



Policy narratives of circular economy in the EU – Assessing the embeddedness of water and land in national action plans



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ABSTRACT

Following the challenges of the European Union (EU), member states have adopted circular economy (CE) plans and strategies, with objectives and measures to foster circularity. Although the concept of CE refers to various natural resources such as water and land, little is known on how current CE policies are integrating these environmental resources. This article assesses how water and land concerns are embedded in the EU CE action plans issued in 2015 and 2020 and a set of nine member states' subsequent national plans. The assessment used a content analysis based on two variables, the frequency of water and land' related terms and the consistency of their inclusion within the plans. The findings reveal that neither water nor land emerge as major concerns in the CE plans, in comparison to materials or waste. Also, they are not consistently associated with the typical components of the plans namely problem-showcase, objectives, strategies and measures, stakeholders, and CE performance indicators. Nevertheless, the embeddedness of water is more evident in the plans of southern countries, whereas land concerns are much more erratic. If water and land concerns, are to be at the forefront of the transition to circularity, as the literature recommends, and if these plans are expected to offer an integrated approach of the CE concept, further efforts should be made to ensure their embeddedness.

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1. Introduction

The concept of circular economy (CE), although not new (Ghisellini et al., 2016), has been boosted during the last decade and became prominent at the level of European policy making (Geissdoerfer et al., 2017; Kovacic et al., 2020; Martinho and Mourão, 2020; Mcdowall et al., 2017; Sileryte et al., 2018). While having a variety of definitions the concept can appear with unique features in different places (Murray et al., 2015; Kirchherr et al., 2017). Circular systems bring environmental and economic sustainable value by minimising resources consumption through closed loops of material flows and economic activities (EMF, 2015a; van Buren et al., 2016). By covering different types of environmental resources, such as energy, materials, water, land and air (EEA, 2016),

CE can be considered from various perspectives and areas of development, and contribute to the global sustainable development agenda through the delivery of various opportunities and environmental benefits (Schroeder et al., 2019; Essex et al., 2020).

Growing pressures on water, a limited and increasingly scarce natural resource, are challenging world-wide decision-making processes. These concerns converge with the circular economy (CE) concept and call for the integration of water in circular economy policies. The inclusion of water in the CE can contribute to technological innovation, improve water quantity and quality by fostering its reuse and also optimize the amount of energy, minerals, and chemicals used in the operation of water systems (EMF, 2018). As it often requires a fit-for-purpose approach, the transition to water CE requires adequate policy making as it is likely to generate the establishment of new water loops with different types or qualities of water, new actors, new responsibilities and, new environmental and health risks (Frijns et al., 2016; IWA, 2016; Goodwin et al., 2019).

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Moreover, the transition to water CE can be influenced by land and land-use planning concerns. Water resources are spread across the territory, namely through the river basin hydrographic networks and ecosystems, including rivers, lakes, water reservoirs, and aquifers. Water ecosystem services associated with the hydrological cycle, and affected by the climate, land cover and management (UNECFE, 2007; Grizzetti et al., 2016; Pham et al., 2019) should be considered as an integral part of the CE concept with an integrated view across the entire water cycle (Ashley et al., 2020). Water resources are also interlinked with the spatial distribution of economic activities, and influenced by land-use planning policy, regulations, and decision-making processes. Consequently, new water loops, created by the circularity of water, are likely to be influenced by land-use planning concerns (Williams, 2019). By integrating land-based resources and models, accessibility, knowledge and governance domains, land-use planning can play an important role to reduce the barriers and unblocking the CE' opportunities (EMF, 2019; ESPON, 2019). Furthermore, land is also increasingly considered as a limited natural resource and related circularity principles are emerging with the 'no net land take' goal (Science for Environment Policy, 2016).

Water circularity, through water reuse, has been a concern of the EU water policy, included in the Urban Wastewater Treatment Directive (91/271/EEC16) and later in the Water Directive Framework (WFD) (2000/60/EC). This directive considered the River Basin Management Plans (RBMP), with their programmes of measures, as a tool for the implementation of water reuse. Moreover, the WFD established a new phase of European water legislation based on the concept of integrated water resources management that stresses the link between water resources planning and land-use planning (Kaika, 2003). In practice, however, the flexibility allowed for the implementation of WFD did not fully secure the expected nexus approach to water and land (Lieberink et al., 2011; EEA, 2012; Fidélis and Roebeling, 2014).

In 2011 the European Commission (EC) introduced the "Roadmap to a Resource Efficient Europe" (EC, 2011) and in 2015 adopted the first EU action plan for CE ("Closing the Loop") (EC, 2015). The 2015 EU action plan aimed at a transition towards the CE and a systematic change to create the enabling conditions for the implementation and flourishing of CE. It focused on the consumption and production patterns, and on the shift from waste to resources, especially, in terms of secondary raw materials and waste reuse (EC, 2015). More recently, a new version of the EU CE action plan ("For a cleaner and more competitive Europe") (EC, 2020) has been adopted. This new plan aims to provide a future-oriented agenda for achieving a cleaner and more competitive Europe in co-creation with economic actors, consumers, citizens, and civil society organisations and is associated with the recent European Green Deal (EC, 2019). After the challenges brought by the EC, 2015 action plan, several member states have adopted national action plans for CE, proposing different objectives and measures to influence citizens and different economic sectors.

The transition to CE requires robust policy approaches capable of ensuring a high level of protection of the environment and human health (EEA, 2016; Guerra-Rodríguez et al., 2020) and, also, a robust communication of the various dimensions, consequent proposals, priorities and actions (Miedziński, 2018). Although the concept of CE refers to various natural resources such as water and land, little is known on how current CE policies are integrating these environmental resources. The narrative of policy documents is likely to shed light on how current approaches to CE are integrating water and land concerns (Lenschow and Sprungk, 2010). Furthermore, if explored in the EU and in member states, may help to anticipate different paths regarding the understanding, and dissemination, of the concept in real national contexts.

This article studies the policy narrative of the CE action plans by analysing the embeddedness of water and land concerns. The research question that guided this study is whether the CE action plans of member states have developed similar narratives to those of the EU or if they have further developed the embeddedness of water and land concerns. For the purpose of this study, narrative is understood as the way the overall text of the action plans address a particular message (Miedziński, 2018) and embeddedness is considered as the inclusion of particular concerns in the text of policy documents, i.e., action plans (Polido et al., 2019). It is analysed through the combination of two dimensions, namely, the overall frequency of particular water and land related terms mentioned and, consistency, understood as the way they are inserted in the narrative of the action plans, i.e., how are they associated with the problem showcase of CE, objectives, measures, stakeholders to engage and, to indicators to assess the implementation of the plans. The study uses a content analysis, first to the 2015 and the 2020 EU CE action plans and, second, to the national actions plans of a set of nine member states.

The paper is structured into five sections. Section 2 presents a brief literature review, exploring how water and spatial concerns are relevant to foster CE approaches. Section 3 explains the methodological approach and the type of information used in the analysis. Section 4 presents the findings of how water and land' related concerns are considered in the contents of the CE action plans. Section 5, assesses and discusses the findings in the light of the objectives and the method used. Finally, Section 6 concludes, suggests a set of recommendations for policy design of CE plans, as well as future research paths.

2. Water and land concerns in the circular economy

The concept of CE can be traced back to the work of environmental economists David W. Pearce and R. Kerry Turner (in 1989), who primarily introduced it based on previous studies by economists Kenneth E. Boulding (in 1966) and Nicholas Georgescu-Roegen (in 1971) (Ghisellini et al., 2016). There are many definitions of CE in the literature (Geisendorf and Pietrulla, 2018; Lahti et al., 2018; Lewandowski, 2016), and they are often context dependent (Ghisellini et al., 2016; Kirchherr et al., 2017). Among the different definitions, and considering the purpose of this study, it is worth highlighting the definition of Sileryte et al. (2018, p. 190): "circular economy is as an economic model based on the renewability of all resources such as energy, materials, water, soil, land, and air while retaining or creating value, promoting positive systematic impacts on ecology, economy, and society, and preventing negative impacts". This includes water and land among the usually referred domains embodied in the concept. The number of scientific papers published in the Scopus database that cross CE and water, represented in Fig. 1, increased since 2015, following closely the evolution of papers on CE. Still, according to Abu-Ghunmi et al. (2016), the number is hardly comparable with the one crossing CE and materials. CE literature is said to be dominated by materials and waste management probably due to a narrow conceptualisation of CE 3Rs (Geisendorf and Pietrulla, 2018). In comparison, the number of papers linking CE with land, territory, or spatial planning concerns is very limited.

