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WATER GOVERNANCE AND MANAGEMENT CHALLENGES IN THE CONTINUUM FROM LAND TO THE COASTAL SEA – SPATIAL PLANNING AS A MANAGEMENT TOOL

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List of Abbreviations

CZM	Coastal Zone Management
CZMA	The US Coastal Zone Management Act of 1972
EU	European Union
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection
GWP	Global Water Partnership
IPCC	International Panel on Climate Change
ICM	Integrated Coastal Management
IWRM	Integrated Water Resources Management
MPA	Marine Protected Area
MSP	Marine Spatial Planning
NOAA	National Oceanic and Atmospheric Administration (US)
TVA	Tennessee Valley Authority
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNCLOS	United Nations Convention on the Law of the Sea
US	United States
WFD	Water Framework Directive (EU)

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1 Introduction

The world's water resources are subject to over-exploitation and degradation along a continuum from land to the coast with impacts also on the high seas. Freshwater is fundamental for economic growth and livelihoods and a key factor for most productive sectors (cf. Granit, 2012; UN Water 2009). The demand for freshwater resources is increasing rapidly due to socio-economic development, population growth and improved welfare. During the past 100 years the world's population has tripled while the use of freshwater has increased six fold (GWP, 2008).

The on-going degradation of freshwater resources due to human activities in river basins and along the coastal zones is having a direct impact on valuable ecosystems, economic assets and infrastructure with the greatest impact accumulated in the downstream coastal zone. Coastal zones are being squeezed from two sides. They face pressure from watersheds, especially in upstream areas where societies make more intensive use of freshwater and land resources, while also suffering the consequences of extensive economic activities in the maritime zone. From the other side, sea level rise, acidification, increasing water temperatures and frequency of extreme weather events due to climate change (cf. EC, 2008; STAP, 2011) are significant threats, which also emanate from human activities. These pressures are increasingly felt by the estimated 40-50 per cent of the world's population that lives within 100 km of the coast (Martinez *et al.*, 2007) on only 5 per cent of the habitable land (Millennium Ecosystem Assessment, 2005).

The two water systems (fresh and brackish/marine) are vital for human well-being and development. They are also inextricably linked through the hydrological cycle. A lack of coordinated governance and management of the freshwater flows in this continuum has however been observed (Cid, Lewsey & Jønch-Clausen, 2008). The impacts of this failure are clearly visible in the marine habitats around the world contaminated with man-made debris from land-based sources (STAP, 2011a) and suffering from excessive nutrients from land and airborne sources (Howarth, Sharpley & Walker, 2002).

Freshwater stocks and flows, and many coastal resources, are widely considered to be common-pool resources. Such resources are public assets that must be managed for the benefit of all. Common-pool resources generate public goods such as water supply, water regulation and storage for flood and drought control, as well as cultural and ecosystem services (Millennium Ecosystem Assessment, 2005). The same stakeholders that intend to enjoy the flow of goods and services from the common-pool resource must ensure that these resources are preserved (Ostrom, 2000). This "summation-problem" implies that the management of the common-pool resource is the sum of all the individual efforts (International Task Force on Global Public Goods, 2006), which in turn demand joint governance approaches. Management of common-pool resources must deal with the needs and claims, often competing and contradictory in character, from a variety of users and interests.

Our starting point in this paper is that the scientific knowledge on how ecosystems function, and the measures that can be applied, is to a large degree known but that the governance systems to address water resources degradation in the continuum have not produced clear and tangible management frameworks that are effective in overcoming conflicting or incompatible goals. Governance defines the principles, values, policies and laws that set the stage for different management approaches concerning how human and material resources can be harnessed to provide tangible benefits (Olsen, Page & Ochoa, 2009). We show how current management frameworks in the continuum are fragmented and disconnected in relation to the goals in society. Most, if not all, of the development objectives that are formulated by various departments or driven by economic interests, have a land and water use implication. Overlaps or inconsistencies in sectoral planning and management often make implementation and monitoring difficult at the local, national and transboundary levels.

Management of freshwater and associated terrestrial systems and the coastal zone are guided by different governance frameworks that in turn are related to legislative and planning frameworks for socio-economic progress. Development objectives tend to be related to specific social and economic criteria. A logical consequence is that governance frameworks for different sectors have been developed with no or little consideration to each other in spite of connections and interdependencies between both social and physical systems. On land, the Integrated Water Resources Management (IWRM) paradigm has emerged as the guiding governance and management framework over the past decades to integrate water management across sectors and to make the best use of scarce resources. Integrated Coastal Management (ICM) (or integrated coastal zone management) has similarly emerged in the coastal zone. Area-based management approaches like spatial planning take place in parallel, primarily at the national level at multiple scales, and are conducted in many different forms such as land-use, urban and regional planning.

