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# The EU Water Framework Directive: From great expectations to problems with implementation

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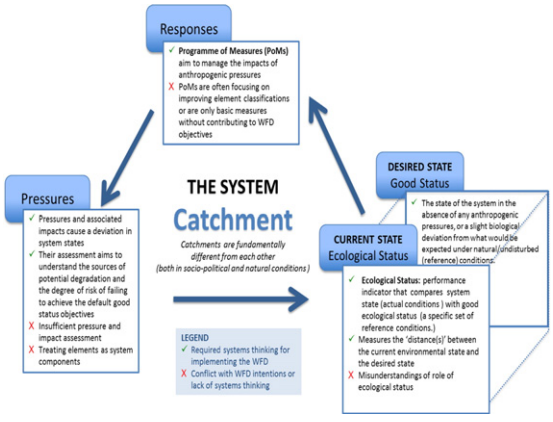
## HIGHLIGHTS

- Systems thinking is a pre-requisite to effective WFD implementation.
- Departure of implementation efforts from the WFD's intention identified.
- Misunderstandings even of WFD core principles highlighted
- Implementing the WFD like any other directive will not work.
- Acknowledging the WFD's systemic intent is required to deliver its full potential.

## GRAPHICAL ABSTRACT

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## ABSTRACT

The Water Framework Directive 2000/60/EC (WFD) is widely accepted as the most substantial and ambitious piece of European environmental legislation to date. It has been referred to as a once in a generation opportunity to restore Europe's waters and a potential template for future environmental regulations. However, fifteen years since it was adopted, and with many problems and delays in its implementation, the WFD has not delivered its main objectives of non-deterioration of water status and the achievement of good status for all EU waters. Putting aside the daunting technical and organisational challenges of its implementation, this paper aims to shed light on why the great expectations that came with the WFD have not yet been fully realised. It reviews how the Directive has been interpreted, focusing on its intentions and how they were applied. The findings reveal the absence of the paradigm shift towards the systems (integrated) thinking that the WFD was grounded on, as a fundamental problem with its implementation. This is also evident in cases where the Directive has been criticised as a policy tool or when implementation efforts were reviewed, indicating misunderstandings even of its core principles. This inherent departure from the Directive's systemic intention and methodological approach needs further investigation, as it could be the reason behind many of its problems and delays. Unless current implementation efforts are reviewed or revised in light of this, enabling the paradigm shift required to ensure a more sustainable and holistic approach to water management, the fading aspirations of the initial great expectations that came with the Directive could disappear for good.



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## 1. Introduction

The introduction of the EU Water Framework Directive 2000/60/EC (WFD) aimed to bring in a new era for European water management, focusing on understanding and integrating all aspects of the water environment to be effective and sustainable (Teodosiu et al., 2003). The purpose of the Directive was to establish a framework for the protection of European waters in order for Member States to reach "good status" objectives for water bodies throughout the EU. These efforts are based on a six-year cycle, whereby the WFD environmental objectives were to be met by 2015, provided that no deadline extension or exception was invoked. Member States that avail themselves of an extension beyond 2015 are required to achieve all WFD environmental objectives by the end of the second and third management cycles, which extend from 2015 to 2021 and 2021 to 2027 respectively (European Commission, 2012a).

The Directive was adopted to succeed and replace traditional management practices predicated upon the command and control paradigm, which looked at pressures in isolation and reduced environmental systems to their constituent elements when setting specific water objectives (European Commission, 2012a). Under this approach, specific parameters were monitored at the point of discharge to control the emissions of individual pollutants beyond specified limits (Petersen et al., 2009; Porto and Lobato, 2004). Under the assumption that managing individually the non-compliant elements could lead to an overall improvement in ecosystem health (Glasbergen and Driessen, 2002), this policy approach was discipline-specific, focusing on compliance of isolated components of an environmental system, in an attempt to increase their predictability and stability (Holling and Meffe, 1996). Although this paradigm had been effective for a long time and enabled developed industrial societies to address the most serious health-threatening environmental impacts, it failed to consider the complexity of ecosystems or the interactions and trade-offs at different scales (Müller-Grabherr et al., 2014).

The introduction of the WFD aimed to facilitate a shift from these fragmented policies to a holistic approach integrating all parts of the wider environmental system (Howarth, 2006). With the emergence of integrated watershed management in several countries throughout the world, the growing recognition of the multiple–often competing–uses of water, and the increased awareness of the interrelationships of water systems with other physical and socio-economic systems (Margerum, 1995) shaped the WFD's systemic intent. As articulated in its Preamble and Article 1, the Directive offers an integrated and coordinated approach to water management in Europe based on the concept of river basin planning (European Commission, 2000). Acknowledging that catchments differ from each other in terms of both socio-political and natural conditions (Hooper, 2003), it signified a shift towards catchment management and systems thinking. In line with systems theory putting emphasis on the interactions and interdependencies within a system that form a functioning whole (Arnold and Wade, 2015), it required understanding the relationship between land and water under different socio-economic drivers in the management of water resources (Vlachopoulou et al., 2014).