Out of the most cited papers crossing CE and water, four major topics emerge. The first deals with water as a key resource for production across supply chains and a pillar of the CE concept (Bianco, 2018), strongly linked to environmental, economic, social, and political drivers (Eneng et al., 2018). It stresses the need to raise the awareness for CE to counter the deficiencies of past water resources management, the pressures on water resources and local scarcity, and the achievement of sustainable goals (Bianco, 2018;

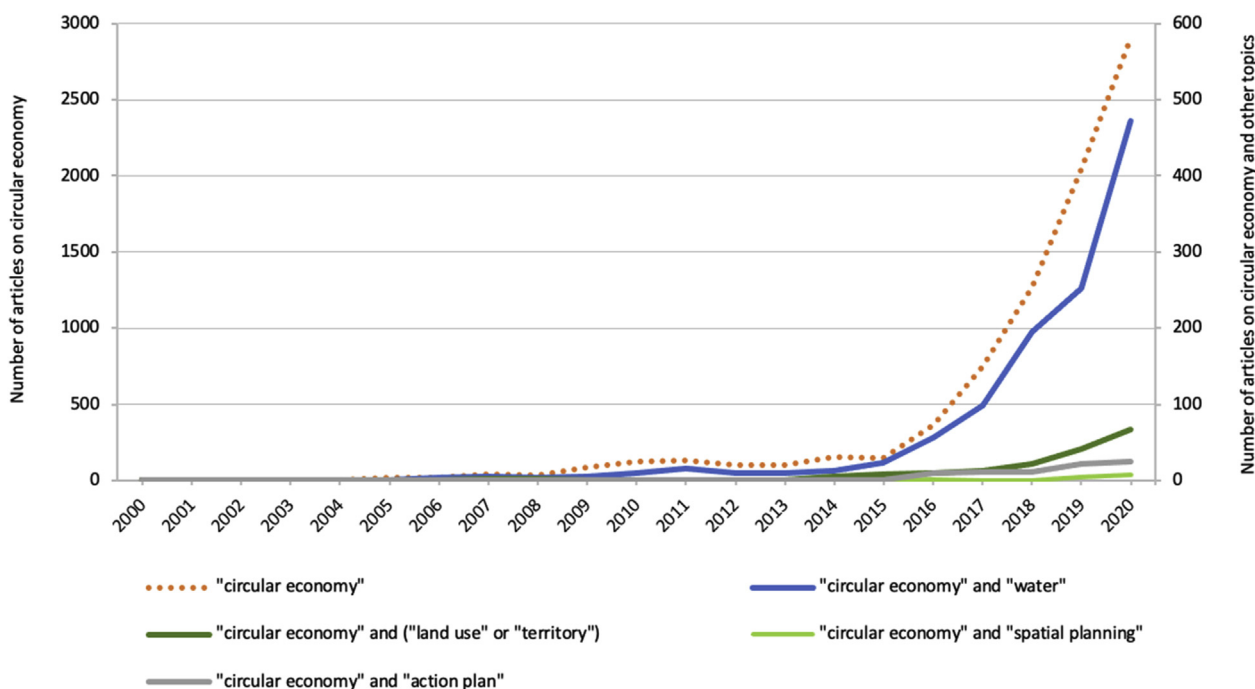


Fig. 1. Number of articles in scientific journals.

Dominguez et al., 2018; Smol et al., 2020). This is attained by transforming the current linear model of water use, from extraction to the use and discard of wastewater while obtaining gains by nutrient recycling and water reuse (Bianco, 2018; Puyol et al., 2016). The second topic deals with the role of CE as a tool or strategy to achieve the UN Sustainable Development Goals, considering all dimensions of sustainability (Fratini et al., 2019; Girard et al., 2019; Medeiros, 2020). Nevertheless, the alleged capability of CE policy and practices to support all the pillars of sustainable development is questioned due to conceptual inconsistencies, compatibility with improved social equity, economic growth, and difficulties in implementation (Millar et al., 2019). The third topic deals with methods to improve economic and environmental decision-making regarding CE. Among these is the estimation of the market value of water to push the water economy towards a more circular paradigm (Abu-Ghunmi et al., 2016). These authors advocate the benefits of moving towards closed loops in the water industry outweigh the costs, usually known as a barrier to choose between recycled and conventional water (Grant et al., 2012). Other methods, based on environmental criteria, as proposed by Dominguez et al. (2018) evaluate alternative treatments, aiming to inform decision-makers on the most environmental-friendly scenarios. The fourth topic deals with governance and institutional issues. After criticising the lack of coherence in water policies, Eneng et al. (2018) argue that CE depends on the water governance system to change water management and reduce social conflicts, using regulations, sanctions for the overuse or misuse of water resources. Casiano Flores et al. (2018) discuss the importance of wastewater policies in the context of CE and list a set of barriers to the transition towards CE, namely top-down models of governance and the lack of participation of all actors in the policy design.

As for the papers crossing CE and spatial concerns, two major topics are worthy of mention. One topic, more of a conceptual nature, stresses the importance of soil, land, and spatial planning in the transition towards CE (Amenta and van Timmeren, 2018; Breure et al., 2018; Mattila, 2016; Mcdowall et al., 2017). Breure et al. (2018) and Mattila (2016) state that spatial planning plays an

important role as an enabler and promoter of CE, in the sense that it can facilitate the actions of all stakeholders by providing the necessary conditions for a successful flow exchange and industrial symbiosis. The land is known as a platform for human activities, where social, economic and cultural activities take place but also a vital non-renewable natural resource, essential to biodiversity conservation, as it supports terrestrial natural capital, provides raw materials, food and biomass, and is fundamental for the closing of natural cycles of water and nutrients (Breure et al., 2018). Another topic is related to the governance process. Under this topic, Mattila (2016) defends that spatial planning may contribute to foster CE by paving the way for both citizens, industries, and government agencies to collaborate in symbiotic approaches. These approaches consider the territorial distribution of water availability and quality and the interdependencies between the actors in the new water supply chains. While Amenta and van Timmeren (2018) refer the spatial fragmentation as a barrier towards CE, Mcdowall et al. (2017) and Cavaleiro de Ferreira and Fuso-Nerini (2019) defend that CE policy can pay attention to scale and place through the integration of CE objectives into land-use planning. Its potential to deal with city problems, such as scarcity of resources, environmental pollution, economic crisis, and lack of social identity, among others is highlighted by Boeri et al. (2018), Bolger and Doyon (2019) and Williams (2019).

Although the integration between land use and water resources is well-discussed in the literature of spatial planning and water management (Biswas, 2008; Brack et al., 2015; Fidélis and Roebeling, 2014), so far, this issue has not been explored in the context of the literature of CE. Land-use planning is one of the main drivers of water use (EEA, 2012). Spatial planning development strategies can influence water demand and pollution, and also the vulnerability to floods and droughts (Fidélis and Rodrigues, 2019). Moreover, water use can be influenced by water property rights, which are closely linked to land property rights (Eneng et al., 2018). Therefore, water and land should be considered simultaneously and as an integral part of the CE equation. Finally, the literature review highlighted that the concept of ecosystem services,

frequently related to the management of water and land, and integrated in the CE principle of regeneration of natural capital in connection with water (EMF, 2018), has only occasionally surfaced in the CE literature (Masi et al., 2018; Kapsalis et al., 2019; Giampietro and Funtowicz, 2020).

Though there is a considerable number of articles crossing the keywords circular economy and action plans, and mentioning the EU CE action plan, or its transposition in the Member States none looks at its contents as a case study. Some papers focus on the assessment of CE practices (de Oliveira et al., 2020) and review of critical success factors for the transition to CE (Khan et al., 2020), with examples of monitoring frameworks (de Oliveira et al., 2020; Moraga et al., 2019), and evaluations of best-performing countries according to the CE and resource efficiency (Domenech and Bahn-Walkowiak, 2019; Garcia-Bernabeu et al., 2020; Škrinjarí, 2020). Others relate CE initiatives in the EU with the SDGs (Rodríguez-Anton et al., 2019). Finally, a few studies on particular member states concentrate on the prospects for particular countries to adopt CE broadly (Whicher et al., 2018), or focus in specific areas of action such as packaging (Gala et al., 2020), wastewater (Haddaway et al., 2019), and climate change mitigation (Gallego-Schmid et al., 2020), among others.

Assessments of policy instruments and of their potential to foster integrative perspectives have stressed the relevance of policy narratives for the development of better results during implementation (Rittberger and Richardson, 2003; Urwin and Jordan, 2008). In the European context the study of environmental policies has questioned the role of the EU as a diffusor of environmental policies (Lenschow and Sprungk, 2010; Diedrich et al., 2011; Arbolino et al., 2018) and the current role in fostering integrative policy approaches (Venghaus et al., 2019) both at sector and stakeholders levels, since many are dominated by particular concerns and groups of interest (Engstrom, 2008; Nilsson et al., 2012). Policy narratives have important dimensions of analysis, namely the problem description, the objectives, the identification of the main types of actors expected to be involved and associated responsibilities which deserve particular attention (Winkel et al., 2017). In the context of water, for instance, clear policy narratives, namely regarding objectives, actors and processes, are considered as key-factors for successful implementation (Waylen et al., 2019).

