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Filling the Gap between Ecosystem Services Concept and River Basin Management Plans: The Case of Greece in WFD 20+

Ifigenia Kagalou *  and Dionissis Latinopoulos 

Department of Civil Engineering, Democritus University of Thrace, Xanthi 67100, Greece; dlatinop@civil.duth.gr

* Correspondence: ikagkalo@civil.duth.gr

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Abstract: The ecosystem services (ES) concept is embedded in all new European directives but its integration in the Water Framework Directive (WFD) is absent, despite the latter being the major legislative tool. The research aims to assess the knowledge of ES that lies within the River Basin Management Plans (RBMPs) in Greece so as to further depict their representation in the relevant planning tools, to support policy making and express the implementation experience to Member States for assisting EU reloading processes. The information on the ES' status was extracted by the official RBMPs, processed and grouped following Common International Classification of Ecosystem Services (CICES) classification. The prioritization of ES included in the programs of measures (PoMs) further showed the targeting for each River Basin District (RBD). The results were not homogenous for the RBDs, revealing different needs in measures and indicating there is a lack in “communication” between the relevant EU and national regulations. Moreover, a wide suite of water-related ES is hindered in addressing multiple benefits coming from provisioning, regulating and cultural ES. For a proper WFD reload and continuation, the infusion of the ES concept and prerequisites in its objective, and the reviewing of the RBMPs' target and the suggestion of integrated PoMs are necessary steps that could deliver added value in such legislation.

Keywords: Greece; River Basin Districts; River Basin Management Plans; program of measures; ecosystem services; Water Framework Directive reload

1. Introduction

Human society is extremely dependent on aquatic ecosystems as part of the global water–energy–food [1,2]. Water-related ecosystems provide multiple benefits and services to society, making them essential for reaching several Sustainable Development Goals (SDGs) [3]. They offer significant economic, cultural, aesthetic, recreational and educational value while they help to sustain the global hydrological, carbon and nutrient cycles. They support water security and biodiversity, regulate flows and extreme conditions, purify water and replenish aquifers providing water for drinking, agriculture, energy generation, navigation, recreation and tourism. Their sustainability and their resilience depend upon social, economic and environmental strategies [4].

As a consequence of an increasing interest in the importance of key ecosystem services, including water-related ones, for maintaining human well-being, there is a lot of political and scientific drive to embrace the “ecosystem services based approach” [5–8]. It is important to highlight that the concept of ecosystem services (ES), although it was originally developed two decades ago, is still a relatively new concept, especially amongst water policy makers and managers. The 2012 Blueprint to Safeguard Europe's Waters [9] provided an overview of the state of ecosystems and their capacity to supply services, showing also that the ecosystem services approach can be useful at different stages of EU water

policy implementation as the Water Framework Directive (WFD) [10]. Two years later, the resource document “Support Policy Development for Integration of Ecosystem Service Assessments into WFD and FD Implementation” reported by European Commission (EC) [11] provided inputs on how to use the ecosystem services approach to improve or support the implementation of the WFD and Floods Directive (FD) [12].

There are many links between the WFD principles and ES approach [13], while it is well documented that, among the Articles of the WFD related to ES, Article 11 (e.g., selecting cost-effective measures in the program of measures (PoMs)) is very important. Such importance lies in the fact that PoMs related to various management practices can provide important ES co-benefits. The River Basin Management Plans (RBMPs), with a temporal scope of six years, provide the basis for the protection and management of the environmental, social and economic value of water [14], while the chapter of PoMs is considered as the main instrument for establishing policy guidance by the competent authorities. For the waterbodies at risk of failing to achieve good ecological status, management responses should be in place for the improvement of the overall system’s health by targeting the pressures and their drivers contributing to ecosystem dysfunction.

The suggested measures are classified in two main categories in terms of: (a) their compliance with the EU environmental and national legislative framework and further with environmental objectives, namely basic measures; and (b) site-specific measures for improvement of the ecological status along with awareness activities, namely supplementary measures. The development of River Basin Management Plans (RBMPs) could benefit from the concept of ES, prioritizing the measures through their PoMs and justifying the costs of protection and restoration for achieving a “good ecological status” [15]. The prioritization of the PoMs has been documented by several methodologies [16,17] providing the best option from a series of alternatives. Yet, there is a need to embed the ES concept addressing win–win solutions for multiple actors/stakeholders. Although references to ES as well as the terminology of ES were generally absent in the first cycle of the RBMPs, they have started to appear in the second cycle [13,15]. The Fitness Check of EU Freshwater Policy [18] and the Blueprint document [9] already acknowledged the importance of actions for protecting ecosystems and delivering services in the context of sustainable water management. These documents further highlight the need to integrate more of the ES in RBMPs, while Bouwma et al. [6] strongly suggested that for the WFD, a start might be to develop a guidance document on how in the next planning cycle of the River Basin Management Plans ecosystem services could be considered.