Furthermore, the Directive's requirements for public participation in its planning process address the inherent complexity of water resources management, and create the impetus for the integration of multiple perspectives and skills for decentralised policy-making in freshwater governance (Steyaert and Ollivier, 2007). Through the WFD Common Implementation Strategy (CIS), a recursive process of provisional goal-setting and revision based on learning (Sabel and Zeitlin, 2012), the WFD introduced an experimentalist approach to water governance, offering much more flexibility than previous directives, and opportunities for continuous policy learning and adjustment (Behagel and Arts, 2014; Von Homeyer, 2010), leaving many choices open to the Member States (Liefferink et al., 2011). Unlike any other environmental directive that prescribes specific targets, the WFD is manifestly not a target-based piece of legislation, the only notable exception being the WFD's explicit obligation that no water bodies are to experience deterioration in status from one class to another (Howarth, 2009; Donauhanse, 2013). Instead, it sets specific operational and technical implementation obligations for member states that could be referred to the EU Court of Justice if these were not followed correctly (European Commission, 2012b, 2012c). Overall, the WFD was seen as the first European Directive that focused on environmental sustainability (Johnson, 2012; Carter, 2007), and partly because of this, its introduction and innovations created revolutionary prestige for the Directive, which was considered as a potential template and pilot for future environmental regulations (Josefsson, 2012).

However, fifteen years after the WFD was introduced, achieving its objectives remains a challenge, with 47% of EU surface waters not reaching the good ecological status in 2015–a central objective of EU water legislation (European Commission, 2012a). During the first WFD cycle, which operated from 2009 to 2015, the number of surface water bodies in "good" state only increased by 10% (van Rijswick and Backes, 2015). This has led to the Directive's effectiveness as a policy tool being questioned; with many reviews further highlighting drawbacks and weaknesses (Josefsson, 2012; Moss, 2008; Rettman, 2007; Boscheck, 2006).

This paper reviews the WFD implementation efforts, focusing on the interpretation of its key principles in the process, in order to shed light on why the great expectations that came with the Directive have not yet been fully realised. Putting aside the daunting technical and organisational challenges of the Directive, It investigates the extent to which implementation practices might not be aligned to the Directive's initial aspirations and systems approach. Also, it reviews some of the main criticisms of the WFD, and the extent to which these may be attributed to a lack of appreciation or understanding of the Directive's integrated and systemic nature.

## 2. A "systems" approach to water management

The WFD prompted a shift from traditional end-of-pipe solutions insufficient in achieving its ambitious goals, towards sustainable catchment management (Tippett, 2005). It requires in depth understanding of catchments and management that is aligning human-nature interdependencies with the goal of improving the system as a whole, under an ecological vision that considers human activities as a source of disturbance and water quality degradation (Kelly, 2013). In support of this, the WFD adopted the Drivers-Pressures-State-Impacts-Responses (DPSIR) framework (Oliveira et al., 2005; European Communities, 2003a), which aims to provide a systemic understanding of the relationship between environmental effects, their causes and measures taken (Nõges, 2002), in an approach that requires Programme of Measures (PoMs) taken to manage anthropogenic pressures in order to improve ecosystem health (European Commission, 2000). The WFD calls for a 'catchment-based approach' and 'integrated river basin management', terms both used to refer to the management of land and water as a system, thus requiring a paradigm shift in management, towards systems thinking, which adopts an interdisciplinary, integrated, and holistic approach (Voulvoulis, 2012).

The WFD required competent authorities and all relevant parties to define their *system of interest* (catchment) and have a more tailored understanding of its conditions. This was a pre-requisite for river basin management, away from the standardised instructions of traditional water policies, often not relating to the catchments (Sabatier et al., 2005). As systems are identified by their *structure* and their *function*, and their state (health) is an expression of both (Arnold and Wade, 2015), ecological status or potential, according to the WFD, is an "expression of the quality of the *structure* and *functioning* of surface water ecosystems" (European Commission, 2000) and is therefore expressing the system state–the ecosystem's health (Fig. 1). As the main objective of the WFD is for all waters to reach good or high ecological status,

monitoring is essential for assessing their current state, in order to establish how far it is from good or high ecological status, therefore indicating the need for management in the process.

Because of ecological variability and in recognition that different water types (e.g. different types of estuaries or lagoons) may be characterised by distinct definitions of quality, with respect to environmental metrics such as phytoplankton biodiversity (e.g. Ferreira et al., 2005), benthic species composition (e.g. Borja et al., 2000, 2004; Salas et al., 2004) and supporting quality elements (Bald et al., 2005), good ecological status cannot be defined across Europe using absolute standards. The WFD provides the definition of good ecological status as the state of the system in the absence of any anthropogenic pressures, or a slight biological deviation from what would be expected under undisturbed/reference conditions ("no, or only very minor, anthropogenic alterations") (European Commission, 2016). The Directive utilises the reference conditions concept to provide a description of biological quality elements at high status (European Communities, 2003b) to assess deviations of biological communities from the desired "good" conditions. The requirement of a definition of type-specific reference conditions (Vincent et al., 2003) is another innovation of the WFD.

