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Despite Great Expectations in the Seine River Basin, the WFD Did Not Reduce Diffuse Pollution

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ABSTRACT: European stakeholders engaged in combatting the eutrophication of the North Sea welcomed three Water Framework Directive innovations: a more holistic approach to quality, the binding nature of WFD objectives, and greater public participation. Twenty years later, however, there has been a disappointing amount of progress in the reduction of diffuse pollution. In the Seine River Basin, the amount of livestock rearing is low; yet the basin is subject to significant diffuse pollution due to agriculture. This paper reports our study of this case; we examine the literature on WFD implementation policy in order to identify the physical and social causes of this failure to reduce diffuse pollution. We show that the nitrates, phosphorus, and pesticides that affect ground, surface and marine waters are attributable to structural changes in agricultural production rather than to inefficient farming practices. We describe how a series of instruments that were designed to combat the diffuse agricultural origins of pollutants have had little effect. We identify the main obstacles to improvement as being the dispersion of the targeted public and the dispersion of benefits, given the current nature of legitimacy in the European Union. This case illustrates the fact that intensive agricultural production has an impact on water quality far beyond the problem of excess manure from livestock production.

KEYWORDS: Diffuse pollution, policy implementation, output legitimacy, regulatory space, intensive agriculture, WFD, Seine River Basin, France

INTRODUCTION

The European Water Framework Directive (WFD, 2000/60/EC) has significantly raised expectations of better management of European hydro systems; this is particularly true with regard to the diffuse pollution from agricultural sources that worsens eutrophication in Northern European aquifers, rivers and oceans, and the pesticides which threaten biodiversity. In 1992, environmental non-governmental organisations (ENGOs), together with representatives of the most environmentally active countries (Vogel, 2005) in the Oslo-Paris Convention (OSPAR) for the reduction of pollution in the North Sea, convinced Spain and France to ratify a target of a 50% reduction of discharge of nitrogen, phosphorus and hazardous substances by 2020 (Skjærseth et al., 2006). Since the OSPAR Convention was a soft law treaty, however, the penalty for failure to meet its targets was solely reputational. The WFD, by contrast, has set more binding provisions and more holistic targets (Voulvoulis et al., 2017; Howarth, 2006) and has been able to foster greater public participation (Behagel and Arts, 2013). It requires member states to set and meet environmental quality standards for all water bodies whatever their use; it also stipulates that the quality of groundwater and surface water must not further deteriorate. Public participation is required in the defining of these environmental quality standards, a provision that was added in order to ensure that objectives were not defined solely by sectoral interests. Proponents of improved water quality have welcomed the WFD with enthusiasm (Kaika and Page, 2003).

The WFD is 20 years old and two planning cycles are almost complete. The European Commission's assessment of the WFD's fitness for purpose (European Commission, 2019c: 5) acknowledges that results are mixed. It states that,

> On the one hand, the WFD has been successful in setting up a governance framework for integrated water management for the more than 110,000 water bodies in the EU, slowing down the deterioration of water status and reducing (mainly point source) chemical pollution. On the other hand, no substantial progress in water bodies' overall status has been made between the first and the second river basin management cycles.

The results of this recent report reveal that governments across Europe are still "struggling to achieve good ecological and chemical status" (De Vito et al., 2020: 3). Only 64% of all surface water bodies are expected to be in high or good ecological status (or 'good potential') by 2021, and 38% of surface water bodies are affected by diffuse source pollution (Carvalho et al., 2019). Like many environmental policies, water policy is hampered by the difficulties of implementing a framework for action that is otherwise considered to be "broadly fit for purpose".

Diffuse pollution is well acknowledged as being the most problematic issue. At the global scale, the nitrogen cycle is affected by human activities to the point where the safe operating space for humanity has been transgressed (Rockström et al., 2009; Steffen et al., 2015). In the industrialised regions of Northern Europe (England and Wales, Belgium, France, Germany, Denmark and the Netherlands), one of the major challenges in the implementation of the WFD concerns the reduction of diffuse agricultural pollution within aquatic environments (Jacobsen et al., 2017); this affects both surface and groundwater as well as terrestrial and marine waters. As reported by 24 member states (and causing failure in 18% of groundwater body area), nitrates are the pollutants that most contribute to the poor chemical status of groundwater bodies; pesticides, secondarily, are reported as causing failure to achieve good status in 6.5% of groundwater body area (European Environment Agency, 2018: 52).

In many countries, nitrates and phosphates are identified as the main pollutants. In Italy, the Lombardy Plain has one of the highest nitrate inputs in Europe (Musacchio et al., 2020). In November 2018, the Commission urged Italy to comply with EU rules on nitrates, pointing out that it had failed "to designate Nitrates Vulnerable Zones, monitor its waters and take additional measures in a number of regions concerned by nitrate pollution". In March 2019, the Commission took Italy to court for failure to properly treat urban wastewater in agglomerations of more than 2000 inhabitants. In Germany, in 2015, only 7% of water bodies were in a good or very good ecological condition, with agricultural pollutants

representing the main cause of this poor showing (Schaub, 2019). In June 2018, the Court of Justice of the European Union (CJEU) declared that Germany had failed to fulfil its obligations regarding nitrate reduction in groundwater; failure in compliance was to result in fines of up to €850,000 per day (ibid). The German Fertilizer Application Ordinance, which had been extensively revised in the spring of 2017 but not sufficiently to reach the target, was again amended to support the achievement of this injunction, and a revised version was adopted by the Bundestag on 27 March 2020. In Belgium, the entire Flemish territory is considered to be a vulnerable area with regard to the Nitrates Directive. In Spain, in a sample of 107 groundwater bodies with poor chemical status, 32% had salinisation problems, 26% had high nitrate content, and 22% were affected by point and diffuse pollution (De Stefano et al., 2015). European authorities, furthermore, consider diffuse pollution to be insufficiently monitored; they state critically that inventories are "mainly based on point sources" (European Commission, 2019a).

The case of the Seine River Basin (which, in this document, refers to the entire Seine-Normandy District, including the small coastal rivers of Normandy) is interesting in this respect, as diffuse pollution is not simply the result of a lack of application of the Nitrates Directive nor a lack of surveillance. Contrary to neighbouring Brittany – sadly famous for its green tides (Bourblanc, 2019) – or to the Hase River in Germany's Lower Saxony (Kastens and Newig, 2007), the excess nitrates in the Seine River Basin do not come from livestock waste. 80% originate from synthetic fertilisers applied to plant crops or from the conversion of grassy meadows to farmland or urban use, and 20% originate from the residual nitrogen load of treated urban water in the densely populated basin area, and from some urban overflows that remain untreated. The increased use of fertilisers stimulates weed growth and makes plants more vulnerable to pathogens, which in turn often results in additional use of pesticides, including herbicides and fungicides. The multiple-caused nature of the diffuse pollution in the Seine River Basin means that the holistic approach advocated by the WFD is particularly well suited to addressing the problem. The basin also benefits from a long history of public investment in environmental monitoring and research, which has allowed environmental authorities to prioritise the causes of degradation. It was expected that the WFD would make a difference in the Seine River Basin, but the quality objectives have not been achieved. Based on the Seine case, we argue that the problem of diffuse sources of pollution may be characterised by strong inertia due to physical legacy, social resistance, and sociotechnical lock-in.