Increased activity in the coastal zones and on the seas leads to competition between sectoral, social and environmental interests such as port development, tourism, offshore energy, fisheries, environmental protection and aesthetic values. This drives an emerging agenda of Marine Spatial Planning (MSP), or maritime spatial planning, as a tool for improved decision making at the national level with better coordination between states (cf. EC, 2008). MSP, in turn, builds on experiences from Marine Protected Areas (MPA) that are designed to reserve a clearly defined geographical space through legal or other effective means to provide long-term nature conservation with associated ecosystem services and cultural values (cf. IUCN, 2008). International law, as defined by the UN Convention on the Law of the Sea (UNCLOS, 1982), regulates transboundary issues affecting the Sea, such as pollution and shipping and also has a bearing on the coastal zone. UNCLOS distinguishes jurisdictional zones within maritime areas, each with attendant rights and responsibilities (Walline & Granit, 2011). Thus, different zones of the same waterbody on land and in the coastal zone can be subject to different rules, governing entities and enforcement authorities (figure 1).

In this paper an overview of the scale of deterioration of water resources in the continuum from land to the coastal zone and the near shore environment is documented. Prevailing governance and management frameworks with regard to freshwater, coastal zone management and spatial planning tools are analysed, looking specifically at examples of the European Union (EU) and the United States (US) that both have a long history of implementation, and their effectiveness is evaluated. Ways to improve governance of water resources in the continuum are discussed. Conclusions are then drawn on how spatial planning tools can be utilised within management frameworks in the continuum across different scales.