Measuring accurately the state of a system is a very complex process that often resorts to the use of indicators in order to evaluate its performance (Mazri et al., 2012). Indicators are "subjective mental constructions aiming to capture one or several aspects of reality considered of importance when it comes to a specific subject" (Mazri et al., 2011), and are meant to provide synthetic and action-oriented knowledge. Following systems principles, in the WFD, ecological status is used as an *environmental indicator* of system performance–the distance between the current state and the desired one (Johnson et al., 2013), in this case, the deviation of the current state of a water body from its state under undisturbed/reference conditions.

The process of assessing ecological status is based on several elements that aim to indicate the deviation of the system state from its state under undisturbed/reference conditions, and not to provide an absolute value of ecosystem quality (European Communities, 2003c). Annex V of the WFD outlines three groups of 'quality elements': biological, and two supporting ones, hydromorphological and physicochemical, to be used in the classification of ecological status (European Commission, 2000).

Deciding which particular ecological status or potential class is assigned to a water body depends on whether the quality element worst affected by anthropogenic alterations matches its normative definition for that class (European Commission, 2000). In short, deriving classification follows a *one out-all out* scheme at the level of the quality elements, meaning that a water body cannot reach good ecological status if any element has a value that deviates moderately or significantly from those normally associated with undisturbed conditions (European Communities, 2005). According to the WFD, as the elements most sensitive to pressures are selected for the classification assessment, and with good ecological status defined as the state of the system in the absence of any anthropogenic pressures, it only takes one element to fail, indicating the presence of pressure(s), to disprove good ecological status. The WFD treats the catchment as a well-connected system, and therefore the elements (selected according to the WFD), serve as alarms for the presence of pressures.

The pressure–impacts analysis and the surveillance monitoring are critical steps in the planning process (European Communities, 2003a; European Communities, 2003c), which aims to acquire in depth understanding of the catchment. This is important in order for water bodies at risk, to be monitored (operational monitoring) for selected quality elements, which characterise the most important pressures that are present in a water body (European Commission, 2003c). Identifying the relevant pressures (i.e. affecting water quality and quantity) and assessing their impacts are also integral to the development of PoMs, the actions necessary to manage anthropogenic pressures in order to improve water status and achieve the environmental objectives of the