This paper first presents a general understanding of the causes of diffuse pollution and its resulting physical inertia. We analyse the water quality objectives set by the WFD and examine the previous regulations on pesticide and nutrient use in the Seine River Basin; we then assess the present situation in the light of these objectives. In the subsequent section, we present the stakeholders involved in WFD implementation; using policy implementation literature, we then screen the political factors that are favourable and unfavourable to the success of WFD implementation in the Seine catchment area. Following that, we discuss diffuse pollution as a problem of political dispersion. We conclude by presenting the lessons offered by the Seine River Basin in terms of the limits the WFD is able to set on diffuse pollution of agricultural origin once the farm-level release of nitrates is under control.

The authors include a political scientist, a sociologist, a marine biologist, an environmental scientist, an economist and a geochemist, all of whom are well versed in interdisciplinarity. All are members of the scientific board of the Seine-Normandy basin committee in France, to which they have provided free scientific expertise for periods of one to several years. The scientific board develops and publishes advisory policy briefs for the committee in the French language (Eau Seine Normandie, n.d.). Our data come from participating observation within the scientific board and from documents produced by the water agency and approved by the river basin committee; the documents included impacts and pressures characterisation studies, management plans and programmes of measures, policy debates, proposals, assessments and experiments.

DIFFUSE POLLUTION STAKES AND REGULATION IN THE SEINE RIVER BASIN

Technical understanding of diffuse pollution in the Seine River Basin

The Seine River Basin today is very unlike its original natural condition, being densely populated and intensively cultivated; pollution sources are numerous and thus diagnosing problems is a complex task. Since 1989, the *Programme interdisciplinaire de recherche sur l'eau et l'environnement du bassin de la Seine* (Interdisciplinary Research Programme on Water and the Environment in the Seine River Basin, or PIREN-Seine) has been active in the Seine River Basin. PIREN-Seine is an integrated and applied research programme that is jointly funded by the water agency, water stakeholders and research institutes; its scientists have developed models to predict flows and material fluxes and to assess the effectiveness of management options. It supports the holistic approach required by the WFD, allowing prioritisation based on effectiveness rather than on the continuation of past policy and management (Voulvoulis et al., 2017). Thanks to PIREN-Seine's technical knowledge, there is a consensus among scientists as to the causes of the problem, the results of past policies, and the targets for action. (This is not a consensus that is accepted by all stakeholders[1].) The interdisciplinary understanding of the situation is detailed below.

Agriculture and urbanisation are the two major drivers of water quality deterioration in the Seine River catchment area. Table 1 shows the situation for nutrient release at the outlet of the river basin. Until 2000, urban sources of nutrients outweighed agriculture sources (Billen et al., 2001); even before the enforcement of the WFD, however, nutrients and toxic substances originating from urban areas had been steadily decreasing.

Since the phasing out of phosphorus-containing detergents in 1991 and phosphorus treatment in wastewater treatment plants from 2000 (Meybeck et al., 2016), the total phosphate loads to the estuary have dropped from 8 kilotons per year (kt/yr) in the 1990s to 1-2 kt/yr after 2010 (Romero et al., 2016). Phosphate releases from urban source (point sources) are now stable and diffuse inputs are equivalent in quantity to those from point sources (Garnier et al., 2013). Phosphates used in agriculture tend to be captured by soil particles and, except for in a few specific locations, erosion in the Seine River Basin is low. It is expected that further reductions in the urban release of phosphates will be more effective than changes in agricultural practices in order to reduce phosphate loads to the estuary (Garnier et al., 2018).

It the case of nitrogen, however, urban reductions are not expected to have a similarly large effect. Urban ammonium releases have declined considerably since the 1970s, having gone from 30 kt/yr to 3 kt/yr of discharge as measured at the marine outlet of the river (Romero et al., 2016). Nitrates leakages, by contrast, have increased from less than 50 kt/yr in the 1970s – slightly higher than ammonium – to approximatively 90 kt/yr currently, rocketing to values above 100 kt/yr during wet years. Only 10% to 15% of such nitrates result from ammonium nitrification and uncompleted denitrification in wastewater treatment plants, while more than 85% of nitrates releases come from intensive agriculture. Agricultural nitrates pollution has two main causes: the extension of arable land to the detriment of meadows and wetlands and the past or current application of excess nitrogen. Given the residence time of nitrates in aquifers in the Seine River Basin, a decrease in current inputs will result in a noticeable decrease of nitrates in aquifers only after 30 to 50 years (Philippe et al., 2011), similarly the outcomes of the 20-year-old WFD might become apparent in the next 10 years (Lassaletta et al., 2014; Flipo, 2005). Aquifer-to-river exchanges can represent more than 30% of the river's discharge and thus are an important source of nitrogen (Tavakoly et al., 2019).

[1] This is quite common in environmental conflicts. According to Farrell (2015), these conflicts involve incommensurable "moral orders"; while facts are important, they cannot be separated from the moral values and narratives that make them meaningful for some and not for others. In our case, the facts about the causes of pollution have less social effect than the narrative about the profession of farming and the place of agriculture in society that was established in the 1960s (Muller, 2000). As in Great Britain (Hodge, 2016), farming has a specific place in France; the Common Agricultural Policy has exacerbated this exceptionality, which has often led to excessive use of exemptions in the implementation of the WFD (Boeuf et al., 2018).

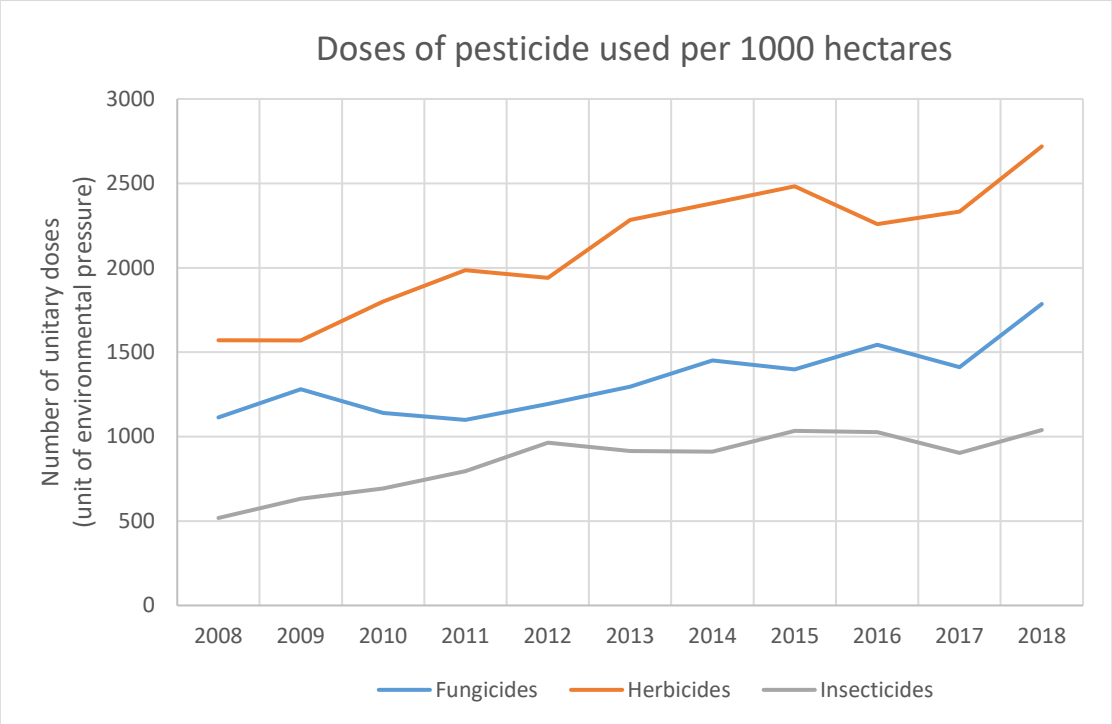
Table 1. Current nutrient releases at the marine outlet of the Seine River.