Figure 1

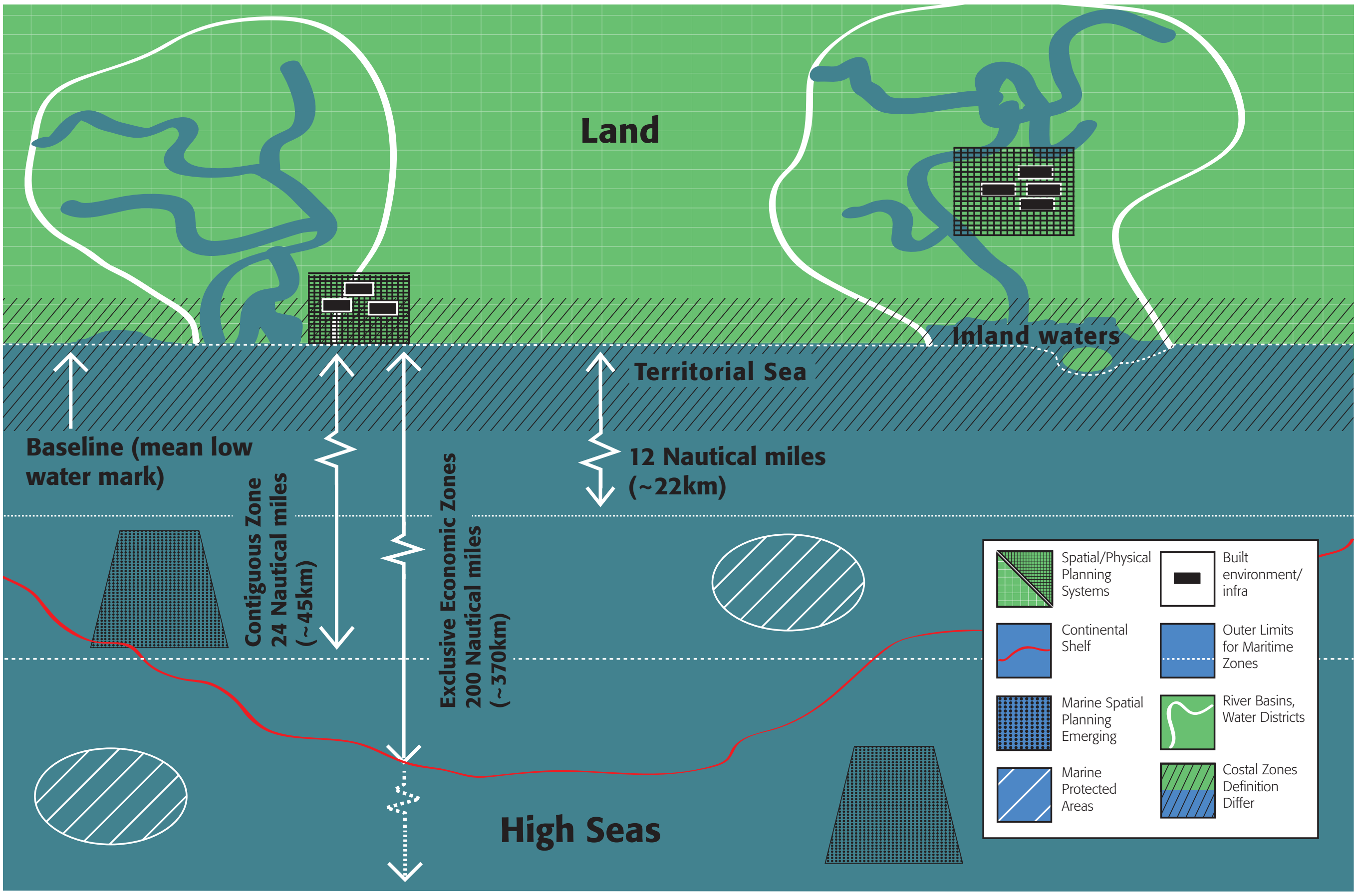


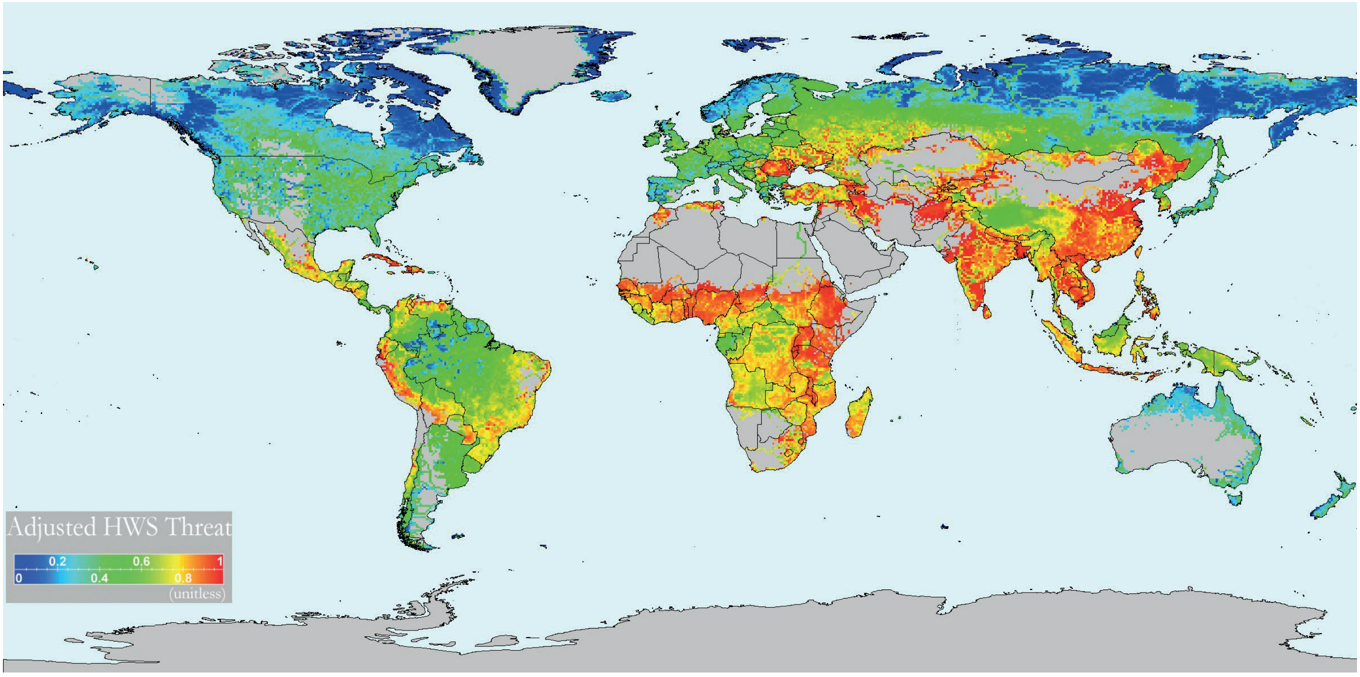
Figure 1. An illustration of overlapping management frameworks in the water resources continuum from land to coastal sea, including management concepts related to the open sea. IWRM in river basin planning areas, land based spatial planning frameworks, ICM in the coastal zone, MSP in the marine areas (an emerging planning framework), MPA to protect marine areas and UNCLOS determining areas of national jurisdiction and governing certain aspects of the high sea. The spatial boundaries between the different management frameworks are not clear and overlap in many areas.

2 Evidence of the Deterioration of Water Resources in the Continuum

In the literature, evidence points towards rapid degradation of fresh and coastal zone water systems. Related to freshwater systems, Vörösmarty *et al.*, (2010) conclude that 80 per cent of the world's population is exposed to high levels of threat to water security because of large scale transformation of water systems through land cover change, urbanisation, industrialisation and hydrologic infrastructure (figure 2). Naturally, these threats are generated by intensified human activities that are driven by ambitions to improve livelihoods and to meet human needs and wants. In rich societies remedial actions can be taken to reduce and to some extent to contain the externalities. The authors argue that the situation is masked by the fact that "Massive investment in water technology enables rich nations to offset high stressor levels without remedying the underlying causes, whereas less wealthy nations remain vulnerable" (Ibid, p. 155). UNEP (2012, p. 6) supports these conclusions in a global survey on the implementation of integrated water resources management and state that "Water-related risks and the competition for water resources are perceived by a majority of countries to have increased over the past 20 years." A major challenge is to co-plan for socioeconomic progress and environmental sustainability through scientifically based policies and management procedures.