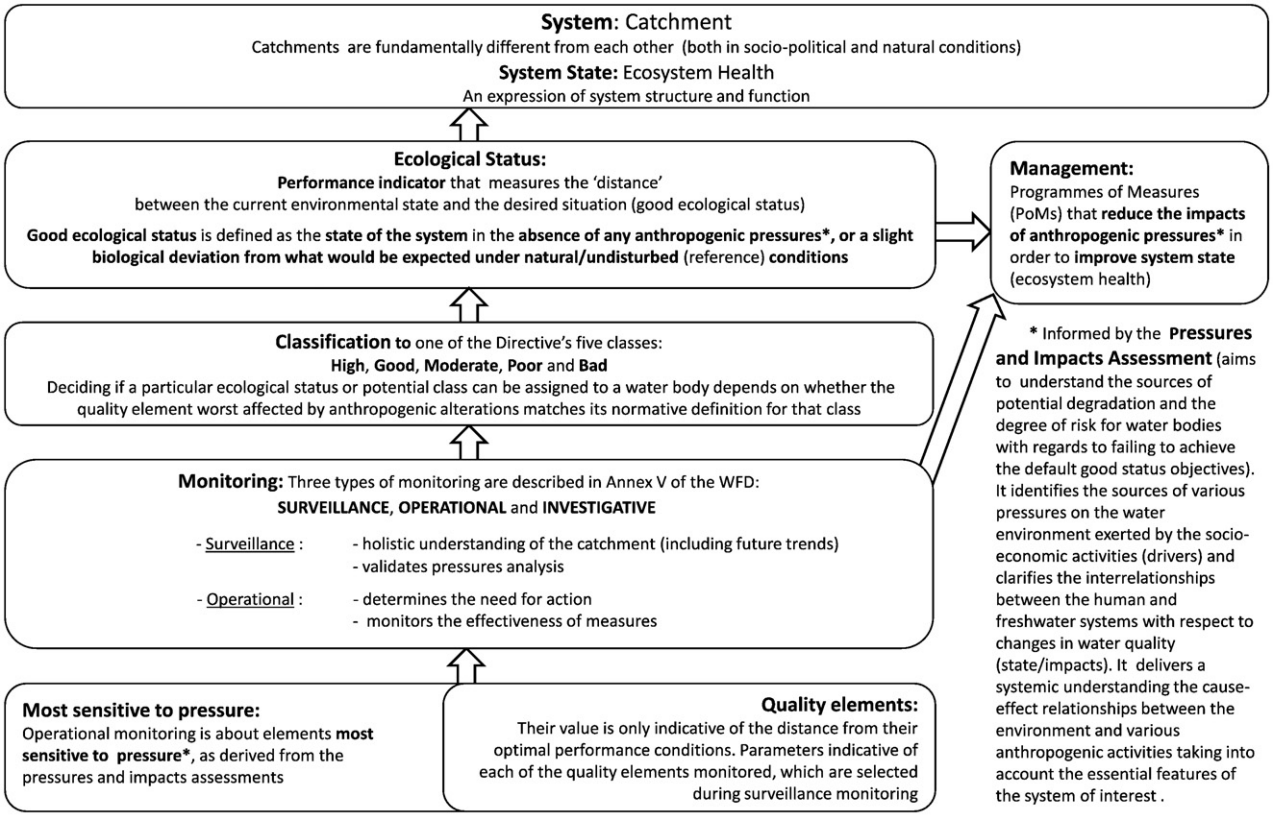


**Fig. 1.** The Water Framework Directive in the language of systems thinking.

Directive (European Commission, 2015a; European Communities, 2003a). The pressure and impact assessment that underpins the development of PoMs not only considers the influence of multiple sectors but also facilitates the integration of freshwater policy objectives that were once treated in isolation thereby driving the need to treat water management from an integrated systems perspective (Kaika and Page, 2003).

## 3. A reductionist implementation of a systems directive

The WFD sets integrative and ambitious ecological targets within a challenging timetable and strict deadlines, while leaving quite a lot of margin for interpretation and flexibility in how these are delivered (Liefferink et al., 2011). As a result, its implementation is immensely important and critical to its success. For that reason, the WFD CIS, was initiated to ensure a common understanding of the Directive and its requirements, and put forward solutions based on shared experience and expertise between the Member States (Scott and Holder, 2006). However, it is recognised that narrow interpretations of the WFD's requirements, and lack of clarity in some of the guidance documents produced technical reports of mixed quality (WWF and EEB, 2004). Some reflected only the lowest common denominator, due to the consensus-based compromises that ruled the decision-making at the Strategic Coordination Group and Water Directors' levels (WWF and EEB, 2004; Kaika, 2004).

The transposition of the WFD into national contexts and in turn capacity for competent authorities to adopt the catchment-based approach of the Directive could have further detracted from its systemic principles. For example, making the transition from established monitoring networks to those that support a more integrated approach to water management, as required by the WFD, has been a real challenge (Collins et al., 2012). The majority of Member States have designed their monitoring programmes based on the details of Annex V and have focused on the monitoring of individual structural parameters on the assumption that good quality of such elements corresponds to good functioning of ecosystems (Solimini et al., 2009). This deviates from the WFD as it fails to recognise that it is the overall status of the ecosystem that the WFD seeks to improve rather than the individual elements outlined in Annex V of the Directive (Collins et al., 2012).

More fundamentally, the characterisation of river basins (including analysis of pressures, impacts and economic analysis) proved to be a real challenge for many Member States. This is also evident in the limited links between pressures and PoMs, in the inadequacy of monitoring to capture the interactions between stressors and how best to manage them (European Commission, 2012d). The pressure-impact analysis validated by surveillance monitoring (collecting data for all quality elements) is key to the success of the river basin management plans (RBMPs) (European Communities, 2003a). For example, if a significant pressure is overlooked during the pressures and impacts analysis, the monitoring will probably not be designed to assess it and the PoMs will not envisage action to address it (European Commission, 2012e). According to European Communities (2009) the number of operational monitoring sites was higher than the number of surveillance monitoring sites in 17 out of 25 reported EU Member States. The 4th WFD implementation report also revealed problems with the implementation of pressure and impacts analysis and with the source apportionment in 14 and 15 Member States respectively. In 21 out of 27 Member States there were no clear links between pressures and the PoMs, and in 23 out of 27 Member States, the gap analysis had not been effectively implemented for the development of appropriate and cost-effective measures (European Commission, 2015a).

In contrast, Member States had often only estimated how far existing measures will contribute to the achievement of the WFD's environmental objectives (European Commission, 2015a, 2015b), which also explained why exemptions had been widely applied but were inadequately justified. Problems with the implementation of the Directive are also evident in cases where instead of following the WFD process to ensure the implementation of appropriate measures that address pressures in order to improve status, Member States often continued with traditional water management practices focusing on regulating individual monitored pollutants that tend to neglect the complexity of the conditions operating within the catchment. The decline in the proportion of water bodies that achieved good status or better, indicating a 4% reduction between 2009 (26%) and 2015 (22%) in England, when 2015 classification results were compared with the monitoring standards and tools used in 2009 classification baseline, despite the significant expenditure on PoMs (Environment Agency, 2015) could be attributed to this. Even when PoMs have been developed to address pressures, they are often been based on improving element classifications that failed to achieve good status (Environment Agency, 2016; Behagel, 2012). Such practices indicate the apparent tendency to base management actions in an assumption of linear causality to improve the actual situation of a system (Hjorth and Bagheri, 2006). In principle, as the elements serve as indicators of ecological status, PoMs might have been selected to target symptoms rather than the causes of water degradation, with such actions taken been found ineffective and often failed (Hilderbrand et al., 2005).