For such prioritization and for proper integration, given that the ES concept is correlated with people’s well-being and prosperity, the PoMs should generally be connected with the affected areas and their inhabitants (end-users), keeping always as a primary goal the environmental values embedded in the WFD. Since the consensus takes place once every 10 or more years, new applications that represent geospatially the real population per area have been produced by large international organizations (POPGRIDS). Examples of such are LandScan, WorldPop and World Population Estimate (WPE). Gridded population data can provide surveyors with updated estimates, and the grid cells in some products may be closer to the actual unit areas that are to be surveyed [19], assisting sustainable management and development.

In Greece, the 14 River Basins Districts (RBDs) (Table 1, Figure 1) were designated in 2010 by the Decision of the National Water Committee [20], while a national monitoring network according to the provisions of Article 8 of the WFD was established in 2011 [21] and turned operational in the following two years. As Greece lagged in the development of WFD compliant methods for the ecological classification of all waterbodies’ types, significant effort was put in place to fill the gap resulting from the EC Decision in 2018 [22]. The first cycle of the RBMPs (2009–2015) of the 14 RBDs of the country was drawn up by the Special Water Secretariat, and the second cycle was published in 2017 (<http://wfdver.ypeka.gr/en/home-en/>), following the development of the WFD compliant methodologies and an extensive consultation of the first revision of the RBMPs. Regarding Greece, Kanakoudis et al. [23] highlighted serious weak issues regarding the qualitative assessment of the

RBMPs, which affect the prioritization of PoMs, while Spiliotis et al. [17] pointed out the need of a scientific framework for the setup of a suite of PoMs supporting the ES in each water district.

Table 1. List of the Greek River Basin Districts with additional information on their areas, and the existence of transboundary waterbodies within their borders.

RBD	Name	Size (km ²)	Countries Sharing
EL01	West Peloponnese	7235	-
EL02	Northern Peloponnese	7418	-
EL03	East Peloponnese	8442	-
EL04	West Sterea Ellada	10,432	-
EL05	Epirus	10,007	Albania
EL06	Attica	3139	-
EL07	East Sterea Ellada	12,268	-
EL08	Thessaly	13,150	-
EL09	West Macedonia	15,218	Albania, N. Macedonia
EL10	Central Macedonia	14,269	Bulgaria, N. Macedonia
EL11	East Macedonia	7320	Bulgaria, N. Macedonia
EL12	Thrace	11,242	Bulgaria, Turkey
EL13	Crete	8300	-
EL14	Aegean Islands	9118	-



Figure 1. Location of Greek River Basin Districts under the Water Framework Directive.

The main aim of this study is to assess the current knowledge of ES status and related data along with the level of their embedment in the RBMPs design and application in Greece (Figure 1). Another aim is to orient future policy and practice on WFD implementation responding to two basic questions: (a) if and how the ES approach is met within the last Greek published RBMPs, and (b) has the ES concept been addressed through the program of measures? All RBMPs for all RBDs belonging in the Greek territory were processed for identification, extraction and quantification of ES to assess how the concept of ES is being represented in the relevant planning tools. Country-focused studies help

national authorities and policy makers to identify potential gaps and to scientifically support the river basin management process which is referred to excellently by Kunz and Rittel [24] as an argumentative process. Taking into consideration that European water governance is characterized by processes of interplay and interaction [25], our paper provides the implementation experience of Member State (domestic) policy which is necessary for reloading processes at the EU level.