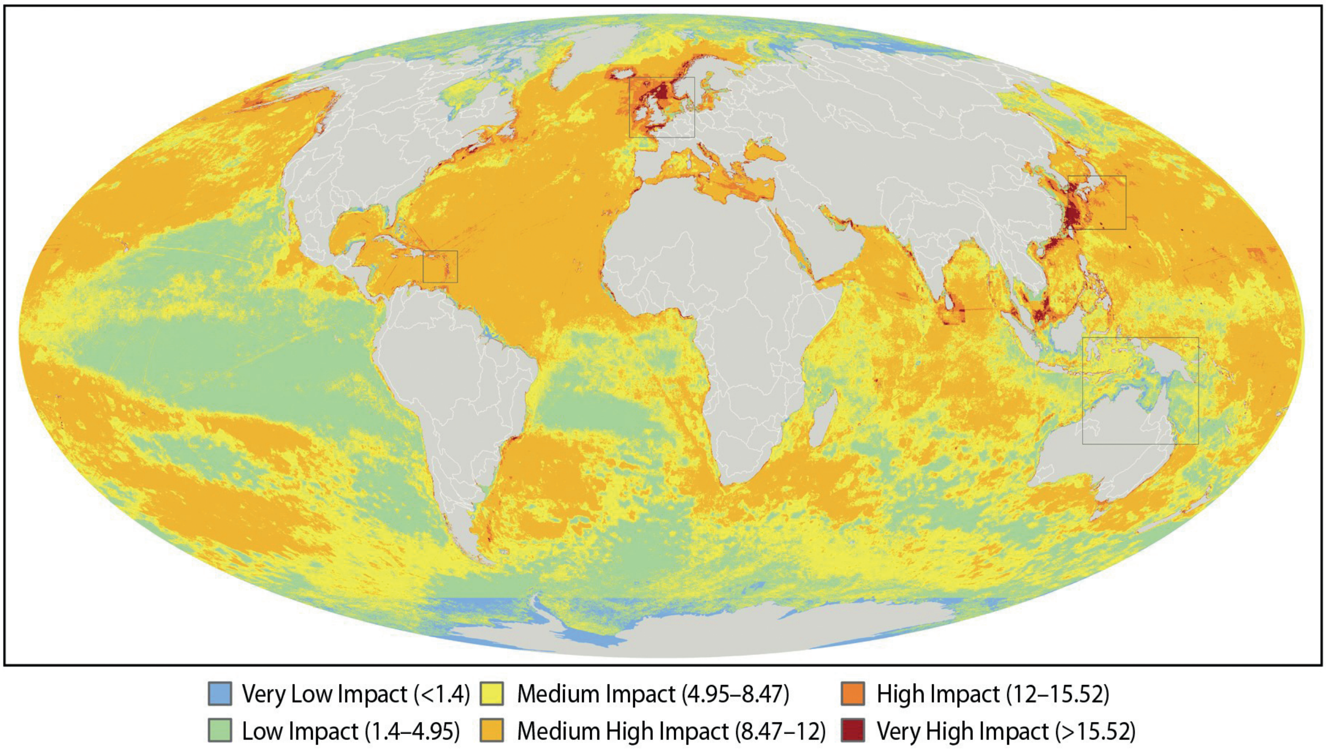
While point-source pollution from industry and urban areas has been largely addressed in developed regions, diffuse pollution from land-based anthropogenic activities, such as from agriculture production, road and air transport, and energy production, has not yet been effectively dealt with (cf. Howarth *et al.*, 2002; Granit, 2011; Lääne, Kraav & Titova, 2005). There has been a dramatic increase in global fertiliser use, which has risen by 700 per cent over the past 40 years (Matson, Parton, Powers & Swift, 1997; Tilman *et al.*, 2001). Atmospheric deposition, primarily from fossil fuel combustion, is also a major contributor of nitrogen to the sea and accounts for as much as 25-30 per cent of the total nitrogen inputs in some regions (HELCOM, 2005; Spokes &

Figure 2



The map titled "Incident Human Water Security Threat" is generated from a geospatial framework and shows global freshwater resources (e.g. rivers) under threat from a set of diverse "stressors". The "stressors" are structured from 23 geospatial drivers clustered in four different thematic groups titled "catchment disturbance", "pollution", "water resource development" and "biotic factors". Expert assessments have been used to produce systems for weighting impacts of different stressors relative to the investigated theme. The spatial variation of incident threat to human water security is then expressed in the different colours of the map." (Vörösmarty et. al, 2010), with permission.