Additionally, the focus on element compliance was also reported by Behagel (2012), who explored the importance of meandering and soft river banks as important measures to improve water quality in the Netherlands, emphasising that "because water quality is defined in terms of six quality elements–chemistry; hydromorphology; phytoplankton; macrophytes (surface plants) and phytobenthos (bottom plants); benthic invertebrate fauna; and fish fauna–measures were specifically designed to address these elements". Fundamentally, such focus on element compliance is reminiscent of traditional management practices predicated upon the *command and control* paradigm that the WFD was adopted to succeed (Fig. 2), resulting to the tendencies for the wider intent and objectives of the Directive often being overlooked (Vlachopoulou et al., 2014). Overall, the improvement in element classifications should not be perceived as the end point when PoMs are selected; rather something that happens as a side effect when pressures are reduced and ecosystem health improves as a result.

Work by Kail and Wolter (2011) demonstrates that in Germany many PoMs have been implemented to address point source pollution for many water bodies, for which point source pollution was not listed as a pressure. Consequently, their effectiveness to contribute towards the WFD objectives was questioned (Kail and Wolter, 2011). A different approach in Sweden, under the form of general instructions to local, regional and national authorities, on how measures should meet environmental objectives (Baaner, 2011), was shown to result in measures that were mostly administrative; they aimed to facilitate the management of water bodies, but did not target particular environmental problems or reduced the impacts of pressures in order to improve water quality (European Commission, 2015c). This was also seen in the case of Denmark and Norway where measures focused more on initiating new actions and projects rather than contributing towards the achievement of the WFD's objectives (Baaner, 2011). Although such administrative measures can be important in facilitating the application of the "physical" measures selected, it is the need for robust evidence on the potential of those measures to manage pressures in order to achieve the environmental objectives that will determine the success of the RBMPs.

An assessment of Member States' progress on implementing PoMs showed that there is a tendency to use measures that comply with the requirements of the directives which pre-dated the WFD (as part of basic measures) that, though they may give general indications, do not provide explicit links and explanations regarding their contribution towards the WFD implementation and achievement of its objectives (European Commission, 2015d). Implementing measures to comply solely with pre-WFD policies follows a "low-hanging fruits" approach, as the tendency is to implement "easy" fixes instead of promoting the acquisition of the systems understanding required for catchment

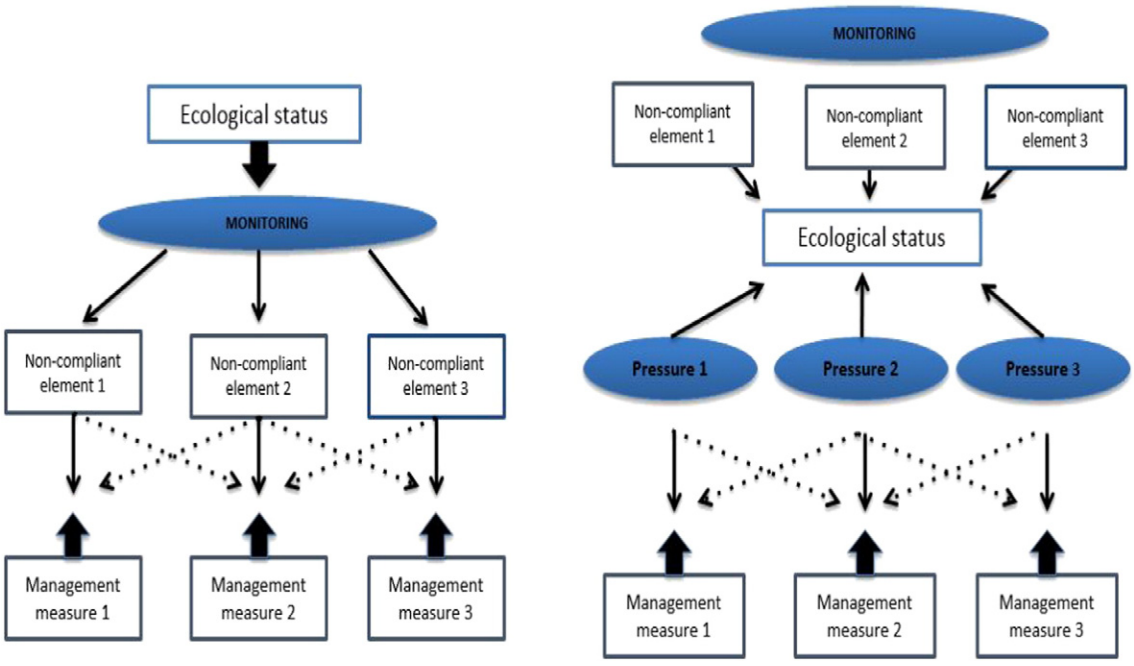


**Fig. 2.** A schematic summary showing the current approach often seen with regards to targeting and improving elements classifications (left) and the intended Water Framework Directive process which focuses on having Programme of Measures that effectively manage pressures to improve ecological status (right).

management under the WFD. This was confirmed by the communication document accompanying the 4th WFD implementation report, where the Commission expressed the need for Member States "to step up their efforts to base their PoMs on a sound assessment of pressures and impacts on the aquatic ecosystem and on a reliable assessment of water status" (European Commission, 2015b).