2. Methodology and Database

As a data source, we used the documents of the fourteen RBMPs (1st revision) corresponding to the fourteen RBDs in Greece, taking also into consideration the LandScan population maps. Additionally, documents produced for the reporting on directives and conventions, such as the Habitats Directive, the Birds Directive [26,27] and the Urban Wastewater Directive [28]), were also used as data sources. The identification and the classification of the ES was based on the CICES framework (CICES) [29]. We adopted the CICES framework since it is considered as a hierarchical one in structure, with each level providing a more detailed description of the identified ES [30,31]. The next step was to select the most suitable indicators associated with the WFD objectives. Some ES are relatively easy to quantify through indicators such as provisional services, while regulatory and maintenance and cultural ES are often more difficult to quantify. Thus, for each ES category, we selected indicators based on (a) the MAES analytical framework [32,33], (b) the resource document on Support Policy Development for Integration of Ecosystem Service Assessments into WFD and FD Implementation [11] and (c) the web dialogue of the working group of ESP (Ecosystem Services Partnership, <https://www.es-partnership.org/community/workings-groups/thematic-working-groups/twg-3-es-indicators/indicators-and-objectives/>). With the intention that our work will truly support the decision makers, we also took into consideration the position paper by van Ouderhoven et al. [34] considering additional criteria for indicators selection. Evidently, data on freshwater abstraction for irrigation purposes and water uses for livestock activities, as well as other activities, such as industrial and hydropower, are considered the best available indicators for provisioning ES [35].

Furthermore, indicators expressing the ecological and chemical status of the waterbodies along with biodiversity aspects illustrate the maintenance of the nutrient cycles addressing the regulating ES. In the quantification of the regulating and maintenance ES, as WFD-related services, we assessed the “Maintenance of physical, chemical and biological conditions”, applying as indicators (a) the chemical status of surface waters, (b) the ecological status of surface waters and (c) the chemical status of the groundwater. Yet, the pollution load in each RBMP is considered an anthropogenic pressure indicator expressing also the capability of the system for providing regulating services. Quantification of cultural services is even more difficult since we are referring to non-material spiritual, religious, inspirational and educational benefits and very often they are site-dependent. It is mostly related to recreation and tourism [36,37] including components that have a specific link with people’s behavior, e.g., degree of naturalness, protected areas as public recreation areas and water attractiveness [30,38]. Recently, the factor of remoteness and accessibility has been added in order to assess how the benefit (recreation) can be delivered to people. We applied the methodology of the Recreation Opportunity Spectrum (ROS) as the most suitable indicator for potential for recreation across Europe using the ROS zones [38]. The ROS system classifies all European Protected Areas under the network Natura 2000 in 9 classes (Table 2) using the Natura 2000 database (<https://www.eea.europa.eu/data-and-maps/dashboards/natura-2000-barometer>). Regarding the Greek Protected Areas, data were extracted from the national catalogues (depositories) [39] and further from the European databases (<http://cdr.eionet.europa.eu/gr/eu/n2000/envwpjtvq/>).

As second indicator of cultural ES, we applied the number of the Environmental Education Centers (EECs) established in each water district. Although recreation had been identified as the most common cultural ES, the environmental educational activities were also considered as a benefit and as a cultural “good” [40]. The Greek network of EECs provide a wide suite of formal and non-formal environmental education projects mostly to the school and student communities, and further to specific

visitors' groups. Yet, they are considered as nuclei for the dissemination of environmental education leading to projects that are associated with multiple benefits for participating students [41].

Table 2. The Recreation Opportunity Spectrum classes (after Parracchini et al. [38]).

Class	Recreation Opportunity Spectrum
1	Low provision—easily accessible
2	Low provision—accessible
3	Low provision—not easily accessible
4	Medium provision—easily accessible
5	Medium provision—accessible
6	Medium provision—not easily accessible
7	High provision—easily accessible
8	High provision—accessible
9	High provision—not easily accessible

3. Results

3.1. Typology and Quantification of the ES in RBDs

The identification and the quantification of the ES in the fourteen RBDs (namely EL 01 to EL 14) are presented in Table 3. Results for water consumption follow either the population load or the different productivity sectors in each RBD, depending on water availability (Figure 1, Table 3). It is apparent that freshwater abstractions for agricultural purposes are a major provisioning and more specifically nutritional ES. Agricultural water demand accounts from 66 to 2313 m³ 10⁶/year. RBDs such as Thessaly (EL 08), regions of Macedonia (EL 09, 10) and Thrace (EL 12) represent the agricultural “hot” areas due to the high water irrigation demand.

Livestock productivity as nutritional provisioning ES accounts from 0.4 to 10 m³ 10⁶/year across the Greek RBDs. A significant proportion of water use goes to livestock consumption (drinking) and cleaning livestock housing in RBDs with a high number of farming activities such as the RBDs of Epirus (EL 05), Thessaly (EL 08) and Eastern Sterea Ellada (EL 07) (Table 3). Total water abstraction for drinking purposes and generally for use by the public sector has been also quantified as an indicator of nutritional (provisional) ES. Populated RBDs (such as Attica-EL 06, Figure 1) and water-deficient RBDs (such as Thessaly—EL 08 and Aegean Islands—EL 14) are already the largest water users nationally, either due to agriculture or tourism.