The study of narratives, through document content analysis, around the concept of CE has raised relevant concerns. One, is the need to further explore how CE policies are integrating the expected decoupling from environmental impacts such as land-use change, biodiversity loss, water pollution and depletion (Lazarevic and Valve, 2017) and avoiding an increasing marginalization of environmental matters (Welch et al., 2016). Another, is the need of fostering holistic approaches to CE (Hartley et al., 2020) assuring adequate indicator systems able to assess performance of CE policies (Grdic et al., 2020; Völker et al., 2020) and schemes to better define epistemic communities and related responsibilities (Martin, 2016; Blomsma and Brennan, G., 2017; Völker et al., 2020). CE is a concept in the locus of complex natural and non-natural systems interacting continuously and involving a great variety of stakeholders and sectors (Silleryte et al., 2018). The study of the embeddedness of different natural resources in CE policies discloses how integrative is the narrative of CE. Table 1 summarizes the conceptual basis of this study, namely the CE dimensions, ideal features of policy plans and the variables that support the study of CE action plans presented further ahead.

This study focuses its analysis in the importance of narratives of CE capable of integrating different natural resources, such as water and land concerns. Apart from the assessment undertaken by Colombo et al. (2019) about the Eco-Innovation and by the EEA (2020) about resource efficiency, CE, and materials, published

articles on the content analysis of policy documents in the interface between the EU and the national CE action plans are scarce. The study undertaken in this paper aims to fill that gap.

3. Assumptions, method, and data

Within the EU, action plans are usually made-up of concrete proposals for better policy, regulation, funding, and knowledge. Under the public policy context, an action plan is usually understood as a document stating a major public concern or challenge, outlining major priorities and objectives to be pursued, and defining a set of strategies and actions to be developed by particular groups of stakeholders within a community (Pal, 2013). These plans define intervention priorities, with economic, social, and spatial contours, and seek to engage both private investors and various public authorities (Knoepfel et al., 2007). Action plans play a communicative role and must craft an appealing policy message (Hossu et al., 2020) and the way they are designed and written is a relevant driver for success (Schneider and Sidney, 2009). Content features of policy documents have implications for their interpretation, implementation and influence in other policy fields. The way they are formulated influence their understanding by the communities and related stakeholders, and consequently their assimilation and implementation (Phillips et al., 2004). In particular, in the institutionalization of emergent concepts, such as CE, the stronger the inclusion of particular terms associated with certain concerns, the greater is the probability of their assimilation by relevant actors and of their incorporation in other sector policy documents (Phillips et al., 2004).

This article studies the integration of water and land concerns in the narrative of CE action plans using a content analysis. The design of the methodology adopted is supported on similar studies (e.g. Norton, 2008; Elo and Kyngäs, 2008; Silva Oliveira, 2015; Fu and Zhang, 2017; Graneheim and Lundman, 2004; Hsieh and Shannon, 2005), including some related to CE (Araujo Galvão et al., 2018; Homrich et al., 2018; Kirchherr et al., 2017). Content analysis and its potential to assess the narrative of policy documents, such as plans, has been widely mentioned in the literature (Miedziński, 2018). Content analysis studies independent realities, can be verified using quantitative and qualitative methods, and it enables comparison among documents, over places or time (Hardy et al., 2004). Methods of content analysis can be flexible and adapted to the aims of the studies (White and Marsh, 2006). In this study, the content analysis uses, firstly, the frequency of water and land related terms in a set of CE action plans and, secondly, their use in the main components of these plan, which we name as consistency. The combination of frequency and consistency is derived in a measure of embeddedness, which is understood as the way a particular concern is addressed in the plans (Miedziński, 2018; Polido et al., 2019). The use of embeddedness of particular policy features has been used in the field of environmental management to address how policy development can foster adequate implementation (Boons and Howard-Grenville, 2009). The analytical steps used to undertake the analysis of the plans are summarized in Fig. 2.

The analytical steps were applied as follows:

- i) Identification of the top ten words of the plan and, then, comparison with the frequency of the words 'water' and 'land'. This step started by the counting of the top ten most frequent words of each document and then by the counting of the 'water' and 'land' words. This counting was automatically made by Atlas.ti software, and completed with the manual removal of irrelevant words, such as pronouns, auxiliary verbs, prepositions, numbers, single letters, signs and symbols, conjunctions,

Table 1
Conceptual and theoretical variables to be considered on CE action plans.

Definition and principles of CE	Dimensions of CE	Features for policy plans of CE	Variables to assess the policy narrative of CE action plans
<p>“Circular economy is as an economic model based on the renewability of all resources such as energy, materials, water, soil, land, and air while retaining or creating value, promoting positive systematic impacts on ecology, economy, and society, and preventing negative impacts” Sileryte et al. (2018, 190);</p> <p>“The CE concept rests on three fundamental principles: 1. preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows; 2. optimize resource yields by circulating products, components, and materials at the highest utility and value at all times within technical and biological cycles; and 3. foster system effectiveness by revealing and designing out negative externalities” (EMF, 2015b; 25).</p>	<p>Reducing environmental impacts by reducing resources exploitation, consumption and increase reuse;</p> <p>Adopting innovative technologies;</p> <p>Engaging citizens, companies and public agencies;</p> <p>Adopting policy, planning and economic instruments capable of guiding and supporting different exploitative and transformative sectors, service providers and consumers.</p>	<p>The rationale for the concept of CE clearly integrates the various natural resources;</p> <p>Objectives and priorities of CE are integrative and cover different natural resources;</p> <p>There are actions and measures targeting the circularity of the different natural resources;</p> <p>Relevant stakeholders associated to different natural resources are duly engaged;</p> <p>A system of indicators able to measure the performance of the CE is developed to cover the different natural resources.</p>	<p>Frequency of the incorporation of water and land related words in the text of the CE plans;</p> <p>Consistency of the incorporation, i.e., if it is placed in the text in association with the major components of the action plans, namely, presentation of the problem show case of circular economy, formulation of objectives and measures, allocation of responsibilities to particular types of stakeholders to be engaged and definition of indicators to assess the performance of the plan;</p> <p>Embeddedness, the combination of frequency and consistency.</p>

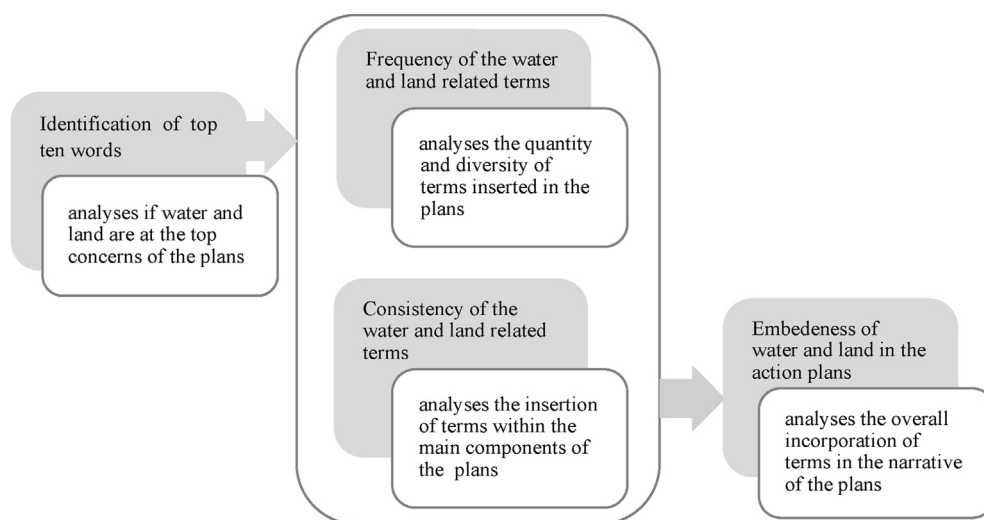


Fig. 2. Analytical steps used for the content analysis.

relative clauses, name of countries and terms related to them (e.g. Danish, Finland, Finish, German, Portugal, European, federal member, states, commission). Atlas.ti is a qualitative data analysis software, widely used in academic research, particularly in social sciences, which allows to manage encoding and access to texts combined with sophisticated searches (e.g. Hwang, 2007).

basin’, ‘waterway’, ‘landowner’, ‘land-use’, ‘landscape’, ‘territory’, ‘zone’, ‘zoning’, ‘town planning’, ‘land-use planning’, ‘urban planning’, ‘spatial planning’, ‘regional planning’ (White and Marsh, 2006). To allow the comparison of documents, the quantities were transformed into percentages using the following equation:

$$\text{Frequency of water or land related words in the CE action plan} = \frac{\text{number of water or land related words in the CE action plan}}{\text{total number of words in the CE action plan}} \times 100$$

ii) Calculation of the frequency of all words related to water and land concerns. This step was undertaken by counting all the terms found in the plans related to water and land, such, for example, ‘wastewater’, ‘groundwater’, ‘rainwater’, ‘hydro’, ‘river

This step was followed by the representation of the words found, on word clouds (using <https://www.wordclouds.com>) to observe their diversity. Word clouds are an information-

visualisation technique widely applied in qualitative data analysis to display and summarise the content of documents (Lohmann et al., 2015). Words are scaled by their size according to the proportion of their usage in the documents (Cidell, 2010; Viégas et al., 2009).

