



# Water Resources and Spatial Planning Systems in Portugal – Using Ria de Aveiro as a Model to Explore Better Synergies

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**Abstract:** Land use planning is essential to maintain and restore water resources, estuaries and associated ecosystem services, as well as, to prevent and adapt to risks in the face of global change. Land use planning can be used to minimize human pressures and associated impacts on water resources and ecosystems as it can significantly affect the impact of human activities on the water cycle of a region. Through the preparation of spatial plans, land-use control, and the application of planning techniques and approaches, spatial planning can contribute to the implementation of the WFD's 'basic measures'. The way land use and water resources planning systems are articulated is crucial for the mentioned potential. Conceptually, spatial planning and water resources planning systems have been conceived out of different scientific contexts, from different institutional frameworks, and with different spatial boundaries – hence hindering the establishment of bridges between these two systems. Using article 11 of the WFD this paper seeks to assess (i) how the Law on Spatial Planning and Urban Development as well as the Portuguese Water Law converge to promote better integration of water resources into spatial planning (ii) how their prospects are developed at the regional basis, namely through the Water Basin Management Plan and Regional Spatial Plan and, (iii) how these are prepared to inform other planning instruments, such as local plans. The analysis uses the Ria de Aveiro in Central Portugal as a case study. The article concludes with a critical analysis of the integration of the spatial planning and water resources planning systems in Portugal, and aims to reveal new insights and challenges for more productive synergies between these systems.

**Key words:** Water resources, land-use, planning systems, Portugal, Ria de Aveiro

## 1. INTRODUCTION

The concept of “integrated water resources management” has been used as a paradigm for good practice in the water sector. It is defined as “a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems” (GWP, 2000). It is a broad definition, able to be accepted by a wide range of perspectives and stakeholders. It includes, however, a critical aspect hardly apprehended in its full length by the society and by the related policy and planning arrangements. This aspect is related to the reference to “land and related resources”. Biswas (2008) questions the wideness of what could be integrated in such expression and the related consequences. The “land and related resources” indeed do suggest all the resources, ecosystem functions (see Garmendia, et al 2012), human activities and stakeholders associated to a territory as well the policies, plans and institutional systems created to control them in order to adjust their likely impacts to the limits of existing water resources carrying capacity. To attain such a demanding challenge, multiple cross policies and cross arrangements are required.

Integrated in the spatial related challenges is the need to take into account the spatial variability of water resources, the associated infrastructures, the different interests and conflicts, the priorities, policies and planning instruments, which need to be tackled by decision-makers and governance institutions. The adoption of integrated approaches for the management of water resources has required significant reforms in many countries leading to adjustments in water policy, water legislation and water resources planning (UNEP, 2012). The water governance’ challenges address the 'vertical' integration problem of how best to integrate water policy between different levels of government. They, also address the 'horizontal' problem of how best to integrate different sectorial policies such as agriculture, industry, energy or ecosystem protection. They all interfere with water

use and their location is, ultimately, considered under the spatial planning and related decision-making process.

In the European context it has also been recognized that the main pressures on Europe's waters, namely diffuse pollution, hydro morphological alteration and over abstraction, are mainly associated to the impacts of land-use and location options such as those associated to agriculture, energy, transport and urbanization (EA, 2012). In 2000, the EU Water Framework Directive (WFD) addressed in a comprehensive manner all the challenges faced by EU waters, making it clear that water management is much more than just water distribution and treatment. It also involves land-use and management that affect both water quality and quantity. Water management requires coordination with spatial planning and integration into funding priorities must be set out by member States in plans for river basins. In spite of the progresses achieved in EU, however, the Blueprint for Water (EU, 2012) still stresses that improvement in the water ecological status and reduction of pressures over water resources requires a stronger integration of water resources and land use planning, which also must deal with climate change, disaster resilience and adaptation.