Two indicators were used to estimate the water-related provisional ES regarding the divisions of material and energy. Across the 14 RBDs, the water quantity allocated for the main industrial sectors, such as mining and fibers, contributes to the increase in this service in EL 06, EL 07 and EL 10 (Table 3). Hydropower is considered among the energy-related provisioning services with the vast majority being small (less than 10 MW) and concentrated in mountainous RBDs such as EL 04 (Acheloos Basin) and EL 05 (Arachthos Basin).

Indicators of chemical status reflect the chemical quality of both surface and groundwater waterbodies, while the ecological status expresses the quality of the structure and functioning of the surface waterbodies. Waterbodies with an “unknown” chemical and ecological status were excluded from our study (Table 3). In terms of chemical status, a low percentage (ranging from 0.95% to 7.14%) of all types of surface waterbodies across all RBDs were classified as “less than good”, while in almost half of the RBDs (N. Peloponnese, E. Peloponnese, West Sterea Ellada, East Sterea Ellada, Crete, Aegean Islands), no waterbody has been classified as “less than good”. Natural surface waterbodies across RBDs show that a range of 2.80% to 58.09% were classified in terms of their ecological status as “less than good”. The Aegean Islands (EL 14) and Central Macedonia (EL10) present the lowest and the highest percentage, respectively (Table 3). Regarding the chemical status of groundwater presented in the fourteen RBDs, it is shown that the observed percentage of waterbodies with a “not good” chemical status varies across RBDs ranging from 3% (EL 04) to 26% (EL 03).

Table 3. Ecosystem services indicators grouped by major categories, depicting the status in all Greek River Basin Districts (RBDs).

	Provisioning					Regulating and Maintenance							Cultural	
	Nutrition			Materials	Energy	Maintenance of Physical, Chemical and Biological Conditions *			Biodiversity	Pollution Load (Point and Non-Point Sources)			Physical, Intellectual Interactions with Aquatic Environment	
	Water Consumption for Irrigation (10 ⁶ m³/Year)	Water Consumption for Livestock (10 ⁶ m³/Year)	Water Consumption for Drinking (10 ⁶ m³/Year)	Water Consumption for Industry, Mining, Fibres etc. (10 ⁶ m³/Year)	Water Consumption for Hydropower (MW. Max Permission Level)	Chemical Status of Surface Water Bodies (% in Less Than Good)	Ecological Status of Surface Water (% in Less Than Good)	Chemical Status of Groundwater Water Bodies (% in Not Good)	Water Related Protected Areas (N ^o of SPA, SCIs or/and SACs)	Total Annual Load BOD (10 ³ tn/Year)	Total Annual Load N (10 ³ tn/Year)	Total Annual Load P (10 ³ tn/Year)	Environmental Educational Centres (N ^o of Centres)	Recreation Opportunity Spectrum (ROS) Classes
EL 01	171.1	1.5	27.5	18.8	14.12	2.41	26.6	7.4	32	13.9	2.1	0.35	2	2,4,8
EL 02	406.4	3.2	61.8	8.7	27.8	0.0	39.2	15.4	7	9.8	3.9	0.31	3	1,4,7,8,9
EL 03	282.4	4.3	31.4	7.6		0.0	25.0	26.0	8	7.9	1.5	0.9	3	4,6,7
EL 04	717.0	8.0	39.0	2.0	114.07	0.0	20.5	3.0	10	10.3	5	0.6	5	1,4,7,8
EL 05	688.0	10.0	58.0	4.5	70.18	2.0	32.0	3.1	14	25.5	9.7	2.9	5	1,4,8,9
EL 06	66.0	0.4	416.0	18.0		2.1	38.2	23.8	7	2.1	1.2	0.46	4	1,4,7
EL 07	839.0	10.5	76.0	29.12	12.53	0.0	43.7	12.2	22	3.5	4.1	1.2	4	1,4,7,8
EL 08	2,313.0	13.0	94.0	9.0	12.39	7.14	40.0	12.0	9	15.3	6.5	0.6	5	1,8,9
EL 09	937.87	7.2	140.77	13.5	61	2.83	50.3	5.67	44	11.6	6	1.6	4	1,7,8,9
EL 10 **	1067.63	8.0	230.0	24.0	3.46	0.95	58.09	13.5	26	17.6	10.1	2.3	7	1,4,7
EL 11	772.0	2.5	58.9	4.1	61	3.89	37.0	6.6	4	9.5	4	0.36	2	1,4,7
EL 12	941.4	3.9	60.5	14.1	3.9	5.32	23.1	22.0	15	19.2	9.1	1.5	4	1,4,8,9
EL 13	415.0	4.16	78.1	0.75		0.0	21.6	9.89	105	34.3	22	5.3	5	4,8,9
EL 14	111.36	2.39	90.66	0.05		0.0	2.8	24.1	89	32.1	15.8	3.3	3	4,7,8

* unknowns were excluded ** Athos Peninsula was excluded SPA = Special Protection Areas, SCI = Sites of Community Importance and SAC = Special Areas of Conservation.