- iii) Estimation of the consistency of the integration of water and land in the action plans. This step was undertaken by analysing how the terms identified are associated with the major components of the plans, namely the problem-showcase, the objectives or aims, the strategies and measures, the stakeholders, and the performance indicators. Here the key-word-in-context was analysed by the considering the surrounding sentences around each water and land related word (Weber, 1990). Atlas.ti software was used as an auxiliary tool to identify and analyse potentially meaningful relationships between location of recurring words and the context. In this step, all the counting was also transformed into percentages using the following equation:

$$\text{Frequency of water or land related words in the CE action plan} = \frac{\text{number of water or land related words in the CE action plan}}{\text{total number of words in the CE action plan}} \times 100$$

- iv) Assessment of the embeddedness of water and land concerns. This was undertaken by a cross-analysis of the frequency of terms related with water and land concerns in each plan, with what we named as consistency, i.e., the frequency of the words while associated to the major components of the plans. For this purpose, the plans were classified into four categories according to the frequency of terms ((A > 0,20; B (0,16–0,2), C (0,10–0,15), D (0,06–0,10) and E (0–0,05)) and their allocation within the major components of the plans (A – associated to all components; B – associated to four components; C – associated to three components, D – associated to components one being strategies and measures; E – associated to two or fewer components other than strategies and measures).

The former steps were applied to analyse the following CE policy documents:

- i) The two versions of the EU CE action plan (EC, 2015; EC, 2020);
 ii) The action plans of nine member states namely, Denmark (Denmark National Action Plan, 2018), Finland (Finland National Action Plan, 2016), France (France National Action Plan, 2018), Germany (Germany National Action Plan, 2016), Greece (Greece National Action Plan, 2018), Italy (Italy National Action Plan, 2017), Netherlands (The Netherlands National Action Plan, 2016), Spain (Spain National Action Plan, 2018) and Portugal (Portugal National Action Plan, 2017).

The action plans were available in English at the EU platform related to CE (<http://circulareconomy.europa.eu/platform/en/strategies>). The version of the Spanish action plan, however, was not available in English. Considering the Spanish language skills of

the authors, language misinterpretations from the translation are negligible.

4. Findings

4.1. Water and land-related concerns in the EU circular economy action plans

When compared to waste, products, materials, and, to a lesser extent, food, water and land are far from being among the top ten words mentioned in the 2015 and 2020 EU CE action plans, as can be observed in Fig. 3. The types of words related to water and land integrated into the EU plans are shown in the word clouds of Fig. 4 for better visualisation of their diversity. The 2015 EU action plan introduces water in the scope of a resource-efficient economy, and it challenges member states to implement water reuse. It includes the objective of reducing water scarcity and adapting to climate change. It refers to water resources over-exploitation by considering the growing threats to its quality and quantity, either through water pollution or water over-abstraction (EC, 2015). Under this

concern, it mentions water scarcity as a driver to action and a requirement to reduce pressures on the water resources. The plan states that “in addition to water-efficiency measures, the reuse of treated wastewater in safe and cost-effective conditions is a valuable but under-used means of increasing water supply and alleviating pressure on over-exploited water resources in the EU” (EC, 2015, p. 12). It also states the need to promote water reuse with legislation setting minimum quality requirements, to support safe and cost-effective water reuse; to deliver guidance on the integration of water reuse in water planning and management; to disseminate best practices and finance innovation and investments (EC, 2015, Annex, p. 3). The 2020 version of the CE action plan (EC, 2020), refers to water and water reuse, mainly in the scope of product value chains namely, “food, water, and nutrients”, mentioning industrial processes as other potential loops of reclaimed water, alongside agricultural irrigation. It also mentions integrated nutrient recovery and management (EC, 2020). Half of the references to water are made in the scope of the implementation of the Drinking Water Directive (98/83/EC) for ensuring the availability of drinkable tap water in public spaces, preventing waste and pollution with microplastics from water packaging. The inclusion of water-related concerns shifted from a problem showcase perspective, in the first action plan, to a strategies and measures perspective, in the second.

In comparison to water, land concerns are even less frequent in the EU action plans. They are mainly referred to in the context of waste management, where legislative proposals include long-term targets to reduce landfilling (EC, 2015, p. 2). Other land-related references are made in the context of bioeconomy, and the pressures that the renewability, biodegradability or compostability of the bio-based materials (such as wood, crops or fibbers) may cause on land-use (EC, 2015, p. 17). This trend is maintained in the second action plan, where references to land are only associated with “landfill”. New relevant terms emerge like ‘soil sealing’ and the

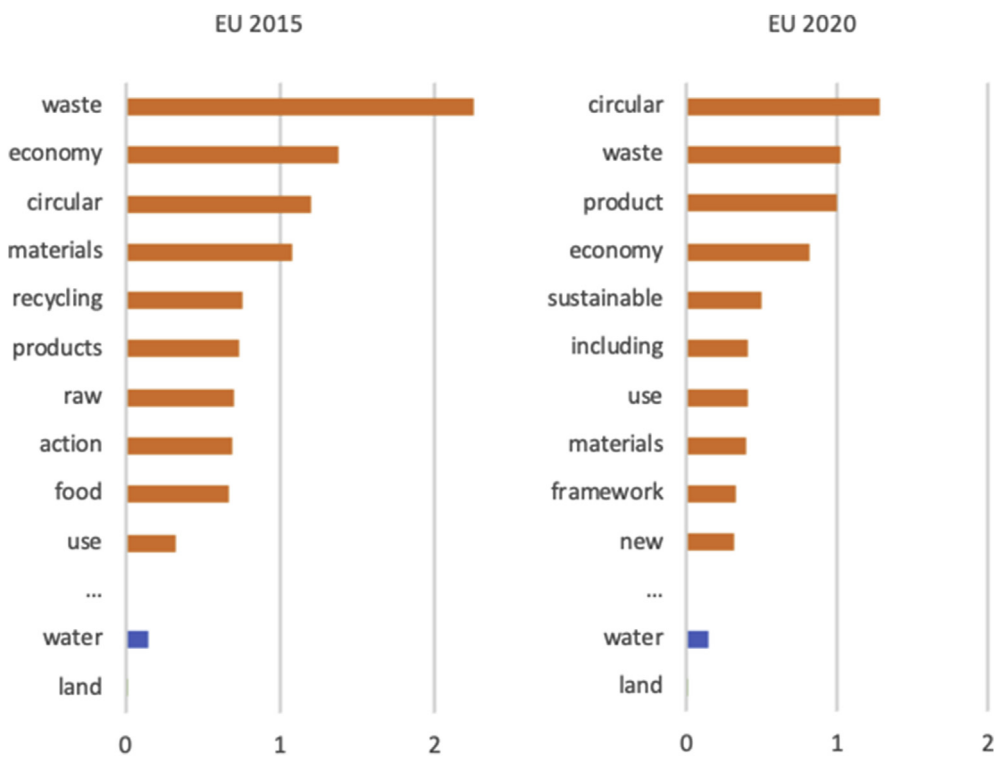


Fig. 3. Comparison between the percentage of the top ten words and the words water and land in the EU action plans for circular economy.



Fig. 4. Word clouds of the water and land related terms in the EU action plans for circular economy.

'rehabilitation of brownfields', though (EC, 2020). The land is poorly stressed as an influencing factor for the implementation of the CE in both versions. In the first action plan, it is mentioned under the

scope of problem-showcase and objectives and in the second action plan only under the scope of strategy and measures.