	Annual loads in kilotons per year (kt/yr)	From point sources (percent)	From diffuse sources (percent)
Phosphates	1-2	50	50
Nitrogen	93	18	82

Source: based on Garnier et al., 2013; Romero et al., 2016.

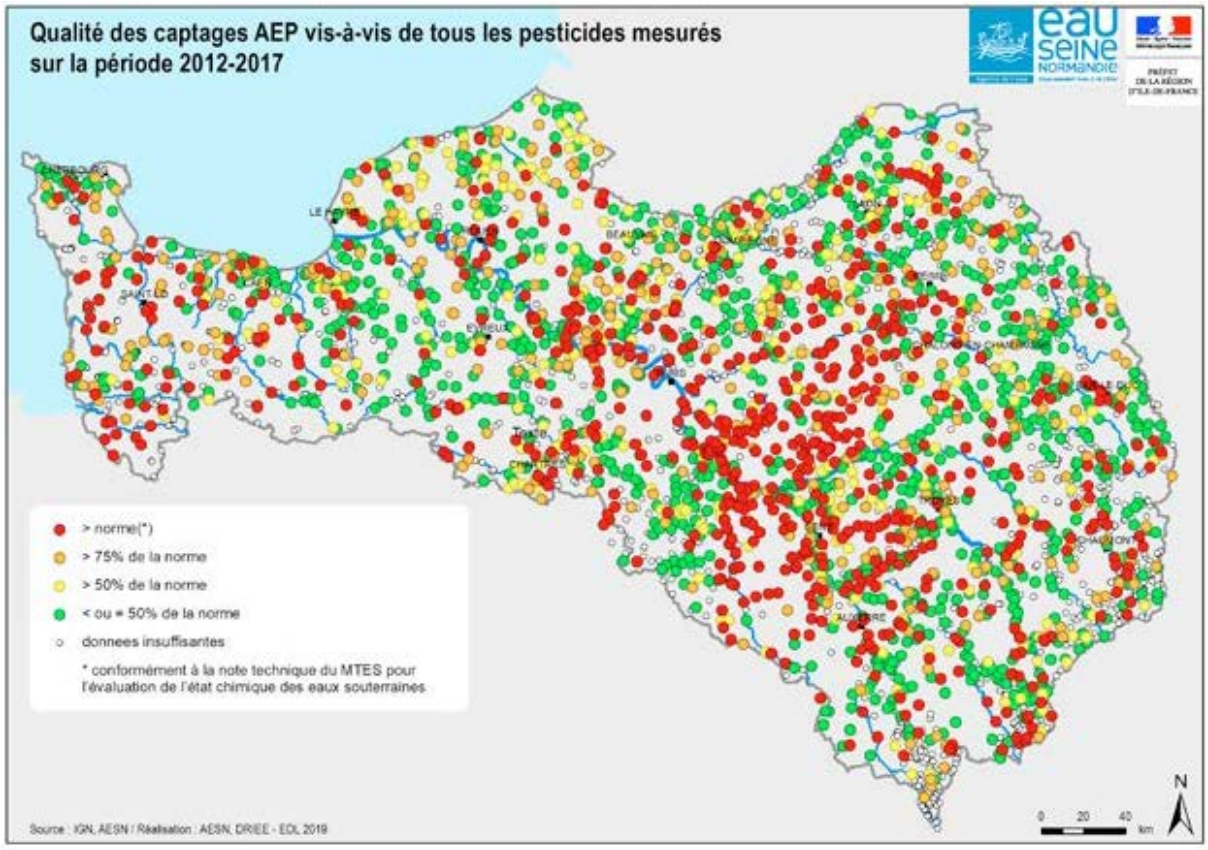
Pesticide use by local authorities and (non-farmers) individuals is now forbidden but their total sold volume has increased; this is reflected in their elevated concentration in groundwater (Figure 2) to the point where they are degrading 25% of surface water bodies and 61% of groundwater bodies. The active ingredients change considerably over time depending on changes in authorisation or the banning of particular pesticides (Blanchoud et al., 2019). The increase in pesticide use is all the more worrisome as their degradation products are also pollutants that remain in the environment for a very long time; because they adhere to soil particles, the process of their degradation and leaching into groundwater is even longer than that of nitrates (Queyrel et al., 2016). In yearly testing, a quarter of the drinking water samples exceed the pesticide standards (Figure 3). As a result, since 2007 more than 80 abstraction sites have been closed and some municipalities in the basin are subject to temporary bans on the consumption of distributed water. Most of the pesticides responsible for downgrading water bodies are still authorised despite awareness of their long residence time and the knowledge that their concentrations in many waterbodies are above WFD standards.

Figure 2. Recent increases in unitary doses of pesticides used per 1000 hectares in the Seine River Basin.



Source: AESN and DRIEE (2019).

Figure 3. Presence of pesticides in groundwater samples in the Seine River Basin, 2012 to 2017.



Source: AESN and DRIEE (2019).

Note: Red dots indicate that good chemical status has not been achieved.

In 2014, the scientific committee issued a public statement saying that an "agricultural transition [was] needed to restore water quality" (Conseil scientifique, 2014). The brief stated that agriculture in the Seine River Basin had radically changed in the 1980s; from that time onward it has favoured intensive crop production at the expense of grazing, which resulted in a dramatic deterioration in the quality of water. According to the statement, economic considerations, supply chain organisation and technological lock-ins were responsible for these transformations of land use. The statement went on to say that the situation was unlikely to improve without radical changes in the agricultural model; it further claimed that these changes were needed if the WFD objectives were to be reached by 2027 and if drinking water uptakes were to be secured. It cited few cases where restoration was achieved following deep transformations of agricultural systems and downstream value chains; it concluded that such changes needed to be implemented at the regional scale where consumption and production schemes could be adjusted. The committee sent this statement of their scientific opinion to the basin committee but it had little effect. Currently, there is a consensus in the scientific community that further reductions in nitrates and pesticides can only be achieved through systematic changes in the agricultural model which produce shifts towards organic and meadow-grazing farms (Garnier et al., 2018).