Hence, the question of how water resources planning can be articulated with spatial planning emerges. How does national legislation deal with this challenge and create opportunities for stronger ties between the two planning systems, conceptually and procedurally? How do the systems communicate and strengthen objectives, priorities and land-use strategies with regards to water resources protection? This paper concentrates on the Portuguese land use and water resources planning systems. It questions how the Law on Spatial Planning and Urban Development (Law n° 48/98 of 11 August and related alterations) establishes the main features of the spatial planning procedures and plan contents regarding water resources. In addition, it analyses how the Portuguese Water Law (Law No. 58/2005 of 29 December and related alterations) has introduced new challenges for the integration of water resources management concerns into spatial planning. The paper uses Ria de Aveiro as a case study to assess how these two systems complement each other in real water resources and spatial plans.

## **2. SPATIAL PLANNING AND WATER RESOURCES PLANNING SYSTEMS – WHY SEARCHING FOR TIES**

The EU Water Framework Directive (WFD) (Directive 2000/60/EC of 23 October) establishes a framework for Community action in the field of water policy and is said to have a strong territorial context as it establishes its implementation through river basin management plans based on natural water resources systems and associated boundaries, instead of on administrative boundaries (EA, 2012). The main purpose of the WFD is to “establish a framework for the protection of inland surface, transitional, coastal and ground waters in order to: i) prevent further deterioration and protect and enhance the status of aquatic ecosystems, terrestrial ecosystems and wetlands with regard to their water needs; ii) promote sustainable water use based on a long-term protection of available water resources; iii) enhance protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances; iv) ensure the progressive reduction of pollution of groundwater and preventing its further pollution, and v) contribute to mitigating the effects of floods and droughts.

In article 11 of the WFD it is defined that each Member State shall ensure the establishment of a programme of measures for each river basin district, aiming to achieve the quality objectives of water resources. Each programme of measures to integrate the River Basin Management Plans (RBMP) must include basic and supplementary measures. Their main types are summarized in Table 1. The formulation, design and effective implementation of many of these measures are intrinsically dependent on the decision-making process adopted by land use plans, as major instruments to define development priorities and related location and density of human activities and infrastructures. In addition, such decision-making processes are most influenced by

stakeholders, associated interests and governance structures. If spatial issues are of utmost relevance for water resources protection, articulation with spatial decision-making is then, crucial.

*Table 1. Main types of measures foreseen in the WFD*

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(a) to implement Community legislation for the protection of water;
(c) to promote an efficient and sustainable water use in order to avoid compromising the achievement of the objectives
(d) to safeguard water quality in order to reduce the level of purification treatment required for the production of drinking water;
(e) to control the abstraction of fresh surface water and groundwater, and impoundment of fresh surface water;
(f) to control of artificial recharge or augmentation of groundwater bodies;
(g) to control point source discharges liable to cause pollution;
(h) to prevent or control the input of pollutants for diffuse sources liable to cause pollution.
(i) to ensure that the hydro morphological conditions of the bodies of water are consistent with the achievement of the required ecological status or good ecological potential for bodies of water designated as artificial or heavily modified;
(j) to prohibit direct discharges of pollutants into groundwater;
(l) to prevent losses of pollutants from installations, impact of accidental pollution and to reduce the risk to aquatic ecosystems.

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The advantages of improving synergies between water resources and land-use planning systems are multiple, alongside a stronger contribution for the implementation of the measures mentioned above. Three major examples emerge from the literature. One is related to the need to reduce the various types of negative externalities resulting from the miss-match of human activities and associated water uses and conflicts. Among these, are those externalities resulting from the frequent unbalanced share of cost and benefits among those who use water resources and those that face the impacts of pressures over water resources (Roebeling et al, 2009). Others are associated to gains resulting from a proactive action, namely through the integration of development objectives within the spatial and water resources' use patterns. Examples include the reduction of overuse of water in vulnerable and water scarce areas, the conciliation of actors' expectations with water availability and the avoidance of flooding events, among others. Having in mind the contributions from Carter (2007), the main gains from improving the synergies can be synthesized as the following:

- it brings a long-term, strategic focus covering large areas, similar to the perspective of the WFD;
- it influences a broad range of economic sectors that affect river basins through water consumption and pollution as well as the modification of water bodies;
- it influences the type and location of new polluting activities and thus water status;
- it can be used to translate water management goals, such as measures for more efficient water consumption, into local government action, for example for new housing developments;
- it shares a number of key tools with RBMP, including, for example, SEA and public participation;
- it is a key tool in addressing flood risks.