Biodiversity is at the hard core of the ES concept, highlighting the state of an ecosystem and the benefits for human well-being. The Natura 2000 sites have been designated under the Birds Directive (Special Protection Areas—SPAs) and the Habitats Directive (Sites of Community Importance—SCIs, and Special Areas of Conservation—SACs). Since Natura 2000 water-related protected areas offer a degree of security against degradation in RBDs, their number in each RBD is provided as a biodiversity ES indicator. Crete (EL 13) and the Aegean Islands (EL 14) RBDs present a high number of water-dependent Natura 2000 sites, including the special island wetland sites (Table 3), reflecting the high non-monetary value of nature in those districts.

Pollution load and nutrients enrichment from both point and non-point pollution sources in river basins threaten essential water-related ES illustrating their sustainability resilience. Applying as proxies the annual total load of biochemical oxygen demand (BOD₅ in tn/year), the total annual nitrogen load (as TN tn/year) and the total annual phosphorous load (as TP tn/year), we provide an overview of their variation across the Greek RBDs (Table 3). As regards the BOD₅ proxy, high organic loads are produced in EL 05, EL 13 and EL 14 (Epirus, Crete and Aegean Islands), mostly coming from livestock activities, oil mills and semi-urban settlements not served by wastewater treatment plants.

Higher nutrients loads are present also in Crete (EL 13) and the Aegean Islands (EL 14), contributing to the total pollution load. A lower nutrient contribution has been recorded in East Peloponnese (EL 03) and Attica (EL 06), supposing that the main pollution burden comes more from the industrial sector than from the agricultural or/and livestock activities. There is a paradox with higher nutrient loads in the islands and Epirus which comes in contradiction with the local livestock and agricultural water consumption.

Concerning the mapping of the cultural ES, there is a rather non-homogeneous distribution of the number of Environmental Education Centers (EECs) across the RBDs. An average value of four centers per RBD ranges up to seven (EL 10) and declines to two (EL 01, EL 11). Of course, the Greek scheme of environmental education is a geographically dispersed network according to the regional governance structure of the country and not to the water districts. So, it is evident that in cases such as the Aegean Island district (EL 14), the number of centers (3) is considered as inadequate to provide environmental education services to a widely remote area.

Regarding the ROS indicator, almost all classes (Tables 2 and 3) represented in the 14 RBDs offer high recreation services, with the mountainous and remote ones being characterized by higher classes 7, 8 and 9 (high provision categories with variation in accessibility). It is worth noting that the Athos area (EL 10) has not been included, since citizens have limited access due to the special administrative framework with a religious “separate” governance. It could be stated though that the natural resources are almost intact.

3.2. The Program of Measures (PoMs)

Concerning our second hypothesis “if the ES concept has been addressed through the program of measures reported in the first revision of the RBMPs”, Figure 2 provides an overview of the measures and the prioritization of the potential ES that are being supplied. We divided the measures in two categories, i.e., “Technical” and “Administrative”, and we excluded from our research the “basic administrative” measures since they are repeated through all RBMPs as compliance measures to the EU water policy. As a general output, the suggested technical measures deal with fertilizer and pesticide application control and changes towards low-input farming. As for the quantitative measures, all PoMs include measures for water saving or efficiency increase for water usage in agriculture, highlighting the importance of this sector’s consumption. It is clear that the “ecological perception” of the WFD is not reflected upon the measures, since the majority of them deal with water as a resource to be protected and not as a living environment. As for the spatial distribution of these measures, southern Greece has the fewest in almost all categories and especially Peloponnese lacks measures in four–five general categories, depending on each RBD (Figure 2).