This observation is echoed at the European level. Managing diffuse pollution requires strengthening coherence between public policies, particularly between the Water Framework Directive and the Common Agricultural Policy (CAP) (European commission, 2012). In order to improve coherence, the 'cross-compliance' mechanism aims at linking some CAP payments with environmental requirements

(European Court of Auditors, 2014; European Commission, 2019c). In the coming CAP, which takes effect after 2020, cross-compliance will be replaced by "conditionality" which "links income support (…) to environment and climate-friendly farming practices and standards known as 'Good Agricultural and Environmental Conditions' (GAECs) and Statutory Management Requirements (SMRs)". Two GAECs are listed for water: 1) establishment of buffer strips along watercourses (GAEC 4); and 2) compulsory use of the new Farm Sustainability Tool for Nutrients (GAEC 5) (European Commission, 2019b).

How was diffuse pollution addressed in previous directives?

The earliest European directives on water quality were issued in the name of public health. As nitrates and pesticides were suspected to be harmful, their presence was regulated by the Drinking Water Quality Directive (75/440/EEC); this imposed a limit of 50 milligrams per litre (mg/l) of nitrates in surface water and 0.1 micrograms per litre (µg/l) for each pesticide, or a total pesticide limit of 0.50 µg/l. The Nitrates Directive set no limits for groundwater, while the Drinking Water Directive (98/83/CE) regulated tap water according to the same standards. When water no longer met these standards, in many cases local authorities simply gave up the use of that water and sought new uptakes from more distant catchments, which increased the cost of distributed water (Roussary, 2013). The Groundwater Directive (2006/118/EC) now imposes a 50mg/l limit for nitrates whether or not the water is used for drinking purposes.

The problem of eutrophication was taken into account in the European directives in a second step (Aubin and Varone, 2004), the Nitrates Directive (91/676/CEE). This directive addresses the eutrophication risk for surface freshwater and marine waters; it sets requirements for the delimitation of areas vulnerable to eutrophication and imposes national and regional action programmes. Since 1995, a decrease in the soil's nitrogen balance has been noticed, particularly in Belgium, Denmark, Ireland, the Netherlands and the United Kingdom, though since 2000 there has been "a modest decrease of nitrates concentrations in fresh surface waters in most countries. This decrease is even less prominent for groundwater in view of delayed response of nitrate in deep aquifers" (Van Grinsven et al., 2012). The directive, however, does not regulate the release of nitrates from soils when grasslands are turned over, a particularly important source of nitrogen in the Seine River Basin due to galloping urbanisation and the disappearance of grazing in favour of field crops. Until the new obligations put in place by the WFD, the failure to effectively reduce nitrates release in groundwater had no consequences in terms of sanctions, provided the Nitrates Directive's requirements were met.

In France, at the national level, the problem was mainly due to livestock waste. The *Programme de Maîtrise des Pollutions d'Origine Agricole* (Programme to Control Pollution of Agricultural Origin, or PMPOA), in effect between 1993 and 2000, was a policy instrument that specifically targeted livestock farming. Consisting of public aids to help large farms comply with their legal obligations to store waste and plan spreading, it helped farmers obey the law without significantly reducing environmental pressure (Busca, 2002; Doussan, 2002). As mentioned above, however, livestock is not responsible for the situation in the Seine River Basin. Fertilisation is the issue there. Since 1991, the voluntary policy tool 'Ferti-Mieux' ['Better Fertiliser'] has awarded a distinctive label to farmers who improve their practices, however this only affects a certain percentage of the cultivated area located in vulnerable zones. The Nitrates Directive was also implemented through departmental action plans, but these had little effect and did not prevent the transfer of excess nutrients beyond controlled zones; this resulted in further deterioration of other water resources, as was also observed in Italy (Musacchio et al., 2020). Since 2011 other national action plans have followed, yet farmers still use more fertilisers than the fertilisation balance method recommends (Ravier et al., 2016). The control policy based on means does not give farmers full responsibility for their impact and farmers do not trust the method; this contrasts with what exists in, for instance, Wallony, in southern Belgium (Barthod et al., 2019).

Farmers must now report their use of pesticides, which have become subject to a tax; they can also benefit from the water agency's financial support in order to convert to organic farming or low-nutrient

systems. In all cases, they are asked to reduce the transfer of pesticides to the hydro system so that concentrations can remain below the WFD threshold; methods of doing so include establishing riparian strips, crop selection and rotation, and the reduction of surface runoff (Blanchoud et al., 2019; Jacobsen et al., 2017). Of these solutions, only the riparian strip is mandatory; its effectiveness has declined, however, because in some regions the width of the riparian strip has been reduced and/or certain rivers have been reclassified as ditches, which means that a riparian strip is no longer compulsory. These changes have resulted from pressure by farmers on state officials. This year, there was discussion of imposing a minimum distance of 5 to 10 metres between fields and surrounding houses when applying pesticides because of health concerns, however this regulation has not yet been fully applied.

WFD regulatory innovations

The WFD provides two regulatory innovations that render diffuse pollution more visible in policy documents: its holistic approach and the incremental update of regulations. The first of these, the holistic approach adopted by the WFD, allows for stricter limitations on nitrates, phosphorus and pesticides when they impact the ecological status of surface water bodies; the problem of eutrophication is thus regulated through both the chemical and the ecological status of water bodies. (If member states fail to achieve good status, they may request and justify exemptions by the technical or economic impossibility of its achievement.) The Groundwater Directive 2006/118/CE, which was a spinoff from the WFD, also imposed new binding environmental objectives on all groundwater bodies for nitrates and hazardous substances. The Marine Strategy Framework Directive further develops the holistic approach since it sets environmental objectives for marine waters that further impose limitations on upstream flows. In the next WFD planning cycle, the need to prevent eutrophication in the North Sea will imply stricter objectives for the reduction of diffuse pollution in the Seine River Basin.

In France, the WFD implementation process coincided with a political momentum on environmental issues. Following a promise made by candidates during the 2007 presidential campaign, *Grenelle de l'environnement* (or the Grenelle Environment Round Table) was convened that same year; this was an open, multi-party debate which involved national and local governments as well as representatives from industry, labour, professional associations and NGOs. It led to the drawing up several new measures, including a law which set an ambitious goal for the ecological status of surface waters: that one-third of water bodies should reach good ecological status by 2015. Bourblanc et al. (2013) believe that the ability to set such an ambitious goal can be attributed to the public involvement in the policy process and its transparency. This law has prevented the setting of exemptions for certain surface waters which has been permitted, for example, in Germany's Lower Saxony (Kastens and Newig, 2007). Quality objectives set in WFD River Basin Management Plans (*Schéma Directeur d'Aménagement et de Gestion des Eaux,* or SDAGE/RBMP) must respect the ambitiousness of the goal. This law also creates an impetus for monitoring and publishing the percentage of water bodies in each basin that are not achieving good ecological status.

The second of the WFD's innovations, as stated above, is the progressive and continuous updating of regulations. The Common Implementation Strategy foresaw that the development of ecological status metrics was progressive, that pesticide monitoring would improve and that objectives would thus need to be accordingly updated. As new elements are included in the WFD assessment, the share of water bodies that achieve good ecological status declines; the progressive nature of the regulation thus makes diffuse pollution increasingly visible in notification documents.