Figure 3



A global map of Human Impact on Marine Ecosystems" was generated using 17 global data sets of anthropogenic drivers of ecological change for 20 marine ecosystems. Land-based drivers include nutrient input, non-point source organic and inorganic pollution and direct of impact of humans (such as coastal engineering, intertidal trampling and noise pollution). Ocean-based drivers include commercial and artisanal fishing, benthic structures (oil rigs), commercial activity (shipping lanes), invasive species (ports), ocean pollution (shipping lanes, ports), climate change (sea surface temperature, UV radiation and acidification). (Halpern et al, 2008), with permission.

Jickells, 2005). These factors have contributed to widespread eutrophication, which is one of the leading causes of decreasing water quality globally. Apart from nutrients, there are many other land-based sources of pollution that end up in the water systems including heavy metals, oil-related pollution and persistent organic pollutants from sources like pesticides and industrial chemicals. New forms of pollution in emerging economies and the emergence of new problems, like the disposal of electronic waste, complicate the picture (UNEP/GPA, 2006).

The situation is similar in the marine environment, which acts as a sink for pollution generated by land-based activities, transported by air and water flows downstream. Halpern *et al.* (2008) concluded that practically no marine area is unaffected by human influence. The highest human impact on marine ecosystems is noted in coastal areas (or the areas of continental shelf and slope), which are subject to both land- and ocean-based anthropogenic drivers (figure 3). Pressures are mounting in the coastal zones as populations grow and coastal regions continue to develop. Marine pollution, more than 80 per cent of which comes from land-based sources, is projected to continue to increase (Nelleman, Hain & Alder, 2008). In developing areas, the discharge of untreated sewage adds large amounts of nutrients to the sea and coastal zones. Wastewater treatment is, unfortunately, one of the areas where least progress is made globally (Ibid).

Nutrient inputs to coastal areas are likely to increase in most regions and more coastal systems are likely to become eutrophic by mid-century (Seitzinger *et al.*, 2002; Rabalais, Turner, Díaz & Justic, 2009). Symptoms of eutrophication include hypoxia (oxygen depletion) and harmful algae blooms. Hypoxic (low-oxygen) areas have spread exponentially in coastal areas, their number having doubled each decade since the 1960s, currently affecting a total area of more than 245,000 km^2 (Diaz & Rosenberg, 2008). Only a small fraction of the over 400 systems exhibit any signs of improvement (Ibid). Most hypoxic zones have been observed in coastal waters. They occur in water bodies with limited water exchange (due to morphology and stratification) and where eutrophication produces a greater demand of oxygen. Observations of harmful algal blooms are also reported with increasing frequency since the 1970s (van Dolah, 2000).

The effects of climate change are predicted to add stressors to this situation. The Fourth Assessment Report of the International Panel on Climate Change (IPCC) (Nicholls *et al.*, 2007) states with very high confidence that coasts will be exposed to increasing risks, including coastal erosion, due to climate change and sea-level rise; and that the impact of climate change on coasts is exacerbated by increasing human-induced pressures. Accelerated rise of the sea level, increasing sea surface temperatures, intensification of cyclones, altered precipitation/runoff and ocean acidification are some of the climate-related changes contributing to erosion, hypoxia and habitat degradation which will all have severe socio-economic consequences (Rabalais *et al.*, 2009; STAP 2011b).

3 Evaluating the Current Integrated Water Governance and Management Approaches

A common feature of the current water governance and management concepts in the continuum is "integration"; meaning moving away from compartmentalised planning to a coordinated, cross-sectoral planning and implementation approach where major stakeholders are engaged. Two management concepts that both promote integration of sectors and approaches have dominated the discussion since the United Nations Conference on Environment and Development (UNCED) in 1992 – Integrated Water Resources Management (IWRM) in freshwater and terrestrial systems and Integrated Coastal Management (ICM) in the coastal zones. Both are deliberate attempts to move away from engineering and sectoral dominated management approaches and towards policies and management based on participation and integration (Ast & Bouma, 2009).

The UN Water Learning Centre distinguishes between four different forms of integration ("Lesson 3: Integration", n.d., para. 2): "Technical integration" exists where scientific descriptions of the environment being studied are reported in a compatible manner. Each report should be useful to the other groups involved.

- "Procedural integration" exists where an agreed set of protocols is used for all the aspects of the integrated management approach to try to make all the information accessible in a standard or known format.
- "Imposed integration" exists where one or a few agencies drive the process and define the scope, methods, format and reporting of the various aspects of the study.
- "Reporting integration" exists where the various aspects are summarised, analysed and reported by an appointed group or unit (and they integrate the various aspects).