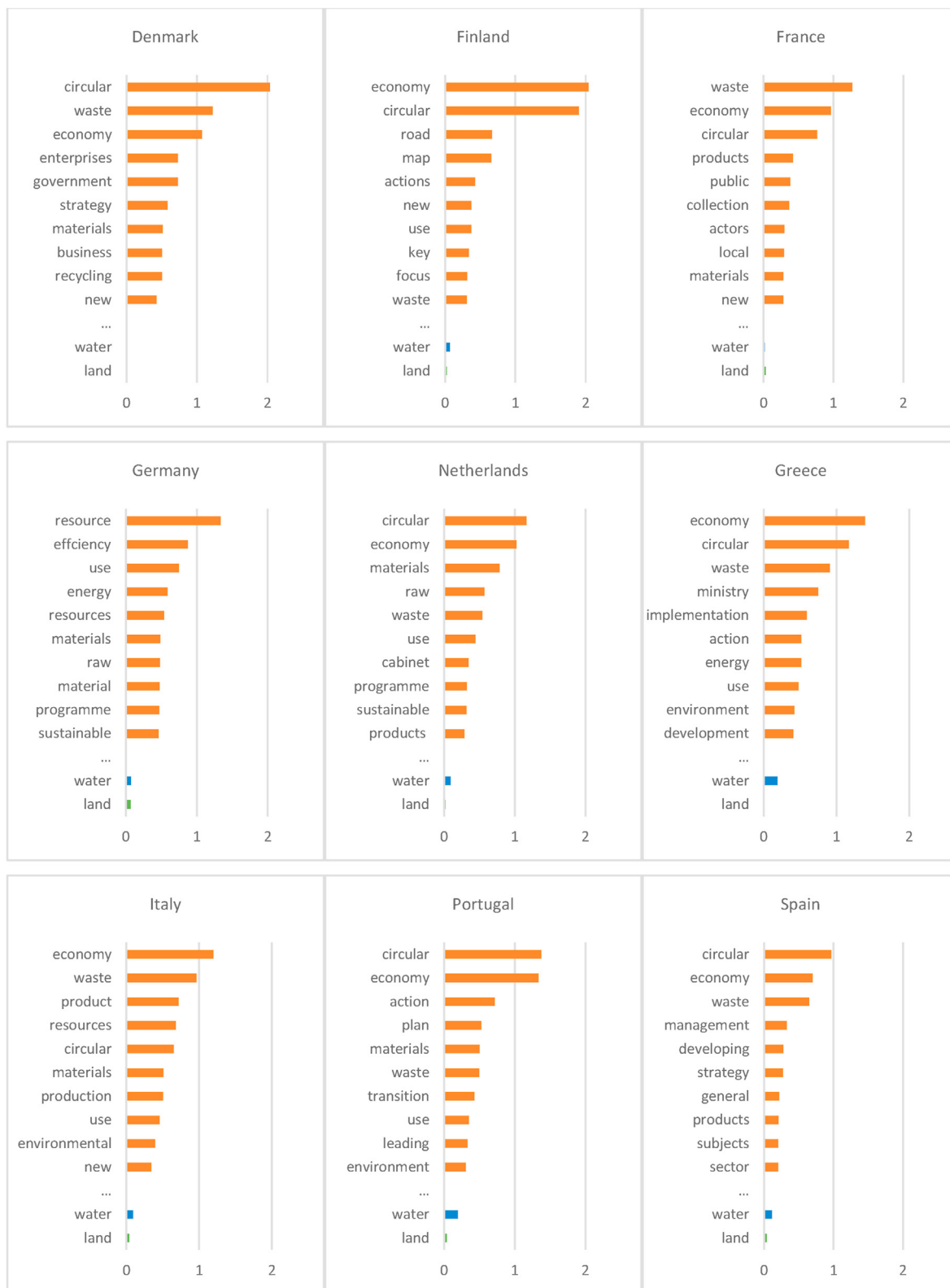


Fig. 5. Comparison between the percentage of the top ten words and the words water and land in the selected action plans for circular economy.

4.2. Water and land related terms in member states circular economy action plans

Similar to what happens in the EU action plans neither water

nor land are close to the top ten words in the set of CE national action plans that were analysed. This can be observed in Fig. 5. A deeper analysis of the plans, now covering all the words related to water and to land concerns included in the plans, represented in

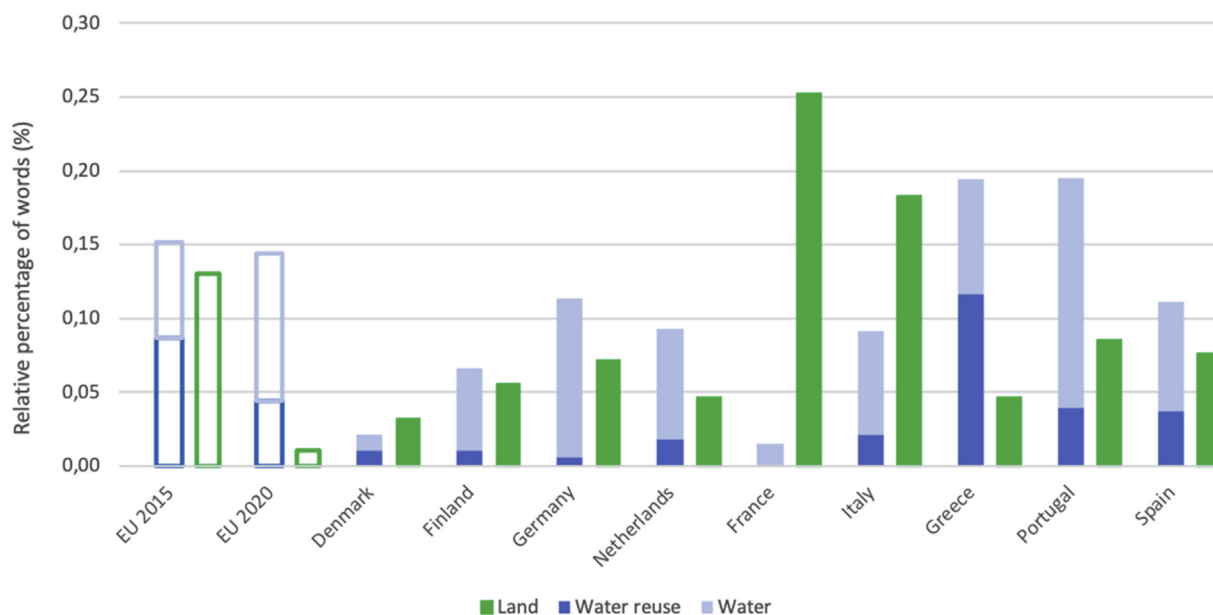


Fig. 6. Water and land related terms in action plans for circular economy.

Fig. 6, shows a higher frequency of water-related terms in the national action plans of southern countries including Portugal, Greece, and Spain, where the presence of the word water reuse is much more frequent. The frequency of terms related to land is much more irregular among countries, but France and Italy are clearly at the forefront.

The word clouds, represented in Fig. 7, help to visualise the types of water and land-related terms present in each plan. They uncover different approaches followed by the plans, which may be arranged in three groups. One group, that includes the plans of Greece, Portugal, and Spain, on which “water reuse” or “regenerated water” are more frequent. Another group including the plans of the Netherlands, and Italy that mainly use broad terms such as “water resources”, “water management” and “wastewater”. And, another group including the plans of Denmark, Finland, and France on which the references on the water are poorer. The Finnish plan mainly mentions water in contexts associated with transportation. The content of the plans also shows that whilst growing scarcity of natural capital and raw materials is a common theme in CE, only Portugal, Spain, and the Netherlands refer to water scarcity. While for Portugal and Spain the concern with water scarcity is a national problem, for the Netherlands it is a question of interest for international cooperation and trade. The Dutch action plan mentions that value chains and waste flows are international and there are opportunities for “mutual gains approaches” (symbiosis), that can be considered at the international level, recovering nutrients and “reducing vulnerability to water scarcity in other countries” (Netherlands National Action Plan, 2016, p. 42). Wastewater treatment for water reuse is frequently mentioned in the southern national action plans (Spain, Portugal, Italy, and Greece), while wastewater processing mainly as a source of recycled nutrients occurs in the action plans of the northern countries, such as Netherlands and Finland. Among the southern countries, some go even further than the EU Action Plan (Portugal and Spain) by adding specific mentions to the integration of water reuse in the scope of water resources planning. In the Italian plan, water resources are stated as an important element of the CE (Italy National Action Plan, 2017, p. 50). The Spanish plan includes water reuse as one of its main action areas, on which policies and instruments are to be

focused, separated from raw materials (Spain National Action Plan, 2018). Water reuse is also mostly referred to in the Greek case. In the German plan, the importance of preserving this resource is strongly established as an objective of the action plan (Germany National Action Plan, 2016). The concept of virtual water trade is also referred to, highlighting the need to develop water footprint analysis, taking into consideration the water-related negative impacts in the exporting countries (Germany National Action Plan, 2016, p. 37).

The types of words related to land represented in the clouds of Fig. 7, also show different paths followed by the action plans. One group, including the plans of Germany, Netherlands, Finland, and Portugal, consider them more richly, using a set of different terms such as “territory”, “spatial, land use or regional planning” and “zones”, among others. In the remaining countries, the land is rarely mentioned, similarly to what was observed in the EU action plans. The analysis also shows that not all countries refer to the articulation between water and land concerns. Among the plans that do this are the ones from Germany, Finland, the Netherlands in northern Europe, and Italy, Portugal, and Spain in southern Europe. The connection between water and land concerns is mainly done in the sense of environmental media or factors of production. The German plan is where this relation is stronger, with a higher number of conjoint references to integrated approaches that consider regional resource cycles with sustainable water and land programmes (Germany National Action Plan, 2016, pp. 49 and 86). The German plan also mentions land use as a “cross-cutting category”, at the intersection between natural and socioeconomic resources (Germany National Action Plan, 2016, p. 76). Moreover, this plan emphasises not only the integration amid natural resources such as water and land but also the view that the transition into the CE depends on the synergies established between associated environmental policy areas.