In the Seine River Basin, there are 14 pesticides that need to be monitored, while in 2010 there were 5. In 2004, ecological status was measured according to metrics that have since been revised. Between 2004 and 2019 the ecological status of watercourses improved from 38% to 41% using constant metrics; the new metrics, however, make it possible to better see deteriorations that previously were not visible, and now only 32% of surface water bodies are in good ecological condition according to these new metrics.

WFD compliance gap in the Seine River Basin

The impact of diffuse pollution of agricultural origin on aquifers of the Seine River Basin has not decreased since the 1990s. Although surface water conditions have improved overall, since 2013 the number of surface water bodies that have been downgraded by nitrates has doubled; this is largely due to a shift in land use from grassland to arable or construction land, and the loss of riparian buffer zones and wetlands which performed denitrification (Billen et al., 2007). In other words, new arable land receives more nitrates and these are being less denitrified by wetlands. Restoration is possible but to be effective large surfaces are required (Tournebize et al., 2012; Passy et al., 2012). Currently, pesticides degrade the status of 26% of surface water bodies and 61% of groundwater (Table 2; Figure 3).

Table 2. Degradation of the status of water bodies due to diffuse pollution in the Seine River Basin in 2019.

Causes of water status downgrading	Percentage of surface water bodies with poor ecological and or chemical status (%)	Percentage of groundwater bodies with poor chemical status (%)
Diffuse sources of nitrates	8.5 (4 in 2013)	42
Pesticides	26	61

Source: AESN and DRIEE (2019: 49, 57).

Note: Rows are not mutually exclusive; excessive nitrates often implies excessive pesticides.

WFD IMPLEMENTATION IN THE SEINE RIVER BASIN

In order to assess the potential of the Seine River Basin for successfully implementing the WFD, we draw on the work of Sabatier and Mazmanian (1980) who have provided a list of favourable and unfavourable factors for implementing a policy; we also draw on Kastens and Newig's (2007) adaptation of this list to the policies for control of diffuse pollution in Lower Saxony, which they considered a difficult case. On the basis of these two references, we detail why the case of the Seine remains a difficult one for the implementation of the WFD even though it has no surplus livestock effluents and a highly developed knowledge of the functioning of the basin (Table 3).

Table 3. Important factors influencing the regional success of diffuse pollution prevention policies.

Factors influencing policy implementation	Factors identified in implementation literature (Sabatier and Mazmanian, 1980)	Relevant factors for the prevention of diffuse pollution	
		In Lower Saxony (Kastens and Newig, 2007)	In the Seine River Basin
Stable contextual factors	Socio-economic, cultural and historic, and geographical conditions	Economic and symbolic importance of agriculture in the region	Symbolic importance of agriculture in the region
	Policy configuration (patterns of interaction, issues and policy networks, attitudes and resources of constituency)	Proximity of pollution inspection agencies to farmers	Lack of effective control of nitrates and pesticides inputs
		Mutual trust between water suppliers and agriculture	Various levels of trust between water suppliers and agriculture

		Correct levels of knowledge among environmental NGOs, who are thus capable of balancing agricultural interests	High levels of knowledge among scientists but insufficient support from NGOs
Relatively changeable factors	Media and public support	Low attention from the media and the public except in the case of episodic events or investigations	
	Support from authority	Goal exemption allowed by national authorities but challenged by the European Commission (see Introduction)	A declarative ecological ambition stated in the Grenelle Law
	Financial means	A yearly water fee of €20,000,000 for reducing nitrate pollution in drinking water protection areas, plus €420,000/yr for implementing WFD measures on 48,000 km^2, equals €425/km^2.	50,000,000€/yr for mitigating the cost of changing framing practices in the 79,000km^2 area, equals 632€/km^2, rather small compared to CAP subsidies.
	Formal access by outsiders: citizen participation	Involvement of NGOs is needed in order to balance agricultural interests in so-called 'area cooperations'	Few NGOs are engaged
	Clear ranking of statutory objectives	The use of exemptions may not comply with the WFD and current litigation with EC regarding nitrate reduction in groundwater (see Introduction)	It remains uncertain whether the EU court will sanction failure to comply
	Hierarchical integration/implementing institution	Significant leeway for implementation decisions in 'area cooperations'	The pending litigation on the Nitrates Directive is putting pressure on the River Basin Management Plan (RBMP)
	Decisions and rules of implementing agencies	Failure to achieve 'good' status is attributed to strong representation by agricultural interests	Strong ambitions in the RBMP for attaining 'good' status (although these were below the expectations of the scientific committee)

Adapted from Sabatier and Mazmanian, 1980; Kastens and Newig, 2007.

Note: Grey boxes are unfavourable factors.

In the next sections, we detail the stakeholders implementing the WFD (3.1), the stable contextual factors (3.2), and the relatively changeable factors (3.3) in the Seine River Basin.

Stakeholders implementing the WFD in France and in the Seine River Basin

In France, the issue of diffuse pollution by nitrates, phosphorous and pesticides opposes two public policy networks, the one organised around water quality and the one governing agriculture. The Water and Biodiversity Department, which is the government ministry in charge of the environment, steers water quality policy in France; it is responsible for implementing the related European directives. France has implemented river basin management since 1964 and planning tools since 1992. In each river basin, a water agency collects water charges and finances actions according to the guidelines set by a river basin committee; the latter is a forum for dialogue between state-appointed representatives of all the stakeholders concerned with water, including users (40%), local authorities (40%), and state administration (20%). The river basin committee members vote on the intervention programme of the water agency: the rates of water charges, the types of works to be carried out, and the related aid modalities (subsidies, advance payments); they also approve the River Basin Management Plan (RBMP) drawn up by the water agency and state services. This network on water policy deals with both diffuse and point source pollution; it has had important success in its efforts to address the main point source of pollution, water treatment plants (Aissa-Grouz et al., 2015).

The policy for the reduction of non-point pollution has also relied heavily on agricultural policy actors. While state environmental services designated vulnerable zones wherever the nitrate content of groundwater exceeded 50mg/l of nitrates, agricultural actors negotiated nitrate action plans that included only best-effort obligations. In the Seine River Basin, the origin of nitrates surpluses is not animal rearing but crop fertilisation; actions revolved around the limitation of nitrogen inputs, the establishment of grass strips along watercourses and, in some cases, 'catch crops' (Constantin et al., 2012) which are crops, or vegetative cover, grown in the space, or time, between two other main crops. (The latter have often entailed an increasing use of herbicides, which are applied to get rid of this cover.) In a few cases, actions have consisted of system changes from crops to pasture and extensive grazing. The mobilisation of environmental associations and of farmers who were victims of pesticides (Jouzel and Prete, 2015) led the government to launch an EcoPhyto plan in 2008, whose goal was a 50% reduction in pesticide use over ten years; this programme failed, however, and there was instead an increase in pesticide sales. The agricultural administration in charge of implementing this policy opted for non-binding instruments and did not retain a national steering mechanism (Ansaloni and Smith, 2017).

Local authorities whose catchments are threatened by diffuse pollution are now required to put in place an action plan for restoring the quality of the drinking water supply; most of these action plans, however, are not "designed to be effective or evaluated from this perspective" (Zakeossian et al., 2017), but rather seek to avoid conflicts with farmers.