Furthermore, in light of the WFD's participatory requirements, most Member States opted to adapt traditional administrative structures and assigned a competent authority through which associated catchment management activities could be made operational (Nielsen et al., 2013). This tendency to favour more traditional practices of centralised decision-making could lead to significant barriers to the enabling of effective multi-sectorial integration and governance championed by the WFD. For example, work by Moss (2004) analysing the institutional misfit between the water management structure in Germany and the WFD's catchment management requirements, indicated cross-sectorial cooperation and public involvement to be considered a low priority, as they were considered alien to traditional water management practices. Additionally, Nielsen et al. (2013) demonstrated centralised decision-making, as seen in Denmark, to lead to missed opportunities for efficient policy implementation gains at the local level, as more centralised institutional arrangements only focus on shallow integration of water management. Even in Member States that had previous arrangements for catchment management, the policy shift towards the WFD's integrative and participatory requirements has proven to be difficult. In the case of France, Liefferink et al. (2011) showed that inclusion of stakeholder interests at the river basin committees, did not assure the integration of these interests at the regional and local level where implementation was taking place. Their findings also indicate that the French legislation did not offer a legal framework for integrating other policy fields in water management except for spatial planning (Liefferink et al., 2011).

Although the lack of a paradigm shift towards the systemic principles of the WFD can be seen as either the cause or the effect of traditional decision-making processes and structures continuing to be employed, there has also been progress reported with state actors "planting the seeds" for integrated water management (Nielsen et al., 2013). This is supported by the workings of Jager et al. (2016), with significant progress towards more participatory forms of water management reported, even in Member States where public involvement and cross-sectorial cooperation have been previously limited.

## 4. Fundamental misunderstandings of the WFD principles

The absence of the paradigm shift towards the systems (integrated) thinking embedded in the WFD is also evident in cases where the Directive has been criticised as a policy tool or when its implementation has been reviewed. Central to this seems to be a misunderstanding of *ecological status*, used in the Directive as a performance/normative indicator for Environmental Policy rather than a descriptive ecosystem-based measurement (Johnson et al., 2013).

The Directive's strong emphasis on ecology as opposed to the chemical water quality that had been the previous basis for water quality management (Moss, 2008), does not mean that ecological status was introduced as an alternative to measuring water quality or that it can be applied with the same thinking. In the same context, although ecological status, as an expression of the quality of the structure and functioning of surface aquatic ecosystems, is indeed a better indicator for ecological quality, it is not correct to assume that the way it is measured (elements) offers a more integrative way to measure ecological quality as Hering et al. (2010) seem to suggest. In fact, as pointed out by Solimini et al. (2009) , ecological status measures the need to reduce anthropogenic pressures that modify ecosystems through alterations of the abiotic components or of the various compartments of the food web either directly or indirectly. This can be better understood if the classification process is seen as indicating the need for management action (the distance between current and desired state), and a process also used to monitor the effectiveness of PoMs (measures applied to reduce this distance).

A similar misunderstanding associated with the use of ecological status in the WFD is evident in criticisms of its strong focus on the role of biological quality elements in determining the environmental objective of good ecological status. Baaner and Josefsson (2011) emphasised that the problem does not lie in the legal norm itself, but on how it is used in the legal and ecological specification of the legal norm in the Directive's Annexes, which can be perceived as turning the legal norm from a key provision of the Directive into an inadequate ecological characterisation.

Several authors argued that this has led to a strong focus on Ecological Quality Ratios (EQR) rather than to holistic ecosystem indicators (Josefsson, 2012; Moss, 2008; Grimeaud, 2004). It is only when the systemic nature of the directive as a policy tool is realised, that it can be recognised how EQRs indicate the gap between the system at its current state and under reference conditions (European Communities, 2005).

Treating quality elements as more than performance indicators is often seen in the scientific literature too. Baaner and Josefsson's (2011) criticism of the directive advocating "the ecological status of a body of water is based on a continually-changing combination of factors… seems to be poorly accounted for in the Directive's objectives, as set out in Article 4 and Annex V" is not in line with how ecological status is used in the WFD process. The language of the Directive as it used in the guidance documents provides further evidence and insights on the rationale and utility of ecological status as an indicator (European Communities, 2005; European Commission, 2016). In that context and in order to ensure comparable definitions of ecological status across Europe, Member States were also obligated to participate to an intercalibration exercise. The process aimed to ensure common understanding of 'good ecological status', in accordance to differing methods of assessment employed by Member States (Josefsson, 2015). Therefore, its purpose was not to harmonise assessment systems, but only their results (Prichard and Makuch, 2012). It uses an ecological quality ratio scale, as described in Annex V section 1.4.1(ii), to correlate Member States status classes (Josefsson, 2015). The ratio represents the relationship between the values of the biological quality elements observed for a type of body of water, and values for these variables in the reference conditions are applicable to that type of body of water (Josefsson, 2015).