Because river basin management plans and land use plans are usually developed under different institutional and technical contexts, the expected influence between them is still very limited (Moss, 2004). Several reasons are pointed out by the EA (2012). They are usually carried out by different governance structures, technical fields and traditions, hindering the necessary interconnectedness. They also differ in their spatial fits (Moss, 2004). While spatial plans normally fit administrative boundaries, water basin management plans fit into geographical areas with natural boundaries. In addition, their borders rarely match also due to different government sectors responsible for their elaboration and implementation. Political contexts and stakeholders are also different in nature and relative weight. Time and spatial scales also differ, as well as specific associated methods and data. Finally, few opportunities exist for the systems to be developed under a joint work process, hindering any attempts to design an integrated vision for sustainable development and quality objectives between the two institutional sides. According to Moss (2004), if water managers have to adopt a more integrated approach to water protection they will need to cooperate to a far greater extent than in the past with organisations outside the sphere of water management.

Having in mind the potentials highlighted above, and the factors that are hindering effective articulation, new solutions have to be identified and explored in order to improve bridges and synergies. Examples referred in the literature review include the following:

- creating governance guidance on how to improve articulation (see examples in Scotland and the Netherlands)
- improving the spatial analysis in RBMP, namely through better representation of water resources vulnerabilities, like flooding areas, showing the room for rivers.
- encouraging the involvement of stakeholders in both participation schemes
- exploring the contributes of SEA and the potential to evaluate the articulation between objectives and measures
- establishing voluntary guidance by plan teams and authorities responsible for the plan preparation.
- sharing data and indicators (see Valenzuela Montes & Ruiz, 2008).

In the majority of national frameworks, spatial planning systems are dedicated, not only to establish development priorities, new infrastructure and services location, and spatial ordering, but also to establish rules for land-use to guide, and often mandatorily control, private initiatives. The planning of water resources has been mainly centred in public water infra-structures and public interventions to improve water quality, quantity and ecosystem services. In addition it establishes objectives and measures, as referred above, which also affect water resources users and stakeholders. Both systems hardly question each other as to where conflicting objectives and strategies are at stake (Moss, 2004). Having in mind, the concerns referred to in literature, a set of factors, among others, enable the assessment of how national laws foresee the articulation between spatial planning and water resources planning. A first factor is the way specific planning systems' law refers any need for articulation or integration of their broad objectives. A second factor relates to the spatial units used by each planning system. A third factor refers to procedural mechanisms to ensure articulation and share of objectives between spatial plans and water resources plans. A fourth factor relates to the articulation of plan preparation process. In this case the spatial analysis included in water resources plans and the integration of water resources spatial vulnerabilities in the spatial plans is of crucial relevance. A fifth factor relates to the participatory measures, the types of stakeholders to be involved as well as the mechanisms for connecting and, therefore, enriching both systems. Last but not the least, the seventh factor relates to the authorities responsible for plan preparation and their integration within the institutional framework of environmental and land-use planning and governance.

### **3. SEARCHING FOR SINERGIES BETWEEN THE LAND-USE PLANNING SYSTEM AND THE WATER RESOURCES PLANNING SYSTEM IN PORTUGAL**

The main features of the Portuguese land use and sector planning system have been established under the Framework Law of Spatial Planning Policy (Law n.º 48/98, de 11.08, altered by the Law n.º 54/2007, de 31.08). It establishes the three main levels, national, regional and municipal, and their articulation requirements, the various types of plans that integrate the planning system, as well as the main planning objectives, principles and state responsibilities regarding the ordering of the territory, as well as, the related formulation and implementation of plans. Later associated updates and regulations (Decree-Law n.º 380/99, of 22.09, altered by the Decree-Law n.º 316/2007, of 19.09, and by the Decree-Law n.º 46/2009, of 20.02) have contributed to the consolidation of territorial planning system, by clarifying the object, content and procedures of preparation, modification, revision, and implementing of plans foreseen in its structure. Column A of Table 2 briefly presents the main features of the Portuguese Land-Use Planning System. The Portuguese Water Planning System is established in chapter III of the Water Law in 2005 (Lei n.º 58/2005, 29.12 altered by the Decree-Law n.º 245/2009 of 22.9 and by the Decree-Law n.º 130/2012 de 22.6), which transposes into the national law the EU Water Framework Directive. It establishes the basis and institutional framework for the sustainable management of surface waters (including inland,