In the case of France, Liefferink et al. (2011) have shown that the inclusion of stakeholder interests in the river basin committees did not assure the integration of these interests at the regional and local levels where implementation was taking place. Their findings also indicate that, with the exception of spatial planning, the French legislation did not offer a legal framework for integrating other policy fields into water management (ibid); this lack of an option for integration is particularly true for agricultural and environmental policies, which so often conflict. The balance of power could change in 2020, however, as the composition of river basin committees is about to be expanded to include more NGOs.

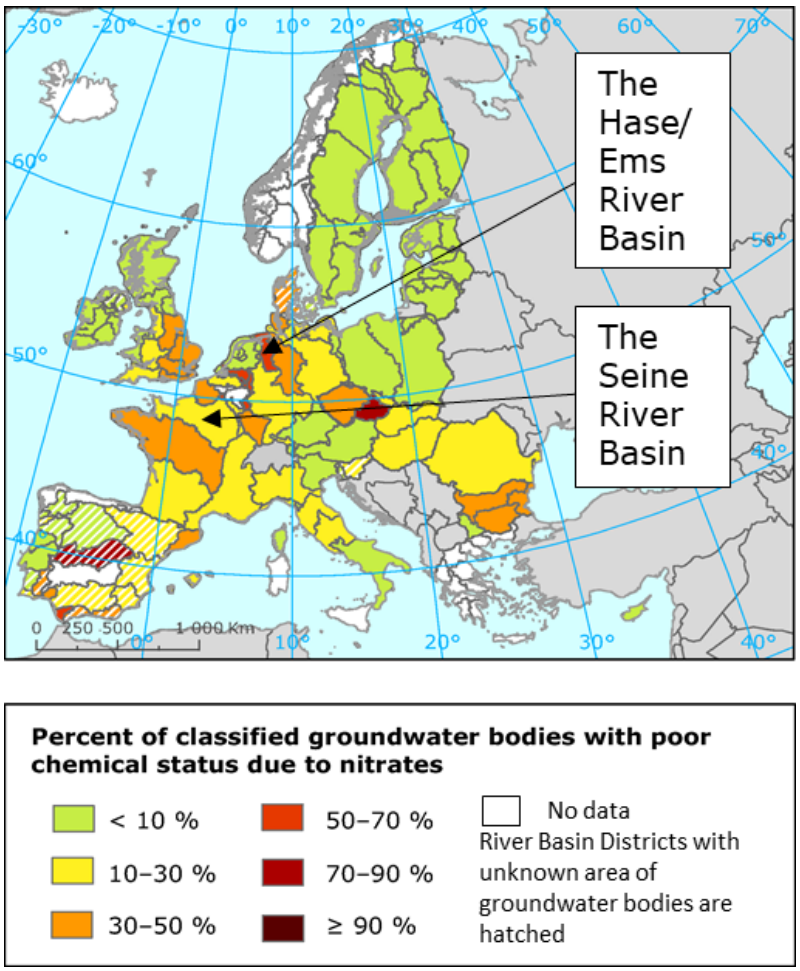
Stable contextual factors in the Seine River Basin

Socio-economic and cultural factors: The place and nature of agriculture in the basin

The pollution of groundwater bodies by nitrates is a general problem in Northwest Europe; as mentioned in the introduction, the Seine River Basin is one of the areas where nitrate levels in groundwater is a problem, though the situation is more severe in other parts of this region. Figure 4, below, shows the chemical status of groundwater bodies in Europe in 2012; Table 2 shows the percentage of surface water

in the Seine River Basin whose ecological status is degraded by the presence of nitrates, as measured in 2019.

Figure 4. Boundaries of European river basin districts and percentage of groundwater body areas not achieving good chemical status due to nitrates, as measured in 2012.



Source: (EEA, 2012)

When the agricultural sector directly or indirectly employs a large part of the labour force in a given territory it takes on cultural importance, and local actors then tend to understate environmental externalities. Kastens and Newig (2007) have described such a situation in Germany's Lower Saxony, where the productivist model that encourages nitrates leakage receives support, more than do the agricultural players themselves. While the economic weight of agriculture in the Seine River Basin is less important than it is in Lower Saxony, its symbolic weight remains decisive; the situation favours no clear incentives and weak enforcement, which is acknowledged to be a bad combination for reducing diffuse pollution (Gault et al., 2015).

Agriculture in the Seine River Basin is intensive; indeed, it accounts for 23% of French agriculture while taking up only 12% of France's land area and 10% of its total water flow (Meybeck et al., 2016). Agriculture represents 100,000 jobs, while industry employs 1.2 million people but, even so, the political power of agriculture exceeds its economic weight. In France, as in Great Britain, the countryside occupies a specific place in national life (Hodge, 2016); French farmers, moreover, are over-represented among elected

officials by a factor of ten. A hegemonic discourse at the state level promotes an image of farmers as being indispensable for the country's food sovereignty at the same time as being victims of globalisation and 'agribashing' (a term coined in 2016 for verbal, and sometimes even physical, 'anti-farmer' attacks on those practising conventional modes of agricultural production). Every year, the Paris International Agricultural Show welcomes more than 600,000 enthusiastic urban visitors and is considered a must-see for politicians; furthermore, French farming organisations have a long history of co-producing agricultural policies at government levels (Muller, 2000).

Policy configuration

Totalling 15 out of 185 members, agricultural representatives are only a minority within the Seine River Basin committee; in their discourse, however, representatives of many local authorities actively support intensive agriculture. Decisions that may negatively affect intensive farming are difficult to make in this committee. There are two major proposed waterway projects, for example, that will impact the quantity of water in the basin but are nevertheless being supported by the river basin committee since they are located in cereal-growing regions and are aimed at promoting wheat exports. (The two proposed projects are the Seine – Nord Europe Canal and the widening of the inland waterway link between Bray and Nogent-sur-Seine). Except in rare situations, rural municipalities are not likely to oppose farmers locally, even in cases of polluted drinking water uptakes. At the national level, Amblard (2019) identifies six factors which favour local authorities steering effective action programmes to reduce diffuse pollution: a chemical-induced health emergency (with no cheap technical treatment or alternate supply), the presence of a local political leader who is able to negotiate with farmers, a small catchment area, diverse agricultural production, and the short residence time of water within the aquifer (little hydrological inertia); none of these factors apply strongly in the Seine River Basin.

Relatively changeable factors

Political support from the public, media and authorities

Public and media attention for groundwater quality is weak. Some attention was given to algal bloom in Brittany (outside the Seine River Basin) when it was said to cause the death of boars, a horse, and even humans[2]; in the Seine River Basin, however, nutrient excess remains mostly invisible in rivers and is only visible in reporting documents which are out of the public eye and thus do not find support for addressing the problem. NGOs argue in vain for the closure of abstraction sites; on the coast, scallop producers complain about toxic algae but fail to make their voices heard at the river basin level. In the end, authorities' support for WFD implementation depends on the risk of sanctions.

In 2013 and 2015, the state was censured for its lack of enforcement of the Nitrates Directive; the national media passed these condemnations on to the public, accompanied by impressive images of algal blooms on the Brittany coast. The highest administrative court, the *Conseil d'Etat*, stated that, "Community sanction is the only effective lever for overcoming the combined weight of economic or categorical interests and the inertia of the State and local authorities in relation to them" (Conseil d'Etat, 2010). This fear of litigation is probably the main driver for adhering to the original goals set up for implementing the WFD.