A deeper insight into the plans, analysed the frequency of references to water and land associated with the typical components of action plans, namely problem showcase, objectives, strategies and measures, stakeholders to be involved, and performance indicators. Table 2 illustrates examples of sentences mentioning water and land concerns inside the plans. The results, represented

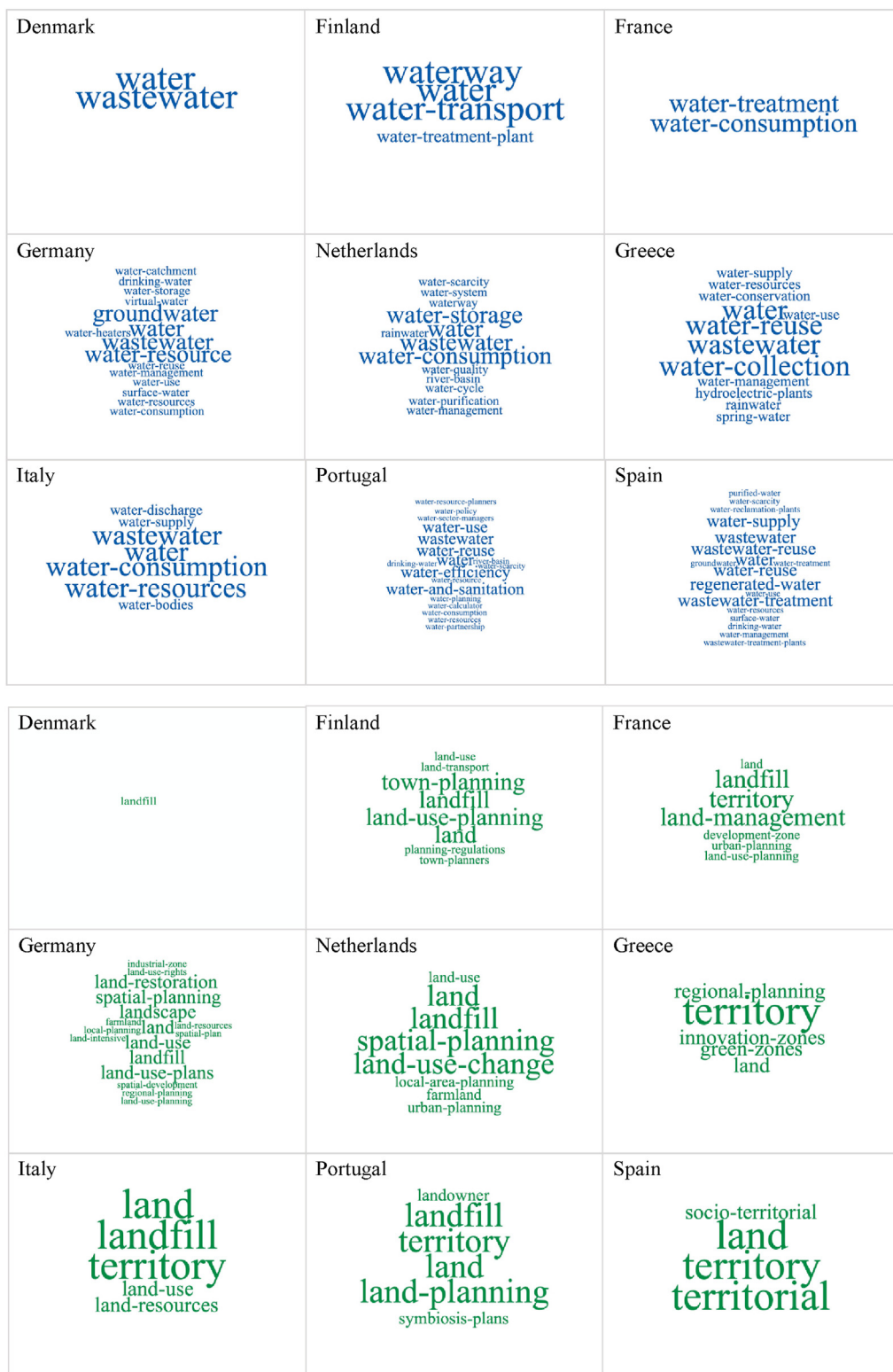


Fig. 7. Word clouds of the water and land related terms in the selected action plans for circular economy.

in Fig. 8, show that the allocation of water and land-related concerns inside the action plans is rather varied. For water, notwithstanding differences among the countries, more consistent approaches are observed. The majority of the action plans mention water under the problem-showcase and the strategies and

measures. Nearly half refers to water in the objectives of CE (Germany, Netherlands, Greece, and Portugal). The action plans of Germany, Portugal, and Spain relate water concerns with specific stakeholders such as state agencies, water managers, and planners. The action plans of Germany, Italy, and Spain are the only ones

Table 2
Selected content related to water and land in the national action plans.

	Water	Land
Problem-showcase	- "Even the efficient use of water resources is an element of significant importance in a circular economy context. It is necessary to pursue actions, especially in the context of production processes, aiming at optimising water consumption and reducing discharges in water bodies , in particular through the reuse of treated wastewater , in conditions that are safe and cost-effective." (Italy National Action Plan, 2017, p. 50).	- "In terms of the circular economy, town planning is the first decisive phase, because it can, for example, be used to steer construction efficiency and material choices" (Finland National Action Plan, 2016, p. 25); - "A notable problem is the rapid rate of land take for development and transportation. Approximately half of all land thus used is made impermeable" (Portugal National Action Plan, 2017, p. 38).
Objectives	- "To improve water efficiency ; To increase water reuse ;" (Portugal National Action Plan, 2017, p. 43).	- "To Protect life on land " (Portugal National Action Plan, 2017, p. 43).
Measures	- " Re-usage of water and use of the sludge from wastewater purifying plants" (Greece National Action Plan, 2018, p. 15).	- " spatial planning solutions can also contribute to the transition to a circular economy. (...)Regional spatial planning policy offers greater scope for supporting circular activities" (Netherlands National Action Plan, 2016, p. 18).
Stakeholders	- "State agencies for business, environment, water , agriculture, energy, innovation and health: develop and monitor activities, promote measures" (Portugal National Action Plan, 2017, p. 43).	- "Strengthen synergies between companies (Industrial and territorial ecology - Industrial symbiosis): Promote industrial and territorial ecology (industrial symbiosis) in regional schemes for regions that wish to participate" (France National Action Plan, 2018, p. 38).
Performance indicators	- "Recovery rate of phosphorus (for example in readily plant-available form) from wastewater/sewage sludge " (Germany National Action Plan, 2016, p. 42).	- "measure and separately present the use of soil, water, land , energy and raw materials associated with the production and transportation of imported goods together with the impacts on air quality, the climate and biodiversity" (Germany National Action Plan, 2016, p. 43).