transitional and coastal) and groundwater. The system is schematically described in column B of Table 2.

*Table 2. Portuguese Land-use and Water Resources Planning Systems*

	A		B	
	Land-Use Planning System		Water Resources Planning System	
	strategic	regulatory	regulatory	strategic
National	National Land-use Policy Program (PNPOT)			
	Sector Plans (ex. water, energy, forests, agriculture, transports etc.)			National Water Plan (PNA)
Regional		Protected Areas Plans (POAP)		River Basin Management Plans (PGBH)
		Coastal Management Plans (POOC)		
		Public Water Reservoirs Plans (POAAP)		
		Estuary Land-use and Management Plans (POE)		
	Regional Land-use Plans (PROT)			
Local	Inter-municipal Land-use Plans (PIOT)			Specific Water Management Plans (PEGA)
		Municipal Master Plans (PDM)		
		Urbanization Plans (PU)		
		Detailed Plans (PP)		

The system is constituted by three types of instruments, the Special Land-use Plans, the Water resources plans and the measures for the protection and improvement of water resources. The first version of the Water Law brought new challenges to the legal, institutional and regulatory framework of water resources, by creating new authorities, and changing roles and responsibilities, including the the five Administration of Hydrographic Regions (ARH), which, after recent elections, have all been integrated into a unique centralized agency, the Portuguese Environmental Agency. It also established the need for specific planning instruments. One set is of strategic nature binding only the public authorities that includes the River Basin Management Plans, which aim to implement the WFD in Portugal. In addition, the Law also foresees another set of regulatory plans, mandatory both for public authorities and for private initiatives. These include the plans dedicated to special water resources values like coastal, estuarine and public water reservoirs.

One evidence of complementarity between the two systems emerges from Table 2. There is a set of plans, those dedicated to coastal, estuary and public water reservoirs, which are considered simultaneously by the two planning systems. As the land-use planning system, considers them as special plans, they assume, therefore, a double mission where land-use and water resources objectives and measures are merged into unique plans. These plans are subject to the same discipline as established by the Land-Use Policy Planning regulations, particularly with regards to the procedures for public and institutional consultation, contents and documentation as well for preparation, modification, revision, suspension and implementation. In addition, in spite of the broad objectives of coordination established by the specific Laws, the prospects and opportunities for connection between the two systems are not very strong. Table 3 briefly summarizes the main features of each system at regional level having in mind the critical factors mentioned in the literature review.

Table 3. Links between the Portuguese and Land-use and Water Resources Planning Systems