Integration, as discussed by the UN Water Learning Centre, emphasises integration of natural and socio-economic systems in all aspects of planning and implementation of water management and development, but eludes the issue of conflicting uses of land and water. However, the typology includes all natural systems, such as freshwater and coastal water; land and water; green and blue water; surface and ground water; quantity and quality; upstream and downstream.

The concept of IWRM has a foundation in the Tennessee Valley Authority (TVA), which began its operations in 1933 (Snellen & Schrevel, 2004). The TVA represents a first attempt to combine the use and development of natural resources, with an integration of issues related to economy and social aspects. The TVA was primarily aimed at improving power production, navigation and flood control in the aftermath of the Great Depression and follows a tradition of imposed integration (Ibid).

The modern IWRM approach originates from the Dublin Statement on Water and Sustainable Development (UN, 1992) and follows a tradition of procedural integration. It was developed in preparation for UNCED in 1992 and was then promoted in Chapter 18 of Agenda 21 (UN, 1993). The Dublin Statement highlights four principles related to the management of water resources. These are: (i) water is a finite and vulnerable resource; essential to sustain life; (ii) water development and water management should be based on a participatory approach; (iii) women play a central part in the provision, management and safeguarding of water; and (iv) water has an economic value and should be recognised as an economic good. There is no specific reference to spatial and terrestrial issues. IWRM has since UNCED in 1992, been extensively advocated by natural resources managers as the foremost management concept to address the cross-sectoral challenge of freshwater resources management and development (cf. Dombrowsky, 2007; Giordano & Wolf, 2003; UNEP, 2012). The spatial dimension refers to a "basin approach", which is a key principle of IWRM that implicitly defines the spatial scale of interventions. While the basin approach makes most sense from a natural resources management perspective, it is necessary to acknowledge the challenges posed by the fact that many government authorities, economic entities and other institutions do not naturally operate at the basin level but are instead bound by politically defined jurisdictions. The Global Water Partnership (GWP, 2000, p. 22) that was established in 1996 by the international community to promote IWRM globally defines IWRM from a procedural point of view as follows: "Integrated Water Resources Management (IWRM) is a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment."

Europe has been a leader in implementing IWRM principles. The European Community adopted the EU Water Framework Directive (WFD) in 2000 with a specific objective to direct collective action in the field of water policy (EC, 2007a). It aims to expand the scope of water protection to achieve "good status" for all waters with the river basin as the management unit and integrating sectors and actors in society. A key objective of this legislation is to address water quality degradation in European water bodies. The WFD provides for a comprehensive planning approach of water resources covering 27 EU countries and establishes a legal framework to protect and restore clean water across Europe (EU, 2000). Generally agreed principles and concepts are embedded in a binding regulatory instrument which can be followed up and enforced since EU Directives establish mandatory objectives, which member states are required to "transpose" into national law and implement and enforce nationally (Walline & Granit, 2011). In the case of the EU, a combination of the four types of integration (technical, procedural, imposed and reporting) has been implemented. The on-going implementation of the WFD has, however, had mixed results (EC, 2007a). While most member states are able to report in time within the agreed deadlines, the translation of the WFD into national laws is still on-going. The complexity of the task is demonstrated by the fact that the European Commission in its work programme for 2010 announced a "fitness check" to review the entire body of legislation related to the policy field of water management. The objective is to "identify excessive burdens, overlaps, gaps, inconsistencies and/or obsolete measures which may have appeared over time" (EC, 2010, p. 10).

At the global level, the Johannesburg Plan of Implementation in 2002 reiterated the commitments in Agenda 21 (UN, 1993) that all states should design and initiate targeted national action programmes, appropriate institutional and legal instruments to implement IWRM according to their capacity and available resources. UNEP (2012) reports in a survey covering responses from two-thirds of all UN member states that 80 per cent of the countries have embarked on reforms to improve the enabling environment for water resources management since 1992. The report does not clearly specify how the measures that constitute these reforms are designed or their legal character. While progress in terms of the implementation of IWRM is taking place in many countries, the lack of clear and defined measurable outcomes and outputs (beyond the agreement to create plans) makes its monitoring and follow through less than straightforward. The EU WFD is an exception in that it states environmental objectives to be met by certain time periods.