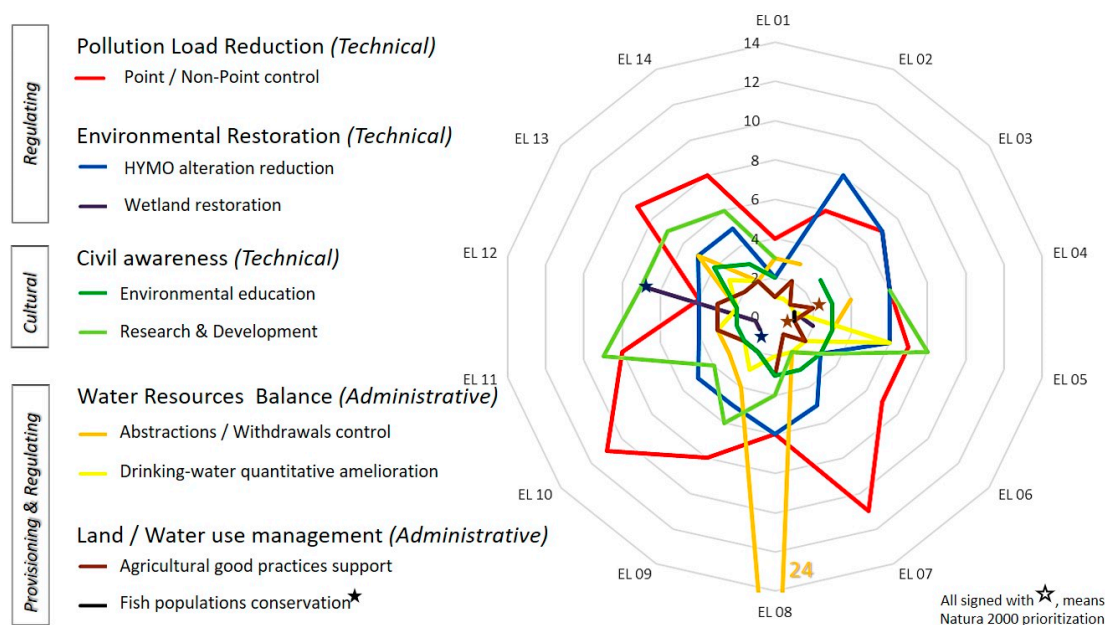


Figure 2. Program of measures breakdown per River Basin District, grouped per ecosystem services (ES) served and the nature of the measures.

Administrative PoMs mainly include measures for implementing existing relevant EU directives, measures related to increased knowledge for decision making and others related to environmental licensing and national environmental legislation, and these are coupled with measures regarding institutional changes, training/awareness raising and specific research and development projects.

Our results show that there is a lack in “communication” between the relevant EU and national regulations, thus the concept of ES becomes fuzzy. Only in two cases (West Sterea—EL 04 and Epirus—EL 05) is there a link between the WFD and the Habitats Directive addressing good agricultural practices and fish species conservation as regulating and provisioning ES. Regulating ES mostly tackling the point and non-point pollution sources are super expressed across RBDs, probably because the designation of PoMs is driven from the concept of “Pressures” in each river basin, rather than the ES concept. Yet, hydromorphological pressures are tackled through technical measures in all RBDs, responding to the pressures and impacts deriving from large-scale construction works (dams, water storages, hydropower establishments). On the contrary, restoration measures (habitat connectivity, fish ladders, inundation of floodplains, coastal erosion) that could provide all types of ES are very limited. As an example, Thessaly (EL 08) hosts a significant number (24) of PoMs on water resources balance (mainly water storage units) as a result of the high water needs of the entire region. The established PoMs across all Greek RBDs are expected to offer policy tools to water users and water authorities, but, looking from a different perspective, it can be seen that planning issues interdependent on water (land use, land cover changes, wetlands, biodiversity, climate crisis) have gained little attention.

Cultural ES are expressed as measures concerning educational and research and development projects. Among the suggested ones, across all RBDs, the farmers’ awareness projects, as well as monitoring projects, are the most popular PoMs. We consider the farmers’ awareness, and generally social learning, as something that could be an additional horizontal pillar in all PoMs due to its high importance to disseminate the value of water-related ES to the stakeholders’ community.

4. Discussion

Since people benefit from various ES from river basins, ranging from nutrition and pollutants removal to cultural values, managing the costs and benefits becomes a complex [1,42]. This is the reason why the ES approach came into play, aiming at the organization of social challenges and natural science measurements [43,44] towards catchments’ sustainable management. The largest water-related

policy that exists at this moment in Europe is the Water Framework Directive 2000/60/EC, introducing a “catchment-basin approach” in line with the Integrated Water Resources Management (IWRM) paradigm. Acknowledging that water in the European Union (EU) is under increasing pressure due to the continuous growth in demand for sufficient quantities of good quality, the WFD introduces a framework for the integrated basin approach in water management, considered as “the blueprint for IWRM”. When applying the WFD, RBMPs have to be developed and reviewed on a six-year basis, specifying the actions required within each river basin to reach good ecological status. In cases where the ecological status is less than good, stakeholders have to apply strategy planning, meaning the PoMs, to manage anthropogenic pressures and improve ecosystem health. Yet, the practical implementation of best practices and experiences at the domestic level should be mobilized across Member States, along with governance organization levels which can act as an instrument for the delivery of the directive’s benefits.