	<b>Land-use planning law</b>	<b>Water law</b>
Main planning Aims	<ul style="list-style-type: none"> <li>- Strengthening national cohesion, organizing the territory,</li> <li>correcting regional unbalances and ensuring equal opportunities for citizens in access to infrastructure, equipment, urban functions and services;</li> <li>- Promoting integrated enhancement of the diversity the national territory;</li> <li>- Ensuring the rational use of natural resources, the preservation of cities and functionality the built environment;</li> <li>- Ensuring the protection and enhancement of cultural and natural heritage;</li> <li>- Promoting the quality of life and ensuring favourable conditions to the development of economic and social activities and cultural rights;</li> <li>- rationalizing, rehabilitating and modernizing urban centers and promoting their coherence;</li> <li>- safeguarding and enhancing the potential of rural areas, containing desertification and encouraging the creation of employment opportunities;</li> <li>- safeguard the civil protection of the population, preventing the effects of natural or human associated disasters. (art. 3)</li> </ul>	<ul style="list-style-type: none"> <li>- Harmonizing and integrating the sustainable use of these resources for their protection and enhancement, as well as the protection of persons and property against extreme events associated with water;</li> <li>- Planning and regulating water resources uses and zones that confine them in order to protect the quantity and quality of water, the aquatic ecosystems and sedimentological features. (art. 14)</li> </ul>
Planning principles	Sustainability and intergeneration solidarity, economy, coordination, subsidiarity, equity, participation, responsibility, contractualization, juridical security. (art. 5)	Integartion, global ponderation, functional adaptation, durability, participation, information, international cooperation. (art. 25)
Articulation	<ul style="list-style-type: none"> <li>- land-use plans and sector plans reflect a mutual commitment for integration and harmonization of the respective options;</li> <li>- sector plans must develop and materialize, in their area of intervention guidelines defined in the national policy planning;</li> <li>- regional land-use plans must incorporate the rules defined in the national policy plan and the existing sector plans;</li> <li>- the preparation of sector plans must articulate with the land-use regional plans. (art. 10)</li> </ul>	<ul style="list-style-type: none"> <li>- the drafting of the water management plans must guarantee the contribution of the various ministerial departments that oversee the activities involved in the use of water resources and the public bodies that affected the administration of the areas involved. (art. 26)</li> <li>- the drafting of the land-use and water resources plans must enure that the articulation and consultation schemes complies with the rules set out in the legislative acts governing land-use plans and the special rules provided under this law or others related to it. (art. 19)</li> </ul>
Information and participation	<ul style="list-style-type: none"> <li>- private citizens and organizations have the right to access information during the drafting and alteration of plans, as well as after their publication., and may consult the or obtain copies of files. (art. 20)</li> <li>- the plans are submitted to public discussion before approval;</li> <li>- the plans that are mandatory for privates are subject to stronger processes of public participation and confict minimization measures. (art. 21)</li> </ul>	<ul style="list-style-type: none"> <li>- the drafting of the land-use and water resources plans must guarantee the information and participation, according to with the rules set out in the legislative acts governing special land-use plans, the rules provided in this Act and the legislative acts that it refers to. (art. 19)</li> <li>- the drafting of water resources management plans must guarantee the participation of stakeholders through the process of public discussion and representation of water users advisory bodies;</li> <li>- it must also be ensured the publication of the plans in the electronic site of the national water authority, namely, the plan proposal and all the associated documents relevant for the discussion process. (art.26)</li> </ul>
Planning units	National territory, administrative regions, municipalities, cities, specific areas.	National territory, hydrographic regions (integrating one or more contiguos river basins), specific areas

The Water Law also provides that during the preparation, review and evaluation of planning instruments, it must be ensured the intervention of various ministerial departments that oversee the activities involved in the use of water resources. To do so, it explicitly states that the National Policy Planning (PNPOT) and the National Water Plan (PNA) should articulate with each other, ensuring a reciprocal commitment to integrate and harmonize the respective options, and that the resulting regional plans should be consistent with this aim. It also determines that the measures

advocated in territorial management tools, including special plans for land use planning and plans of municipal and regional planning, must be articulated and harmonized with the water planning instruments and measures for the protection of resources water, and that specific measures are consistent with the guidelines laid down in water resources plans.

The articulation between the land-use planning instruments and the water resources system is foreseen in the global terms of the spatial law, both vertically and horizontally, and has been object of further attention in the Land-Use Planning System' regulations. These, however, do not add relevant details regarding the articulation of the systems in practice. The analysis of the legal framework laws, briefly described in Table 3, weighed by its real implementation in the recent years, enables the identification of a set of weak points, namely:

- The objectives and principles are not fully articulated though showing complementarities;
- The responsibility for the drafting of the plans lays within the same ministry but on distinct organisms and located at different government levels, the spatial plans at the regional level whereas the river basin plans at the central level, hindering closer communication during the planning process;
- The territorial boundaries are different, the spatial planning uses administrative boundaries and the water resources planning uses the river basin natural boundaries;
- It is envisaged the need for vertical and horizontal articulation including those of territorial levels and sectors, but no procedures or methods are established;
- Both systems predict the existence of mechanisms for the dissemination and public participation but with different traditions, comprehensiveness and public.
- The planning cycles are not coordinated, as they depend on distinct programmatic mechanisms.