The WFD does not guarantee a given level of ambition; on the contrary, it opens up the possibility of lowering the ambition by setting ad hoc objectives for heavily modified water bodies and of delaying the achievement of good status (Keessen et al., 2010; Hering et al., 2010; Grönlund and Määttä, 2008 ; Borja and Elliott, 2007). Negotiations between the European Commission, the Parliament and the European Council have led to the adoption of this trade-off (Boeuf and Fritsch, 2016). The WFD requires economic

[2] For a grounded, detailed and illustrated account of this controversy, see Léraud and van Hove, 2019.

justification but there is no single binding way to do that calculation and there have been wide variations in how member states have interpreted it (Feuillette et al., 2016).

In France, due to the politicisation of the environment during the 2007 presidential campaign, the ambitiousness of WFD implementation was notably high (Bourblanc et al., 2013); by comparison, Germany, Sweden, Denmark and Norway have implemented the WFD by using basic measures that comply with the requirements of pre-WFD directives. They followed a 'low-hanging fruit' approach instead of promoting the systems understanding that is required for catchment management under the WFD (De Vito et al., 2020; De Stefano et al., 2015; Voulvoulis et al., 2017).

The Grenelle II Law of 2010 held that 66% of surface water bodies would reach good ecological status by 2015 – an objective that seemed more achievable when the state of the water was measured using pre-WFD parameters. The development of new metrics and the redeployment of environmental monitoring in accordance with the WFD resulted in a downgraded of the previously assessed status of waters. Currently, 41% of surface waterbodies are in good ecological condition according to the old metrics and 32% according to the new ones. The authorities do not consider the risk of litigation with the European Commission to be as serious for the WFD protocols as for the Nitrates Directive.

Public participation before the adoption of a River Basin Management Plan is not the only way to influence RBMPs under French law; following a procedural defect – the Prefect signed a document with an incorrect mandate – downstream recourse was used by farmers unions to challenge the RBMP of 2016-2021 (Comité de bassin Seine Normandie, 2015a) and its programme of measures (Comité de bassin Seine Normandie, 2015b), which resulted in the current RBMP being cancelled by the court. This had little legal effect since the former RBMP of 2010-2015 still applied (Comité de bassin Seine Normandie, 2009); it remains an important legal document for the preservation of grasslands and wetlands. As environmental administrations do not want this to happen again, however, this 'coup' has actually strengthened the power of farmers in negotiations, beyond their demographic and economic weight.

Financial means

By surface area of the respective basins, the budget for the Seine River Basin that the water agency devoted to the fight against non-point pollution was twice as high as that of the Hase in Germany; this was the case even though the percentage of groundwater body area that was not achieving good chemical status due to nitrates was much lower in the Seine Basin (Figure 1). Between 2013 and 2016, in the 79,000 km^2 basin area, farmers received €20.5 million per year to mitigate the cost of changing their practices in and beyond drinking water protection areas; this will reach €50 million/yr between 2019 and 2024 and additional funding is dedicated to the prevention of diffuse pollution by non-agricultural activities such as urban spaces. This large amount, however, cannot go against the economic incentives for production that are paid by the CAP. A better integration of water issues into the CAP could lead to an improvement of the situation; despite the changes undertaken over the last few years, however, this integration still remains partial "due to a mismatch between the ambition of the policy objectives and the instruments used to effect change [cross-compliance and rural development]" (European Court of Auditors, 2014). Almost one hundred experts, when recently asked about water policy, confirmed that, "continued efforts in 'mainstreaming' water policy into other policy sectors is clearly needed to deliver wider success with WFD goals, particularly with agricultural policy" (Carvalho et al., 2019).

Direction of agriculture from the level of European governance is also more able to influence policy than at the river basin level. European aid for production in the basin is decreasing; it still, however, amounted to €1.54 billion in 2016 (compared to €1.9 billion in 2010). This financial aid creates an incentive structure for field crop cultivation and intensification that far outweighs the incentives for good practices that the water agency can fund. The new programming period is currently under discussion, however, and proposed changes to the CAP include a greater emphasis on the environment. Among many recommendations, a recent European Commission study recommends that "direct payments [Pillar 1 of

the CAP] should be reconsidered in order to better support less profitable farms implementing farming practices beneficial for the environment and water resources". Member states, it is felt, should "increase the attractiveness of the RDP [Rural Development Program – Pillar 2 of the CAP] measures" (European Commission, 2019b).

Formal access by outsiders: Citizen participation

Water quality in the Seine Basin is not the environmental issue that most engages the population; of greater concern is air pollution. There is more concern about groundwater, especially when it is used as a water supply and particularly when the concentration of nitrates exceeds drinking water standards. (In some areas, the municipal government organises the distribution of bottled water to vulnerable populations, especially pregnant women). The European penalty, even if mentioned in newspapers and in the electronic media, is not a major issue; major public reactions only follow from exceptional events such as the fire at the Lubrizol factory in Rouen in September 2019, the June 2016 floods, or, to a lesser extent, the floods of the winter of 2018.

Some groups of actors show strong motivation; these include environmental protection associations (Ile de France Environnement, for example), or the local authority of Val-de-Marne, which is crossed by two large rivers, the Seine and the Marne. For 16 years, from 2001 to 2016, the department organised the Water Festival (Festival de l'Oh!) to increase the population's awareness of the issue of water and aquatic environments. Through educational, artistic, cultural and sports activities, the water festival has brought the inhabitants closer to the rivers they use every day but do not see. This event has created a sense of community around water issues that is crucial if public participation is to go beyond the procedural requirements of the WFD (Benson et al., 2014; Woods, 2008). The festival was stopped in 2017 for budgetary reasons and because of changes in the institutional organisation of the Greater Paris Megacity. The "Big Jump" initiative, which promotes bathing in the Marne River (Syndicat Mixte Marne Vive, n.d.) may also garner some attention in the future. Another initiative, by the consumer association UFC-Que Choisir, is the conducting of national surveys which regularly denounce the cost of agricultural pollution to water utilities (UFC Que Choisir, 2019), with reports that are generally covered in the national press.

At the basin level, the water agency commissioned a questionnaire-based consultation of the population in 2008; this was followed in 2009 by a survey aimed at, among other things, assessing the mobilisation of the population on the water issue. Among the 1437 people questionned in the Seine-Normandy Basin (by a quota sampling method), less than 5% returned the questionnaire, although more than 92% of the surveyed population in 2008 said they were "aware of environmental issues".

For survey respondents, toxins in water were of most concern; many called for a ban on toxic products, pesticides and fertilisers and a majority consider that they were not sufficiently informed about water issues in their region. A consultation was undertaken in 2019 with the public and with institutional stakeholders in order to identify the issues and the means that would make it possible, within the framework of the future RBMP 2022-2027, to achieve good ecological status. Out of 18.5 million inhabitants only 881 responded; of these, 534 included written details which were sent back to the agency. This rate of response, itself, reflects the very moderate general interest of the basin's population in issues related to water and aquatic environments. Responses to the consultation were not representative as they came from people who were knowledgeable enough to want to give an opinion; those respondents recommended the development of organic farming, the protection of watersheds, the efficient treatment of wastewater, and the strengthening of information and awareness actions; they also mentioned their interest in aquatic environments, the protection of biodiversity, and the restoration of rivers, meadows and wetlands. Compared to the 2008 survey, the 2019 survey showed that the issue of climate change and its consequences has come to be seen as a major challenge.