In the present paper, we tried to put the ES concept into practice, especially the ones embedded in RBMPs, so as to achieve the WFD objectives at the country level. To be clear with the terminology, the ES concept is not used in the national RBMPs, and no clear methodologies are provided. This was the case also in other European countries, such as Italy, England, Portugal, Romania and Belgium, where the term of ES was generally absent during the first cycle of RBMPs; the term appeared in the second one at an exploratory stage [8,15]. Now that the WFD is coming to its terminal stage 20 years later, integration with ES as an anthropocentric issue can be the basis for accomplishing SGG, 2030 Agenda and Green Deal goals since it can incorporate financial and economic measures, admeasure the added value of water uses and ensure stakeholder participation along with equity of end-users.

However, analyzing the Greek RBMPs, a wide suite of water-related ES is hindered in the effort to provide multiple provisioning, regulating and cultural ES. Agriculture continues to play a crucial role in the transformation and development of rural societies, while in arid and semi-arid EU Mediterranean countries, including Greece, irrigation for crop production is the larger consumer. Combined efforts between the new Common Agricultural Policy (CAP) and the WFD should be implemented to alleviate the pressures from irrigated farming. Kampas et al. [45], unraveling the synergies and conflicts in the most water-demanding Greek RBDs (EL 08), argued that there are opportunities for combining the efforts of the two policies in order to enhance water saving, taking also into consideration regional-specific factors. Since OECD [46] reported that Greece faces serious water challenges, in particular in terms of its agricultural water use, we strongly recommend co-operation between all stakeholders and policy makers in order to facilitate the design of PoMs clearly addressing ES such as the reassurance of the river’s ecological flow, the ecological water level and the groundwater aquifer. Our results highlight that agriculture and population growth with all relevant services supporting the water–food–energy nexus are expected to be the key drivers for water demand in the coming decades.

Hydropower, along with other renewable energy sources, plays a key role in the implementation of the Renewable Energy Directive and in contributing to the EU energy targets for 2020–2030 and follows several requirements [22]. In Greece, the provisioning energy services originating from hydropower account for 28% of the total energy services [47]. Meanwhile, official EC documents endorse guidelines on hydropower development under the WFD [22,48], and there are not yet PoMs addressing the environmental requirements in relation to hydropower, ensuring the regulating ES, such as the protection of aquatic habitats’ connectivity, sediment transport management, the remeandering of water courses, coastal erosion or the conservation of the composition and abundance of fish species. This is considered as an urgent issue since it also appeals for the need and commitment of halting and reversing the loss of aquatic biodiversity. The designers of the next cycle of PoMs have to face the challenge to strike the right balance among the EU relevant legislation including inter alia the Environmental Impact Assessment—EIA [49] and the Strategic Environmental Assessment—SEA Directives [50], the Birds and Habitats Directive [27] and the WFD [10] and Floods Directive [12].

Considering the water-related ES, the concept followed in the RBMPs is focused on “water uses” instead of services. This often drives the citizens’ opinion towards more a “resource” perspective than an “ecosystem-based approach”, thus synergistic actions that can be developed among uses as agriculture, energy and nature conservation, recreation and sustainability are not clear.

Regulating ES are not clearly referred to in the RBMP objectives, however many of the suggested PoMs show an indirect impact in specific ES contributing to meet the benefits from the WFD objectives (Articles 4 and 7). Panti and Kagalou [51], comparing the first planning cycle of RBMPs in Greece (Thessaly RBD) and Scotland (Solway Tweed), revealed differences in delivering the environmental goals, illustrating the economic and environmental benefits from the implementation of the WFD. Thus, a next cycle with a clear ES approach would be very promising. This remains the case even now, where not enough site-specific PoMs across the RBDs were found, not even in the “supplementary” class. Thus, a clear message should be drawn for the next Greek PoMs package, that they should address the maintenance of site-specific regulating ES. An example could be that apart from the reduction of pollution run-off, that is already clear, attention should be given to improving the water cycle at the regional level, mainstreaming practices that ensure soil–water interactions, facilitating measures for groundwater recharge, wetlands restoration measures and biodiversity conservation. Regarding the latter, although Borgström and Kistenkas [52] argued that EU water management and nature conservation laws should perhaps not be narrowed down to only some ecosystem services, but should definitely start from the aquatic or/and water-dependent Natura 2000 sites, as they are vulnerable and multi-functional ecosystems.

