain stakeholder has to play-out for successful policy implementation EU wide.

IMPLEMENTATION PROCESS

POLICY DESIGN SOLUTIONS

(in practice optimized process)

Professionalize communication from RIA projects.

Make use of new technologies, for example, the use of data platforms and data mining. These technologies and information from other fields and departments can be used as a "feedback loop", where one does something, gets feedback, and can then adjust decision-based on the new input.

Support Independent research, Silo-breaking of closed groups hiding knowledge and Multi-Actor Platform Involvement to establish a balance among policies.

PROBLEM 4 **IDENTIFICATION OF POLICY ISSUES** (broad policy objectives)
Impatience, to see results as the change of policy takes time; development is already positive.
AGENDA ON ALTERNATIVES **ASSESSMENT OF CURRENT POLICIES** (side effects, what is already meet, cost-benefit, needed adjustments/new policies and monitoring of measures)
Reduce the time lag between research, policy change, action (measures) and results (water quality). Site-specific aspects of the identification of best measures are crucial to observe the best results. While some measures may in certain regions return a poor result, may in other be perfect.
FORMULATION OF PREFERRED OPTION **SET DESIRABLE FEATURE OF NEW POLICY** (specify precise characteristics/options of the new policy, adjustments of stakeholders)
The debureaucratization mechanisms needed in science and research project dissemination. There is not enough emphasis on real practical work and experiences; the agriculture sector (production, processing, trade, science) represents a small share of GDP and farmers' small population share. So, decisions are slow, gradual and economically driven. Not enough scientists can tackle the complexity of the problem; in comparison to other sectors that have weak financial support.
IMPLEMENTATION PROCESS **POLICY DESIGN SOLUTIONS** (in practice optimized process)
Many of the current instruments and mechanisms need to adapt and evolve. Implemented measures must constantly evolve (not on six years) based on obtained monitoring information and studies. Better time alignment between research and innovation projects and policy development (more interactions and complementary).

PROBLEM 5 **IDENTIFICATION OF POLICY ISSUES** (broad policy objectives)
Fragmented data on water quality and difficult accessibility of data.
AGENDA ON ALTERNATIVES **ASSESSMENT OF CURRENT POLICIES** (side effects, what is already meet, cost-benefit, needed adjustments/new policies and monitoring of measures)
Secure steady financial resources to monitor data on measures efficiency by science at farm level, river basin or consumers field scale. More site-specific data can broaden the knowledge of policy makers to accept better decisions. Set out a comprehensive approach to monitor all polluters at the same level. Secure financial means for good advisory services and control bodies to check what is happening or should be happening on farms. Involve science and build capacity in advisory services to implement measures and regulatory bodies on monitoring measures efficiency and water quality.
FORMULATION OF PREFERRED OPTION **SET DESIRABLE FEATURE OF NEW POLICY** (specify precise characteristics/options of the new policy, adjustments of stakeholders)
Make all data and deliverables reports obtained in science-research projects and service contracts publicly available on the CORDIS web platform. Public servants in EC and MS involved in policy making would have access to all information's provided by science. Set EU unified indicators for monitoring and evaluation of the results.
IMPLEMENTATION PROCESS **POLICY DESIGN SOLUTIONS** (in practice optimized process)
Digitize the processes; with machine learning and data mining, a real-time picture of what is happening must be obtained (for example, with water quality in Europe). The monitoring system and measure adapting must be done in real-time to provide more value for the public money spent. The entire relationship between data, information and decision making needs to change and speed up. Support and promote pushing for data reuse and open data.