Many scientists (Bouleau and Pont, 2015; Josefsson, 2012; Dufour and Piégay, 2009; Moss, 2008) criticise the concept of reference conditions, as such conditions hardly exist and also underestimate the continuously evolving nature of environmental systems, not considering the long-term interactions between human and natural systems. Howarth (2006) emphasises that the ambiguity of the concept of "naturalness" and the degree of symbiosis between human and non-human components of ecosystems seem to be neglected or underestimated by the Directive. On the other hand, Kelly (2013) claims that the core principle is that reference conditions are defined by the absence of pressure rather than by the presence of a particular assemblage of organisms. But reference conditions are biological community conditions expected under minimal anthropogenic impact and not under the absence of anthropogenic activities. It is the symbiosis between human and non-human components of ecosystems that needs to be understood and managed to allow for current biological community conditions to return to conditions expected under minimal anthropogenic impact. This explains why the CIS mentions that the "High status provides the direction, not the target, for restoration" (European Communities, 2005). Thus, reference conditions facilitate the assessment of ecological status and consequently the assignment of the classifications, and they do not provide a template with which to apply PoMs (Fryirs and Brierley, 2009; Hilderbrand et al., 2005; Hughes et al., 2005).

Another case of misinterpretation of the WFD is related to the *one out-all out* principle. Its application tends to inflate Type I errors in the classification results and thus a water body could be classified as below "good" status, even if it is not (Borja and Rodriguez, 2010). For example, in a study by Prato et al. (2014), results from an integrated assessment of the ecological status in two coastal lakes in Italy were compared to their WFD classifications. Evidence of deviation in this comparison was interpreted as supporting the need to shift away from the *one out-all out* principle. Alternatively, the difference found could be down to the selection of quality elements in the planning phase. Only in depth understanding of a catchment as a system could secure the appropriate selection of quality elements derived from the pressures and impact analysis and validated by surveillance monitoring, processes often compromised by the tendency for their application to follow traditional approaches in management (European Commission, 2015a).

Finally, another aspect of the WFD often criticised is the mismatch between the legal expectations of the Directive and the ecological timeframes required to facilitate an achievement of good ecological status. Josefsson (2012) stated that "the Directive, constructed on a flawed understanding of ecological time, gives EU Member states an insufficient timeframe for rehabilitating what will probably require decades or, more probably, centuries". Similarly, others (Hering et al., 2010; Jones and Schmitz, 2009; Jeppesen et al., 2005) argue that even the extended timeframes of the WFD may not be enough to achieve its objectives. Considering that the authors above make clearly valid points, the only way that the Directive's challenging timetable and strict deadlines could be explained is the nature of the WFD compliance requirements (WWF and EEB, 2004). The WFD's pragmatic approach to water regulation has been to get Member States to sign up to a common framework and common set of objectives, with the implementation timeframes referring to certain procedures rather than outputs (Liefferink et al., 2011).

## 5. Discussion: the need for a paradigm shift

The WFD has been scrutinised by more legal experts than any other legal text, in trying to understand its "real" meaning, with some even judging it as the "worst" piece of EU legislation (European Environmental Bureau, 2003). The slow progress of the WFD implementation is partly a reflection of the Directive's "revolutionary" ambition in how waters in Europe should be managed, EU and national interpretation, and possibly weak enforcement mechanisms (Johnson, 2012). While it is widely accepted that it is too soon to assess overall implementation of the Directive with any degree of certainty, it is also clear that Member States are finding it challenging to implement (Parliament, 2012). Fifteen years from its adoption, either due to lack of ambition in implementation or misinterpretation of the new concepts introduced by the Directive, it is still not clear what lessons have been learned.

Considering the misunderstandings with the definition and the role of ecological status in the WFD process; the ineffectiveness of measures developed to improve element classifications often without fully understanding the system as a whole; the limited contribution of basic measures for previous water policy legislations towards achieving the objectives of the WFD; tendencies to implement measures that do not readily address significant pressures; and continuing with centralised decision-making processes, identified here as obstacles to the shift towards participatory catchment management, the lack of real change enabling a fundamental shift towards systems thinking could be seen as the underlying cause of all of these.

There has often been a direct conflict between the flexibility provided to the Member States in implementing the WFD and the effectiveness of water management with regards to the achievement of environmental goals (van Rijswick and Backes, 2015). This led to the detraction from the collaborative and supportive experimentalist approach, which the WFD aimed to provide by introducing a framework for adaptive management. A good example comes from the Weser case (Court of Justice of the European Union 'Weser-judgment' (C-461/13)) which sheds light on the legal meaning of not only the environmental obligations, but also on the procedural context of the WFD as a whole. It was emphasised that the different provisions of the Directive cannot be properly understood in isolation but should be interpreted within the whole system of the Directive. The ruling of the Court stated the need to balance flexibility for the Member States and enforceable obligations to improve the effectiveness of environmental law. Choosing in favour of strictly binding environmental obligations combined with a large amount of policy discretion seems a workable approach for allowing the systemic nature of the Directive to be employed enabling it to reach its full potential (van Rijswick and Backes, 2015).