Urbanization trends in Greece in recent decades show a shift from the concentration in large metropolitan cities during the 1970s to a strengthening of medium-size urban centers in the late 1990s [53]. Urban waterbodies improve the quality of life in urban areas since they provide various ES [54,55]. In Greek RBMPs, and consequently in the relevant PoMs, the complete absence of measures addressing the urban aquatic ecosystems is apparent.

Administrative measures included in the Greek PoMs across all RBDs remain a weak issue towards achieving the goals of the WFD. While the Greek environmental policy is largely based on EU directives, the lack of implementation is the “Achilles heel” weakening the effectiveness of those foreseen in almost all RBDs. Since there is no requirement to monitor or map the ES, their links to specific PoMs are exacerbated by the gaps in implementation. We suggest that a stronger enforcement is required. For example, although the suggested regulations, in terms of administrative PoMs, the illegal water abstractions or discharges have not been tackled due to the lack of enforcement of the relevant regulations. One explanation is that management responsibilities rest with many authorities at central and local levels with consequent overlapping and coordination problems. Possible causes for inadequacies in PoMs implementation could also be the lack of knowledge on natural water systems behavior and their ES, financial limitations and the poor fitting with other relevant EU policies. Regarding the latter, the recent economic crisis reduced the perception of the severity of environmental issues [56] while creating mutual dependencies between responsible environmental policy implementing agencies that limited the generation of a comprehensive ES overview from complementary perspectives.

Unfortunately, there is not a path to include the cultural ES in EU and national assessments, while structural indicators of cultural services are described more often as the quality of natural areas as experienced by people, with accessibility being the most important indicator for cultural ES [44]. In our study, we included areas under the Natura 2000 network and their accessibility as an indicator for assessing the cultural ES across the Greek RBDs. Our results allowed the evaluation of the type of recreation that EU citizens could potentially have access to in the different Greek ROS zones.

We revealed that ROS zones across all RBDs offer high opportunity for nature tourism, obviously with benefits to the national, regional and local economy. Although it is beyond of the scope of the present study to distinguish which exact ES lead in socio-economic benefits, it is undoubtful that the demand of such services stimulates “green” employment [5,57–59]. Overall, PoMs do not include

specific additional measures for water-related protected areas going beyond the strict WFD objectives, despite that engagement with other directives is highly recommended. Furthermore, this becomes even more urgent since the concept of SDGs goals [3,60] has been put in place. Among the targets of Goal 6, Target 6.6 was set to “protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes by 2020”. It seeks to halt the degradation and destruction of these ecosystems, and to assist the recovery of those already degraded, while the indicators used for Target 6.6 are coping with the water-related ES.

Public awareness on environmental issues is an educational process providing cultural/spiritual ES. Greece has created a robust form of environmental education through a decentralized scheme of EEC covering all RBDs, thus delivering, among others, educational services often as outdoor activities related to the aquatic systems. Regarding the suggested measures, although national and environmental NGOs’ efforts have been made to raise water users’ awareness, PoMs in each RBMP target the farmers’ community and not a wider audience, resulting in a handicap for strong implementation across all stakeholders. PoMs should address collaborative water management fostering equity between users and minimizing socio-economic conflicts.

We further considered the research and development measures as a contribution to educational and knowledge development, hence contributing to the cultural benefits of the RBDs. The majority of the included in the PoMs refer to further monitoring protocols of specific waterbodies needing frequent surveillance or specific management.

5. Conclusions

This study focused on the linkages between the ES and the RBMPs of one EU Member State, but the findings may be relevant in the European context since they raise the issue of whether the ES could either be incorporated or even assist the implementation of the WFD for the years to come through a “reload” process.

In conclusion, linking the WFD objectives with ES prerequisites helps in reviewing the objectives of the RBMPs and the suggestion of PoMs that could deliver added value from the ES concept. The challenge for the next planning cycle is to produce fully operational PoMs, taking into consideration the already drafted national agenda about the ES assessment in Greece. Furthermore, the WFD clarifies that each suggested measure must not compromise other EU environmental legislation, otherwise it cannot be approved and go ahead. The concept of ES is more than necessary to be adopted in the RBMPs for the integration of different policies and stakeholders’ views supporting also the socio-ecological system’s interactions.

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