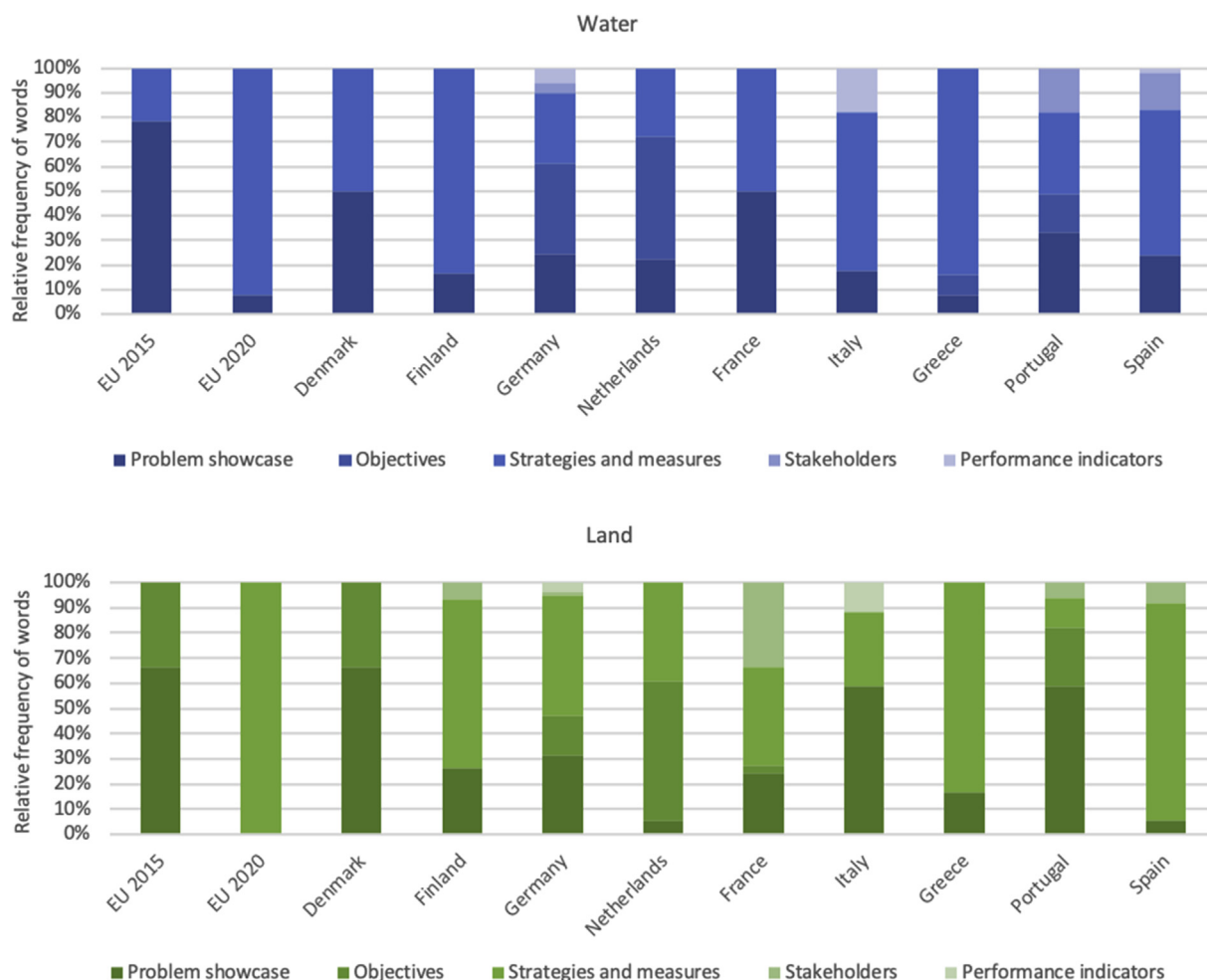


Fig. 8. Association of the water and land related terms to the main components of the action plans for circular economy.

mentioning water in the performance indicators. The plan of Germany, though, has water-related words associated with all the plan components. The inclusion of land concerns in the CE action plans is, broadly, much more irregular and poorer. The majority of the action plans refer to land concerns in the problem showcase and, in

the strategies, and measures. The plan of Netherlands considers land concerns in the objectives, with higher relevance, followed by Portugal, Germany and France. The association of land concerns with stakeholders was identified in the plans of France, with higher relevance, followed by Spain, Portugal, Finland, and Germany. The

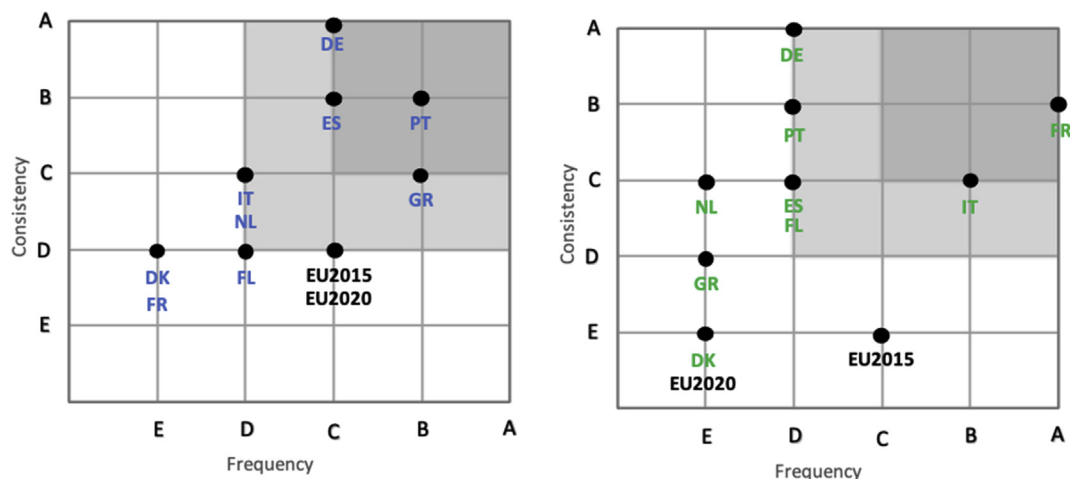


Fig. 9. Assessment of Circular Economy National Action Plans (legend: Water terms in blue color, Land terms in green color) Plans (EU-European Union; DK-Denmark; FL-Finland; DE-Germany; NL-Netherlands; FR-France; IT-Italy; GR-Greece; PT-Portugal; ES-Spain). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

plans of Germany and Italy are the only ones mentioning both water and land related terms under the performance indicators components.

The assessment of the embeddedness of water and land related concerns in the EU and national action plans is presented in Fig. 9. This assessment was undertaken by a cross-analysis of the frequency of terms related with water and land concerns in each plan, with what we named as consistency, i.e., the frequency of the words while associated to the major components of the plans. Three major features emerge: i) the embeddedness of water, and even more on land concerns in the EU action plans are rather low, especially in the most recent version regarding land; ii) the embeddedness of water is stronger in the action plans of most southern countries, and Germany; iii) the embeddedness of land and spatial concerns is poorer and more erratic, but France and Italy are at the forefront.

Water related concerns are more strongly embedded in the

national action plans of Portugal, Denmark, Spain and Greece, followed by Italy, Netherlands and Finland, and finally by Denmark and France. Land related concerns are more strongly embedded in the national action plans of France and Italy, followed by Denmark, Portugal, Spain and Finland, and finally by Netherlands, Greece and Denmark.

The higher embeddedness of water in the southern countries such as Portugal, Greece and Spain, is likely to be influenced by their relative location and confrontation with water scarcity and drought problems, as shown by the positive correlation between the relative frequency of the water related terms in the national action plans and water scarcity (expressed by the water exploitation index) in Fig. 10. In the case of land concerns, the negative correlation, suggests a weak association between spatial planning and water scarcity and drought problems.

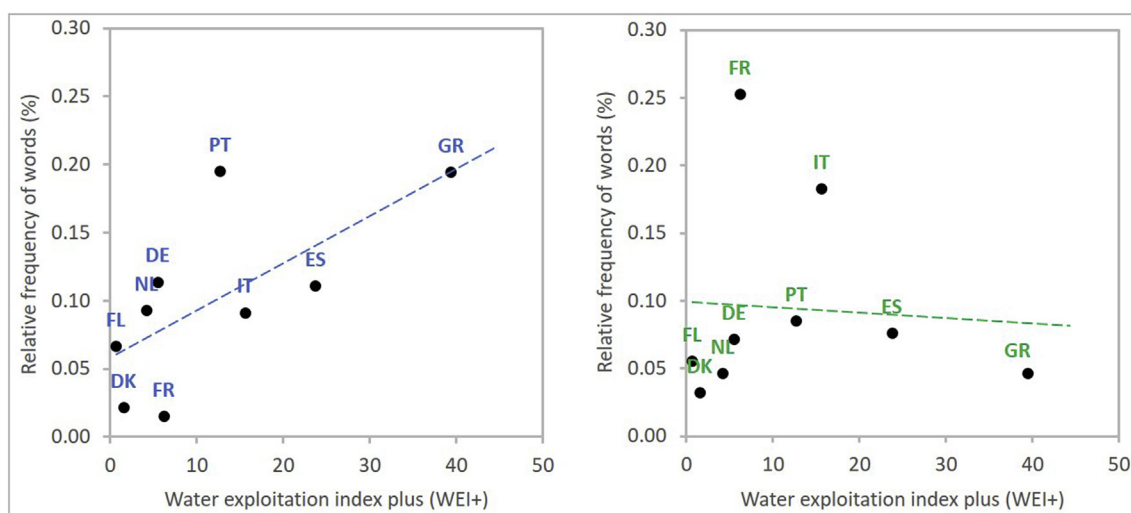


Fig. 10. Correlation between relative frequency of the water (blue colour) and land (green colour) related words in the national action plans and the water exploitation index plus (WEI+). Blue and green dashed lines are just representative of a trend. Legend: DK-Denmark; FL-Finland; DE-Germany; NL-Netherlands; FR-France; IT-Italy; GR-Greece; PT-Portugal; ES-Spain. WEI + data for 2017, from <https://www.eea.europa.eu/data-and-maps/indicators/use-of-freshwater-resources-3/assessment-4>. WEI + illustrates the percentage of water use against renewable freshwater resources in a given time and place. Values above 20% indicate water scarcity, and values above 40% indicate severe water scarcity. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

5. Discussion

5.1. The data, the method and the findings

Action plans establish the priorities for policy implementation in a situated geographic space and time and its formulation is carved by the institutional, administrative, and political traditions and the cultural context. The analysis of the water and land concerns in the CE EU and national action plans focused on the substantive terms systematically used by the action plans, through an assessment of the embeddedness of water and land contents in CE policy, leaving aside their institutional contexts (Knoepfel et al., 2007). This analysis was performed mainly based on counting the frequency of specific words or content to understand their contextual use (Phillips et al., 2004). The assessment of the consistency within each plan is complex and prone to error since the structure of the documents varies significantly, not always having a classical structure of clearly defined components of action plans. To avoid misinterpretation of the texts, the content analysis was supported by Atlas.ti software and further checked by the different authors who cross-read the documents. Also, the analysis was undertaken on plans translated to English, which facilitated the comparison yet missing the particularities of each mother language likely to be lost after the translations. The analysis covered only the plans of nine member states, still, they have shown to be diverse enough to avoid institutional or territorial biases, offering a good room for conclusions about different narratives followed by member states to adopt the EU CE action plan.