The challenge of articulating the two systems can be more easily understood after a closer look into an area where water values, resources and human and economic activities converge over a complex territorial and water body area such as estuary. The next section pursues with this aim.

#### 4. THE CASE OF RIA DE AVEIRO

Ria de Aveiro and the surrounding area is a challenging laboratory to evaluate, and deploy, the articulation between water resources and land-use planning. It consists of a complex estuarine and wetland area where water resources including coastal, transition and river waters inserted in the Vouga river basin (Figure 1).

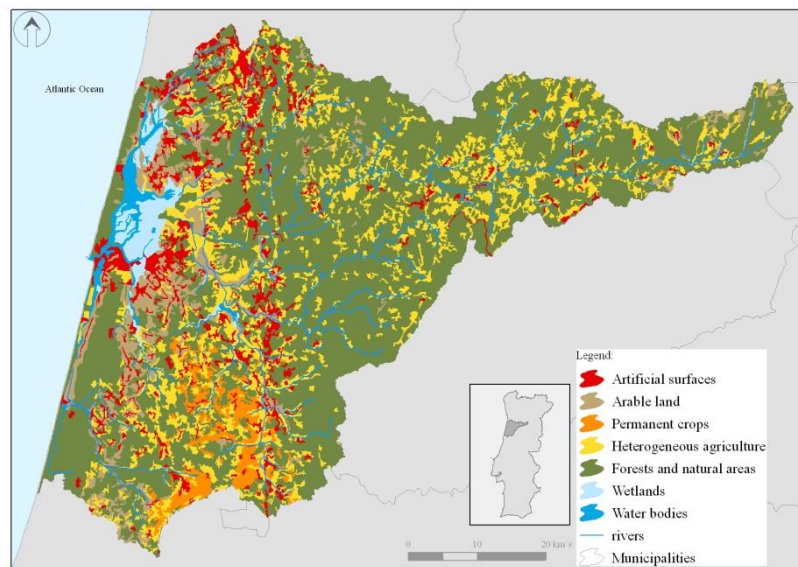


Figure 1. Ria de Aveiro and River Vouga Basin. Source Rocha J., Roebeling P.C., Nunes J.P (2011)

These include water bodies with excellent, good and insufficient quality. Pollution problems are mainly associated to eutrophication and some points of nitrates from agricultural activities (Roebeling et al, 2012) and tetrachlorethylene and nonylphenol from industrial activities (ARHC, 2012). It also includes various ecosystem values and environmental protection statutes including nature reserve, national ecological reserve and Natura 2000 network. It is involved by a myriad of human and land-use activities often conflicting, activities ranging from urban, industrial, fisheries, aquaculture, agriculture, tourism, navigation and harbour activities, among others. These have associated various social and economic dimensions, some with cultural and historical roots. Ria de Aveiro is covered by a complex framework of public agencies with different types and levels of responsibilities for its management. As result of European and national legal frameworks, it is also covered by a set of policies, plans and programs aimed to establish objectives and protection measures, from various government sectors. The fragile (un)balance between environmental and water resources' values, the pressures resulting from the economic activities and associated land-use patterns and the complex structure of stakeholder and institutional framework, makes the management of Ria de Aveiro a complex knot to unravel and a challenge for planning. The need for clear objectives and measures to ensure the protection of water resources is essential for the protection of Ria de Aveiro. Likewise, the land-use planning objectives and rules must ensure the accommodation of new development within the natural limits. Among the various existing plans, two emerge due to their strong expected influence on land-use and water resources, aims and rules. They are the Regional Spatial Development Plan of the Centre (PROT) under approval process and the River Vouga Basin Management Plan (PGBH). Both aim to establish priorities, rules and measures for the protection and promotion of regional assets as well as to inform the preparation of Local Master Plans (PDM), which are mandatory for public and private agents.