Contemporary coastal management also originated in the United States. It was defined in the seminal Stratton Commission report to the US Congress in 1969: "Our Nation and the Sea" (Stratton Commission, 1969). The report declared that the nation's coastline is its most valuable natural feature and found that state and municipal governments had neither the capacity nor the political will to effectively manage this complex common-pool resource and conserve its many qualities. The US Coastal Zone Management Act of 1972 (CZMA, 1972) was one of several responses to this report. This legislation recognised that the responsibility and authority to manage the coast and inshore waters lie primarily with the individual states and municipal governments. Participation in the federal coastal zone management program by coastal states was made voluntary and provided incentives for participation. The subsequent rulemaking process by the responsible office in the National Oceanic and Atmospheric Administration (NOAA), detailed the standards that state Coastal Zone Management (CZM) programmes must meet if they are to benefit from limited and short-term federal funds to assist in a planning process and subsequently, if the resulting state CZM programme is found to meet all federal standards, be eligible for more generous and long-term funding to support the implementation of the state programme. The second incentive is known as the "consistency clause". This unusual feature of the 1972 legislation states that the actions taken by any state agency in a states coastal zone shall "to the maximum extent practicable" be consistent with a state's CZM program. The federal standards require a high degree of public involvement in both the planning and decision-making process and the demonstration of formalised agreements on how a programme will be implemented through collaborative actions with both other agencies of state government (horizontal coordination) and with municipal government and federal agencies with responsibilities in that state's coastal region (vertical coordination). These features made the early state CZM programmes that emerged in the 1970s and 1980s innovative experiments in a fresh and integrated approach to address the many challenges posed both to conserve and develop coastal areas.

The second period in the evolution of contemporary coastal management was shaped in 1992 by agenda 21 of chapter 17 of the UNCED. This put forward ICM as the approach by which sustainable forms of coastal development would be achieved. ICM drew from the experience of the US, as well as initial efforts in other countries. It called for an approach that is "integrated in content, and precautionary and anticipatory in ambit". One of several definitions of ICM as put forward by the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) (1996, p. 2), is as follows: "ICM is a process that unites government and the community, science and management, sectoral and public interests in preparing and implementing an integrated plan for the protection and development of coastal ecosystems and resources. The overall goal of ICM is to improve the quality of life of human communities who depend on coastal resources while maintaining the biological diversity and productivity of coastal ecosystems."

In contrast to CZM, however, ICM defines as its goal a sustainable coastal development, a concept that is absent in the US Coastal Zone Management Act and in the initial state programmes that it catalysed. The centrality of sustainable forms of development throughout the UNCED agenda and subsequent international declarations is significantly different from the world view expressed by the Stratton Commission 20 years before. Instead, the Stratton commission conveys a confident optimism that better coordination within a nested governance system that specifies roles and responsibilities at the municipal state and federal level and addresses a clearly defined set of issues of common concern, in combination with major investments in research and application of new technologies, will generate a positive future for all. The tone of the Stratton Report is optimistic and sees technology and improved management as the source of solutions to any problem. There is no questioning of fundamental goals and the assumption that the "development path" will take all to a positive future (NRC, 2008).

There are other important differences between ICM as put forward at UNCED and the CZM programme in the United States. Most obviously, UNCED is a non-binding agreement negotiated by the representatives of the national governments present at that meeting. The international context for ICM is quite different from that of CZM within the United States. First and foremost, there are no global set of incentives that encourage national governments to invest in ICM nor are there explicit standards by which either planning or implementation of an ICM program can be evaluated. Chapter 17 included the stated goal for all coastal nations to have an ICM program in place and estimated that the cost of preparing such plans by the target date of 2000 would be 6 billion USD. The UNCED did indeed trigger major investments in ICM projects funded largely by bilateral and multilateral donors that, with few exceptions, have been designed as short term projects that focus upon the planning phase. They assume that national governments will provide the necessary funding and other resources required to implement such programmes over the long term. It is unlikely that most individual states in the US would have formulated CZM plans and assigned state resources for their sustained implementation in the absence of the standards for the scope of their CZM programs and without a long-term federal financial subsidy.

Both IWRM and ICM have a tradition in an optimistic planning and engineering approach with their roots in governance models from US government administrations. As demonstrated in section two, the anticipated outcomes from IWRM and ICM in terms of natural resources management indicators and socio-economic gains are not being fully met in the continuum. As a result, the effectiveness of the implementation of IWRM and ICM are being questioned (Cf. Biswas, 2008; Blomquist & Schlager, 2005; Cicin-Sain *et al.*, 2006; Granit, 2011; Medema, McIntosh & Jeffrey, 2008). The critique raised is similar for both concepts. It is argued that they focus too much on processes and procedural integration rather than on outcomes. Both, it is claimed, define a new scientific agenda that is hard to comprehend outside the epistemic communities and have struggled to create valuable tools for effective management and development of water resources in the continuum. A part of the reason for the failure, it is argued, relates to issue of scale. In the case of IWRM, the relation between the management institutions established in the river basins and other institutions in society that operate under different geographical boundaries are often not clearly defined and overlap. Similarly for ICM, the coastal zone is not a distinct spatial feature (the definition of its area differs), especially not in administrative terms, and the complexity between different institutional responsibilities in the coastal zone makes collaboration difficult. Issues relating to physical boundary definition, institutional responsibility and decision-making arrangements can partly explain the apparent gap between theory and practice for both concepts. The incentives to bring different sectors together and thus link an integrated approach to the generation of broader development goals in society are not clear in either approach. One of the major barriers to collective learning and sustained investment in both processes is that there are few accepted evaluation frameworks, including indicators, to measure outcomes from IWRM and ICM. This means there is no clear way to assess the progress made by such initiatives outside of performing detailed evaluations on a case by case basis. A general deficiency in strong institutions and legislative frameworks to implement IWRM and ICM in most places makes the compliance, monitoring and evaluation of the two approaches difficult.