At first sight, the findings of the previous section put in evidence the peripheral relevance of water and land-related concerns in the EU and national action plans. A deeper look, however, reveals the different paths followed by member states. While the plans of some countries do stress these concerns in the design of CE policy, others misapprehended them. It should be noted that this analysis did not scrutinised aspects related to the actual implementation of the CE policy measures. Moreover, this study focused on action plans at the national level, and the importance of water and spatial circularity can also be inserted in different policy levels or other sectoral plans. Thereby, further research on similar plans for other administrative levels like regional or local could shed new light on the embeddedness of water and spatial concerns on the narrative of CE policy and implementation measures. Moreover, the extension of the study to other countries like eastern countries, for instance, could enrich the study.

5.2. The findings and the literature

Water is considered as key resource for production across supply chains is a current concern of the CE policy, particularly concerning environmental management and the pressures on water resources and local scarcity (Bianco, 2018; Dominguez et al., 2018; Engeng et al., 2018; Smol et al., 2020). With this in mind, the EU action plans follow the literature focusing in water reuse from the double perspective of optimising resource yields, through water reuse, and nutrients recovery within water systems (Bianco, 2018; Puyol et al., 2016; Smol et al., 2020). In the same manner, at the national level, two groups of countries develop each one of these perspectives, respectively, the southern countries, where drought and water scarcity are frequently a concern, and a few of non-southern countries. Still, action plans at European and national levels, reveal scant attention to the water governance concerns, considered crucial for the implementation of CE (Casiano Flores et al., 2018; Engeng et al., 2018). In this respect, few countries considered water in the stakeholders' component of their action plans.

According to the literature, spatial planning, and the inherent governance process, at regional and municipal levels, plays an important role as an enabler and promoter of CE and can create possibilities and support conditions for industrial symbiosis (Amenta and van Timmeren, 2018; Breure et al., 2018; Lu et al., 2016; Mattila, 2016; Mcdowall et al., 2017). However, land and spatial planning concerns are poorly considered in both EU action plans, that neglect the relevance of articulating coherently the CE policy and the spatial planning policy, even for industrial symbiosis. However, in the most recent EU action plan is already given attention to the city scale for the implementation of CE, clear with the adoption of circular cities and regions initiative. This follows the recent development of the literature that relates spatial concerns and CE, that deals with the adequate conceptualisation of the circular city approach and its implementation (Boeri et al., 2018; Bolger and Doyon, 2019; Cavaleiro de Ferreira and Fuso-Nerini, 2019; Williams, 2019). Spatial planning, especially at regional and local levels, performs cross-sectoral policy integration and implementation. As such, directives for the integration of CE objectives and measures in urban and spatial planning, referred to in the literature (Mcdowall et al., 2017), would be of foremost importance at the higher level of CE national policy. Only two national action plans mention the importance of implementing CE through spatial planning instruments and three other circular cities' programmes.

The protection of water and land as natural resources are interlinked with ecosystem services and requires the establishment of synergies between policy areas, including of CE, though this is rarely mentioned in the action plans. This is the case of the second EU action plan, which considered a CE as a means to restoring biodiversity and natural capital as well as some national plans but did not propose specific measures for its pursuance. Nevertheless, the regeneration of natural capital as a CE principle (EMF, 2018) is an underdeveloped domain of circularity in the EU and the analysed national action plans. This reflects a conceptual gap since, up to now, ecosystem services have rarely appeared in the CE literature (Giampietro and Funtowicz, 2020; Kapsalis et al., 2019; Masi et al., 2018).

Broadly, this study put in evidence the peripheral relevance of water and land-related concerns in the narrative of CE plans, emphasizing the claimed gaps of integrative approaches (Lenschow and Sprungk, 2010; Diedrich et al., 2011; Arbolino et al., 2018; Venghaus et al., 2019). The results of the analysis of water and land embeddedness, in the interface between the European and national CE policy, fill a literature gap since this type of empirical assessment is seldom made in the scope of the CE action plans (Škrinjarí, 2020). Overall, the narrow narrative of the CE found in the literature is followed by the formulation of CE policy documents, in particular at the European level. This is probably the case because the European policy context is complex, still lacks the necessary cross-sectoral nature and coherence and aims to maintain a high degree of flexibility to give room to member states to adopt policies to their political, administrative, and technical contexts. This is particularly the case with spatial planning, a domain where the EU lacks treaty-based competence (Atkinson and Zimmermann, 2018). Nonetheless, the analysis of the national CE policy reveals a richer picture even if improvement opportunities exist, as stressed in this study, in particular by more effective embeddedness of water and land concerns. The literature accentuates that at the macro-level of the territory the implementation of CE entails the consideration of the necessary co-evolution of technological, social, and institutional innovations to facilitate the transition to CE. Nevertheless, the results seem to corroborate the need, highlighted in the literature review (Geisendorf and Pietrulla, 2018), of a broader knowledge base as well as the effort to create CE transdisciplinary frameworks to be embedded in CE policy.

6. Conclusions

Circular economy approaches demand comprehensive policy frameworks crossing different resources and spatial contexts, among which figure water and land. This paper assessed how water and land concerns are embedded in the EU CE action plans issued in 2015 and 2020, and in a set of member states' national plans. The content analysis of the plans showed that neither water nor land emerged as significant concerns in CE plans compared to materials or waste. Also, they are not consistently associated with the typical components of the plans, namely problem-showcase, objectives, strategies and measures, stakeholders, and CE performance indicators. Nevertheless, the embeddedness of water is more evident in the plans of southern countries, while the concerns on land are much more erratic. These differences are likely to emerge from contextual issues related, either to the particular environmental features of each country, the environmental and spatial planning frameworks in place, and the influence of particular fields of knowledge while designing the action plans.

The transition to CE and the scaling-up of water circularity requires robust policy approaches capable of ensuring a high level of protection of the environment and human health and well-being. However, the capacity of CE policy and practices to support sustainable development is highly dependent on their conceptual consistency, and compatibility with improved social equity and economic growth. In addition, it requires a clear understanding of governance scales and multi-actors' engagement. The role of local and regional actors underlines the need to consider the appropriateness of CE policy models to the specificities of each decision-making, implementation and governance context.

The different pathways suggest that future revisions of the EU CE policy could benefit from national examples, as some have gone further regarding the embeddedness of water and land concerns. Furthermore, water resources are spread across the territory, interlinked with the spatial distribution of economic activities, and influenced by spatial planning policy, regulations, and decision-making processes. CE action plans should integrate these priorities in situated geographic spaces. The territorialization of CE policy needs to take into consideration the institutional, administrative, and political settings and the cultural context. The analysis presented in this article emphasised the link between CE, water resources planning and spatial planning, and identified several limitations in the expected conceptual coherence, articulation between CE plans and the concerns regarding water and land. If these action plans are to be at the forefront of the transition into water circularity, as the literature recommends, and if these plans are expected to offer, and integrated approach of the CE concept, further efforts should be made to ensure their embeddedness. The design of a new narrative on the CE, able to incorporate other resources like water, or land concerns, may contribute to overtake potential barriers for new water loops, provide opportunities to embrace more eco-centric and inclusive approaches to circularity, and strengthen the engagement of relevant stakeholders.

CRedit authorship contribution statement

Teresa Fidélis: Conceptualization, Supervision, Methodology, Writing - review & editing. **Andreia Saavedra Cardoso:** Writing - review & editing, Literature review, Data curation, Formal analysis, Data analysis, Writing - original draft, Draft-writing. **Fayaz Riazi:** Writing - review & editing, Literature review, Methodology, Data curation, Formal analysis, Data analysis. **Ana Catarina Miranda:** Writing - review & editing, Literature review, Data curation, Formal analysis, Data analysis, Reviewing. **João Abrantes:** Software, Data curation, Data, Validation, Writing - review & editing, Reviewing.

Filipe Teles: Writing - review & editing, Reviewing and Editing. **Peter C. Roebeling:** Writing - review & editing, Reviewing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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