Clear ranking of objectives, institutional hierarchy, and decision-rules

At the river basin scale, the RBMP included strong ambitions that were in line with the expected outcomes of the EcoPhyto and nitrates action plans; these plans failed, however, due to lack of enforcement. Given the contradictions between European policies (the CAP and the WFD), the ranking of statutory objectives in the European Union is far from clear. The Commission may not accept WFD-related exemptions that are requested by member states, yet uncertainties also remain on the credibility of European penalties in case of failure to comply with the WFD. Many member states are aware that they will not achieve their objectives and they push instead for lowering the target or for a negotiated postponing of the deadlines. The initial adoption of the WFD benefitted from political will within the EU Parliament (Bouleau, 2017). Contradictions between green energy transition (fostering biomass and hydropower) and water quality preservation may also hamper further support for an ambitious European water policy.

DISCUSSION: DIFFUSE POLLUTION IS AN INSTITUTIONALLY DISPERSED PROBLEM

The situation in the Seine River Basin – where crop production rather than livestock farming causes eutrophication and pesticide pollution – is not atypical; rather, it is an example of intensive crop production feeding the meat production chain, whereby problems remain at the basin level even when stricter controls allow better management of nitrates at the crop level. Subsidies of intensive cultivation in this region allow for cheap feed for livestock to be bought elsewhere; this value chain leads to water degradation everywhere, from crop production to meat production places. The problem is thus not one of livestock production but rather of the intensive cropping associated with livestock production. Extensive cattle grazing is instead favourable to the protection of wetlands and nitrogen recycling. Given the general nature of the institutional obstacles to change, it is also questionable whether the leveraging of EU penalties is credible or whether these pressures will instead lead to a revision of the directive. Two factors could lead to future changes. First, the Marine Strategy Framework Directive reinforces the holistic approach, but the way it is currently being applied in France has only set new targets for the reduction of pollutant flows for nitrates. Second, the growing social demand for agroecology may foster the needed changes in the French agricultural model and in the CAP (which is currently under revision). Such changes question the legitimacy of political action at both the basin and the European level; institutionalist approaches on these issues show the importance of the sense of belonging to a political community for building this legitimacy.

Dispersion of the targeted public

Beyond the technical complexity and the expected changes, what makes the problem of diffuse pollution intractable is the dispersion of the involved actors across space and government levels. The targeted farmers are numerous and the end users affected by poor quality groundwater are widely dispersed. In such cases, when resources are shared between several territories, when several economic sectors are concerned, and when several levels of government are involved in regulation, "functional regulatory spaces" are required (Varone et al., 2013); these are "geographically and socially relevant and politically legitimate – for the arbitration of rivalries and conflicts between the different groups of actors concerned". The lack of such legitimate regulatory space in the Seine River Basin allows agricultural actors, who perpetuate a model that is not compatible with the preservation of the water resource, to oppose the RBMP. The effect on the public is also dispersed over time, first because aquifers are very slow to renew themselves, and second, because public policies supporting agriculture are slow to evolve. The aid granted to cereal growers in the basin, for example, is the legacy of an intensification and price-support policy that has sedimented both the culture and the institutions. There is a need to build a new tradition of belonging to a river basin.

Dispersion of benefits and output legitimacy

Environmental mobilisation is not a matter of individual or corporatist interests because environmental protection produces a benefit that is difficult to assess precisely and is widely dispersed among the population. From a sociological perspective, protecting the environment is a form of redistribution that finds its legitimacy at the community level; historically, countries that have worked for ambitious environmental legislation have done so in the name of a tradition and belief in ecological modernisation rather than out of socio-economic interest (Vogel, 2005; Weale, 1992). Such a tradition remains to be built at the European level as the European political community lacks a pre-existing collective identity or political discourse and does not have an institutional infrastructure that can ensure political accountability – 'input legitimacy' – to the European people. According to Scharpf (1999), when input legitimacy is missing, output legitimacy becomes crucial; that is to say the political power must demonstrate its ability to resolve the problems that cannot be resolved by individual action, the market or civil society. Diffuse pollution is one of these problems and it is precisely on this type of policy that the EU's legitimacy is at stake.

CONCLUSION

WFD implementation set new standards for surface and groundwater quality. In many European countries, it fostered a stricter implementation of the Nitrates Directive and broadened its scope; in some cases, it led to litigation procedures that created an impetus for stricter regulations on manure management. Before these cases – and because of the place of agriculture in national cultures and politics – national governments were often reluctant to adopt clear incentives and enforce controls.

Diffuse pollution is often related to intensive livestock farming, but this is not the case in the Seine River Basin; there, a more nuanced situation is in place where diffuse pollution is mainly due to crop production and the turning over of wetlands and grasslands. In this specific case, where the level of water quality surveillance and the understanding of geochemical processes are strong, the WFD was able to raise the visibility of the problem in public documents. Through its holistic approach and its updates, it increased the percentage of waterbodies where this problem was acknowledged, which allowed for a more comprehensive assessment of the situation. As more elements have been included in the WFD assessment, the share of groundwater reaching good chemical status has dropped, however no political force has seized this information and used it to put the problem on the agenda; meanwhile, the risk of penalty has not yet become strong enough to bring about change.

The Seine Basin has benefitted from ambitious goals at the national level, successful reduction of point source pollution, and a scientific understanding of the dynamics of the basin. Stricter control mechanisms for fertiliser use are being implemented at the farm level under the Nitrates Directive and the Common Agricultural Policy (European Commission, 2019d: 148). France's pending convictions for failure to comply with the Nitrates Directive have led government experts to suggest the policy transfer of the Walloon Nitrawal system, which makes it compulsory to measure nitrogen residues in the soil and provides for penalties in the event of surpluses (Barthod et al., 2019); through this system, the agricultural administration would become accountable for nitrates. Such a successful implementation of the Nitrates Directive would nevertheless signal a return to a more sectoral and less holistic approach; it is also misleading to focus only on existing nitrates discharges. The abandonment of extensive livestock rearing on grasslands opens an avenue for urbanisation and for agricultural intensification; this would entail the reversal of wetlands and grasslands, which account for a large proportion of nitrates leaving the basin. Moreover, if only the nitrates problem was solved, pesticides and phosphate pollution would continue. Given the residence time of these toxic substances in groundwater, the current political tolerance of these discharges is likely to lead to additional costs for drinking water production and ecosystem protection in the future. The public concern for groundwater quality, however, has remained low until now. With climate change, more and more municipalities in France face summer drinking water

shortages. If the concentration of pesticides or nitrates increases while dilution becomes more difficult, one can expect more public involvement in the issue. Eau de Paris, the public water utility that supplies the Paris region with drinking water, has recently begun to try to address these problems by offering preferential contracts to farmers who are converting to organic farming (Eau de Paris, 2020).

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