In PROT Centro, the document that establishes the plan proposal presents a strategic regional vision and its specificities, as well as the main planning objectives, organized in a territorial model including the called biophysical and demographic textures and the structuring systems (urban, economic, tourism and cultural heritage, energy, transports, environmental protection and risks). The valorisation of water resources are considered under the environmental protection system. Water resources are mentioned in the strategic objectives as the need to improve and recover their quality, including the conclusion of integrated depollution projects. The document also presents a set of guiding rules dedicated to each territorial system and territorial unit. Ria de Aveiro, included in a sub-urban system of Aveiro/Baixo Vouga, is frequently mentioned although it is not object of a dedicated set of objectives, measures and guiding rules to be easily identified and translated into PDM by municipalities whose spatial uses converge over Ria de Aveiro' water resources. The program of measures established by the PGBH closely follows the requirements the WFD as presented in Table 1. Their formulation responds to the current status and to the quality objectives for water resources and are structured into basic, complementary, supplementary or additional types of measures. Their organization is also associated to different means to pursue water resources protection, namely "Knowledge", "Organization", "Preparation", "Prevention", "Protection", "Rationalization", "Reduction", "Requalification", "Awareness". The formulation of the measures tends to range from very broad terms to very detailed and localized. Ria de Aveiro is mentioned in some of the measures and many others have direct or indirect impact and relevance for Ria de Aveiro. They are spread in different categories and sections of program of measures. No special method is adopted to easily identify water resources measures specific to Ria de Aveiro or, at least critical, for instance for estuaries, to facilitate the interpretation by relevant local municipalities, which should also consider their role for the implementation of the WFD.

The set of features related to the elaboration process of the PROT and the PGBH as described in Table 4 deserve a few critical comments. Their process of elaboration and approval is not connected nor do they follow a shared time schedule. In addition, although they are promoted under the same Ministry (Agriculture, Sea, Environment and Land-use) the responsibility for their preparation lies in different levels of administration, having in mind the fact that the Regional Hydrographic Administrations have been integrated in a single centralized. In addition, the technical teams



responsible for the plans' drafting are dominated by different scientific fields. The PROT is usually more dominated by the spatial and network urban contexts and the PGBH more framed by the hydraulics and water quality contexts, while the complementing fields are peripheral and with weaker relative power. Also, the spatial development strategy as formulated in the PROT still reveals the fragmented view of spatial planning (see Fidélis & Sumares, 2011) by creating separated systems without an exercise of synthesis to facilitate the articulation between spatial development proposals and environmental protection in real situations. This hinders the necessary integration of policy sectors and creation of synergies for the sake of water resources. In fact the approaches, in both plans tend to be either very self-centered like in the PGBH or very compartmentalized into different sectors, with the environment and water resources systems treated as single system and not as a part intrinsically affected and interrelated to the other systems.

*Table 4. Main Features of the Land-use and Water Resources plans at regional level*