PROBLEM 6 **IDENTIFICATION OF POLICY ISSUES** (broad policy objectives)
The flow of the money in the research community. Available budgets and allocation of the funds.
AGENDA ON ALTERNATIVES **ASSESSMENT OF CURRENT POLICIES** (side effects, what is already meet, cost-benefit, needed adjustments/new policies and monitoring of measures)
Support target studies with a clear aim to be resolved instead of broad general studies with general solutions. Secure new financial sources, out of agriculture, to apply certain measures from the water/environmental sector. Eliminate/reduce financial barriers that limit science, agriculture sector, farmers, water sector and consumers involvement.
FORMULATION OF PREFERRED OPTION **SET DESIRABLE FEATURE OF NEW POLICY** (specify precise characteristics/options of the new policy, adjustments of stakeholders)
Science -policy relationship could be improved; we can see both populistic driven and economically driven decisions. Design special program on educating the general public. To better understand the role of policy making, science, agriculture and water sector in protecting drinking water. Design special program to support integrated river basin exchange programs for scientists that will tackle the complexity of the drinking water protection problem. In comparison to other sectors, agri-water scientists have weak financial support.
IMPLEMENTATION PROCESS **POLICY DESIGN SOLUTIONS** (in practice optimized process)
Civil servants of the commission must have regular involvement in projects, such as H2020 projects, to obtain new knowledge throughout the project. Support solutions that enhance the role of local science level in the case of agricultural impacts on drinking water quality. Funds should be secured at the national or regional level. WFD, ND, DWD and other directives allow member state politicians to prepare tailor-made measures in cooperation with science and sufficient funding, contributing to clean surface and groundwater drinking water resources.

5. CONCLUSIONS

Now days, society is challenged with the sustainable management of water resources. This includes implementing agricultural practices that make efficient use of water and safeguard water quality [107].

Assurance that water resources are allocated efficiently and equitably and achieve environmental, social and economic beneficial outcomes -including the conservation of ecosystems, should be the main responsibility of water managers and users and the scope of sustainable management of water resources in agriculture [108]. Agriculture can also deliver ecosystem disservices or undesirable effects that include groundwater depletion, habitat loss associated with agricultural development, the diversion of rivers and the potential contamination of surface waters with nitrates and pesticides [109].

The EU has a well-developed system of water protection legislation, the backbone of which is the WFD which protects water resources for human use and the environment. This directive is in-part a European Commission response to public concern over water pollution [99, 90]. Furthermore, the new CAP and Rural Development programme include cross compliance and other methods that will help ensure the quality and quantity of Europe's freshwater systems. And also require MS to draw up RBMP.

The workshop debate pointed out issues in relation to nitrates which may not be necessarily bad since they are naturally occurring but pesticides are much more complex. Issues are also related to limited budged, for research and development, needed to achieve the targets of good drinking water for all EU population. Barriers for more efficient system at EU level are mostly connected to socio-cultural differences between member states countries and regions in Europe, reflecting value, education and policy system. All these influence the understanding of EU regulation and their transposition on local level. Reflection of relationship between science and policy in EU legislation opened discussion about public participation or "democracy" in science where public discussions and popular actions of politics can overlook or even change scientifically correct results to suit their agendas. Science as methodological process should be done independently, while policy is a democratic process. Research results should be made public and available for democratic policy making processes. Solutions for improvement call scientists to use language understandable by policy makers and to communicate and resolve with stakeholders in person.

Interviewees highlighted issues in connection to lack of field knowledge and that drinking water protection is local issue with local characteristics. These levees MS to decide on the process for addressing the issues. Nitrate directive does not have target date by which certain results have to be achieved, unlike the WFD. Very few MS set exact load reduction that needs to be achieved Implementation of the sustainable use of pesticides directive (SUPD) has been delayed in MS. There is a lot of legislation "under the implementation", which does not need changes, but rather firm implemented by MS. Tools for that are available and only political will is needed to reach target goals. Expressed barriers are connected with lack of political will, scarce instruction on the legislation implementation process, lack of opportunities for science to be included in policy making. However,

examples from MS show that each has their way of establishing links between environment and agriculture and science and policy making.

While EU research projects disseminations are not really followed through to EC, are service contract studies for DGs ongoing and available. Commission uses the results of these studies in the discussion with the MS, showing that there is a clear role of science in supporting the implementation EU legislation. Solution are clear as system at EU level can be improved, however much of this is a national implementation issue. A lot of work is possible to fulfil trough EU CAP, however clear indicators for the monitoring and evaluation of the CAP have to be defined. Goals of WFD should be much more reflected trough measures in RDP, to make sure that the costs are picked up by the CAP budged and by drinking water providers. Data bases used for agricultural subsidy payments could be used for implementation of environmental measures. Furthermore, some projects just focus on "their business" disregard whether the topic is on the political agenda of the EC or not, with the aim to "tick boxes" fulfilling the Grant Agreement obligations. One trend to make the research project more connected to "up to date" challenges is establishment of project clusters, aiming for longer-term the relationships/communication flows.

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