This was also supported by the key findings of the 3rd WFD Implementation Report regarding the identified gaps in the methodology of assessment followed by the Member States and the need for PoMs to reflect the assessment of pressures and impact (European Commission, 2012e). The conclusion was clear: "implementation should ensure that water management is based on a better understanding of the main risks and pressures in a river basin founded on proper monitoring. This will result in cost effective interventions to ensure the long-term sustainable supply of water for people, business and nature" (European Commission, 2012f). These further highlight the need to appreciate the WFD's systemic nature and to properly implement the processes required by the Directive.

The process of acquiring in depth understanding of the catchment rather than the more traditional focus on policy compliance requires a fundamental shift to systems thinking. Central to this is managing catchments as systems, acknowledging their differences and having a tailored approach for their management. In essence, this requires moving away from having a single mandate for management across Europe to a more robust understanding of the essential features of those systems. Indeed, this shift requires new tools and knowledge to support it that were perhaps not appreciated by those who drafted the WFD, probably linked to the fact that those tasked with its implementation are not the same groups who were lobbying to influence the WFD fifteen years ago (Spiral Project, 2013).

Catchments are composed of highly interdependent human and natural systems and due to this complex web of interactions; the WFD implementation based on catchment management was never going to be an easy process. Addressing such complexity requires interdisciplinary research and knowledge integration (Voulvoulis, 2012). Environmental problems are complex (Hughes et al., 2016) and thus defining them would differ between individuals and across disciplines, thus necessitating the inclusion of multiple perspectives, skills and expertise in overall management practices (Collins et al., 2007; Pahl-Wostl, 2007). Interdisciplinarity is an important characteristic of systemic thinking (Voulvoulis, 2012), and focuses on participatory processes to enable all relevant actors and stakeholders to change their understanding of the problem, co-create new knowledge and to adapt their practices (Steyaert et al., 2007). In contrast, during the implementation efforts the Directive has been reviewed from almost every single discipline perspective (i.e. law, politics, economics, hydrology, chemistry, ecology, and statistics). The need to forge an interdisciplinary blend of natural and social scientific research to enable catchment management confronts a formidable challenge. In addition, the conceptual and methodological frameworks that could be employed for this, such as the WFD process itself are facing fundamental questions and methodological issues regarding the respective roles of biology, social context and culture as influential factors in environmental perception (Ioris, 2008). As a result, it is not surprising that many disciplinary reviews criticise the WFD approach for its lack of focus or for being vague (Baaner and Josefsson, 2011; Moss, 2008).

The interdisciplinary needs of the WFD are addressed to some extent, by the Directive's provisions for public participation. The Directive explicitly states that its success would rely on public involvement (Preamble 14 of the WFD), with decisions made in a collaborative and transparent manner (Kaika, 2003). Overall, this presents an important step towards a successful adoption of the systemic thinking required for its effective implementation. Strengthening the evidence base to address the complexity of water problems and facilitating public participation to create opportunities for better policy decisions are key steps (Howarth, 2009). Ultimately, catchment management for the WFD could only be achieved with the support of stakeholders, when the Directive is applied on a genuinely systemic basis.

Considering that operationalising the WFD's systemic intent has a long way to go, some evidence of policy evolution towards systems thinking is evident in the adoption of the Ecosystems Approach through the integration of ecosystem services in the implementation process (Spray and Blackstock, 2013). Even though ecosystem services are not explicit in the wording of the WFD, there is a clear connection between the Directive and their delivery (Vlachopoulou et al., 2014). The integration of the Ecosystems Approach to the WFD implementation presents a first step to acknowledging the Directive's systemic intent and provides value in communicating its process and objectives to wider societal welfare (Everard, 2012).

## 6. Conclusion

Although the WFD is undoubtedly a major policy progression and is delivering environmental improvements, the Directive could have played a greater role in delivering coherent and sustainable water management in Europe. Why the great expectations that came with the WFD have not yet been fully realised has been investigated here, focusing on the Directive's interpretation, reviewing its intent and how it was applied. Apart from the administrative challenges, the inherent departure from the Directive's systemic intention and methodological approach needs further investigation, as it could be the reason behind many of the problems and delays of the implementation efforts.

In summary, the role of ecological status as a performance indicator, better characterisation of river basins (including analysis of pressures, impacts and economic analysis), improving monitoring to capture the interactions between stressors, ensuring that PoMs aim to improve system state by managing pressures, improved participation and interdisciplinarity to address the complex issues associated with water management, all call for a transition towards systemic thinking that can only be achieved with real transformational change. The WFD offers a platform for system-level shifts that need to take place, and unless it is recognised for this, a real opportunity for collective action will be missed. It is clear that implementing the WFD like any other directive is not going to work. Unless current implementation efforts are reviewed or revised, allowing the Directive to deliver its systemic intent in order to reach its full potential, the fading aspirations of the initial great expectations could disappear for good.

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