	Land-use Regional Development Plan (PROT of Centro Region)	River Basin Management Plan (PGBH of Vouga River)
Main Authority	Regional Development Coordination Commission (CCDR) (regional Level)	Portuguese Environmental Agency (central level)
Spatial unit	Administrative boundaries (set of municipalities)	Hydrographic Region (Rivers Vouga, Mondego and Lis)
Institutional Consultation and articulation	<ul style="list-style-type: none"> <li>- the preparation of the plan is monitored by a committee which includes the public agencies with specific responsibilities and interest in the area, the associated municipalities and other public entities whose participation is advisable;</li> <li>- the final opinion of the committee refers the assessment of the proposed plan and to the environmental report.</li> </ul>	<ul style="list-style-type: none"> <li>- the preparation of the plan is monitored by the Regional Hydrographic Council which includes the public agencies with specific responsibilities and interest in the area, representatives of municipalities, representatives of large water users, water and environmental relevant associations, and other water interests;</li> <li>- the council has to approve the plan;</li> <li>- the final opinion of the council refers to the assessment of the proposed plan and to the environmental report.</li> </ul>
Relevant guiding rules and measures for Ria de Aveiro	<ul style="list-style-type: none"> <li>- ensuring that spatial management assumes the principle of improving the qualitative and quantitative status of surface and of groundwater;</li> <li>- setting conditions for the protection perimeters of surface and groundwater classified as very good and good quality and preventing its degradation;</li> <li>- promoting strategies and programs leading to sustainable water use based on long-term protection of available water resources;</li> <li>- promoting and implementing appropriate measures for effective control of pollution sources focusing special attention on areas classified as sensitive;</li> <li>- promoting the adoption of mitigation measures for diffuse pollution;</li> <li>- preparing spatial plans to promote the protection of the waters and estuaries, namely the estuary land-use and management plan;</li> <li>- planning Ria de Aveiro and controlling the urban sprawl around the wetland area, promoting traditional activities and eradicating exotic species;</li> <li>- promoting a consensus building platform among the various priorities and regulation strategies to ensure the valorization of the multi-uses in Ria de Aveiro having in mind the high environmental sensitivity to eutrophication, salt intrusion, urban pressures and landscape degradation.</li> </ul>	<ul style="list-style-type: none"> <li>- controlling invasive species in water bodies, assessing the occurrence of invasive species of vegetation water-hyacinth (<i>Eichhornia crassipes</i>) and controlling its dispersion;</li> <li>- controlling and monitoring of illegal fishing, directed to invertebrates and fish, oysters, clams and eels, among others;</li> <li>- evaluating and regulating of load rejection and respective impacts of aquaculture;</li> <li>- preventing the high organic loads and concentrations of nutrients and other compounds potentially toxic to the organisms, leading to a depletion of water quality and biological communities;</li> <li>- improving estuarine connectivity through the maintenance and replacement of the natural conditions of Ria de Aveiro to ensure the biophysics stability and minimize risk situations, through the implementation of local sediment siltation problems;</li> <li>- assessing the impact of diffuse pollution on the quality of water bodies with less than good status and where pressures due to diffuse pollution are significant;</li> <li>- elaborating the Estuary Land-use and Management Plan of River Vouga (Ria de Aveiro).</li> </ul>

Finally, the planning methodologies and the terminology used by the two systems varies significantly, see for instance the objectives, the measures, the guideline rules, which formulation, is often far from being clearly distinctive, and able, therefore, to have a strong role for lower levels of planning. Fifthly, it is clear that the use of the river basin concept and the requirements for its full understanding, as Molle (2009) refers, still needs to be fully understood and assimilated by both planning systems, including the water resources system.

## 5. CONCLUSIONS

In recent years, Portugal witnessed a profound reform of the legislative framework for water management and spatial planning systems, as a result of the publication of important pieces of legislation that have brought new challenges to the legal, institutional and regulatory framework. From the analysis of the main laws of land-use and water resources planning, it is clear that it has been recognized the need for articulation between the two systems. In practice, and in spite of the significant work undertaken, further efforts may be deployed in order to better explore the benefits and gains offered by a stronger articulation between land-use and water resources planning system. The two regional plans analysed, do reveal consensual and complementary objectives regarding water resources. This, however, does not ensure i) that effective options regarding the land-use pattern and associated guidelines and the water resources measures are consistent with the local problems and ii) that the plans offer the necessary guidance to better water and land uses. Regional plans, are not meant to focus on local specificities. That is a task to be developed under plans at lower levels in the spatial scale. They should, however, develop a user friendly tool to easily identify the measures that are particularly relevant for particularly complex spatial units, such as the Ria de Aveiro. In addition, if land-use planning is to give stronger contributions for the implementation of the WFD at regional and local levels, then it should be further deployed how the integration of the different land-use systems (urban, agriculture, industrial, etc.) interfere with water resources and how their functioning (or development) must conform and integrate water resources requirements and challenges. Further discussion at the local levels, namely about their role in the implementation of WFD, may also challenge regional and local planning practices and call for new planning approaches and methodologies. The public and institutional participation associated to the Strategic Environmental Assessment processes, and, especially, the implementation process of the Floods Directive may also be further explored for this purpose.

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