Further complicating the picture is the apparent gap between river basin and coastal management. Despite the obvious hydrological upstream/downstream connection, the IWRM and ICM concepts have not been able to connect these two quite separate worlds of water management. There is a widening gap between the issue analysis and planning undertaken in the continuum and the sustained and effective implementation of plans of action designed to reverse or reduce negative trends and to promote more sustainable forms of freshwater and coastal development. It appears that the capacity to effectively manage common-pool resources such as freshwater and coastal ecosystems in the continuum is a scarce commodity. Both IWRM and ICM are in themselves designed to manage highly complex and dynamic systems and with that in mind, it is not surprising that attempts in linking them together have been fairly few and have so far not become widely adopted.

As this section has shown, there are multiple challenges that prevent the implementation of integrated approaches to planning and decision making in the area of water and coastal resources. In the next section we will assess spatial planning as another management framework that integrates multiple interests and objectives at different spatial scales.

In parallel to the primarily process-oriented planning and implementation frameworks offered through IWRM and ICM, spatial planning frameworks that also support integrated approaches are used in most countries. The European Commission uses the following definition (EC, 1997, p. 24): “Spatial planning refers to the methods used largely by the public sector to influence the future distribution of activities in space. It is undertaken with the aims of creating a more rational territorial organisation of land uses and the linkages between them, to balance demands for development with the need to protect the environment and to achieve social and economic objectives. Spatial planning embraces measures to co-ordinate the spatial impacts of sectoral policies, to achieve a more even distribution of economic development between regions than would otherwise be created by market forces, and to regulate the conversion of land and property uses.”

Spatial planning has an important role in relating public policies to geography and in involving a wide range of policy sectors in the process. As such, it has the potential of contributing to a better integration of policies (Adams, Alden & Harris, 2006), and is often recognised as an important tool of the integrated management of a certain area (Cummins, Mahony & Connolly, 2004; Taussik, 2007; Carter, 2007). Spatial planning normally takes place at country level where national- and regional-level plans provide a framework to guide the development of local plans (Carter, 2007). These processes generally have the legal or administrative legitimacy that are often lacking for IWRM and ICM planning.

As noted earlier, the implementation of the EU WFD provides useful insights into the complexities of IWRM and spatial planning. Despite the lack of direct links between spatial planning practice and the WFD, spatial planning is commonly used to address water issues across Europe. Examples include the establishment of flood risk management, sustainable drainage systems, and buffer zones around water bodies, to name a few (Carter, 2007). Case studies have showed that the incorporation of water-related objectives in a spatial plan have added legislative weight to these objectives, leading to the development of concrete implementation measures (Ibid). The different geographical boundaries of spatial planning units and river basins, and the difference in timing between the development of river basin management plans and spatial plans, pose considerable administrative obstacles and create new demands on working practices and stakeholder relationships. Carter (2007) argues that the intensely political spatial planning process has a tendency to result in land use plans whose contents primarily reflect political, social and economic priorities. As noted by Evans (1997), spatial planning has not been able to fully tackle complex environmental processes, such as climate-change adaptation, water resources management and marine ecosystems and needs to address shortcomings in its approach to address biodiversity (Cid *et al.*, 2008).

Sea use planning, on the other hand, has taken a more ecosystem-based approach over the past two decades. This is largely a result of the realisation in the 1990’s that the world’s fisheries were declining and that marine ecosystem management was important to maintain them (Smith, Maes, Stojanovic & Ballinger, 2011). Marine Spatial Planning (MSP) has emerged as a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that are usually specified through a political process (Ehler & Douvere, 2009). A later definition of “coastal and marine spatial planning” put forward by the United States Interagency Ocean Policy Task Force in 2010 (Executive Office of the President of the United States, 2010) clearly stipulates its intention to reduce conflicts among uses, reduce environmental impacts, facilitate compatible uses, and preserve critical ecosystem services to meet economic, environmental, security and social objectives. This explicit notion of the role of planning in relation to uses conflict is fairly recent, taking the recognition of the need to “balance demands for development with the need to protect the environment” (as expressed in the definition of terrestrial spatial planning) one step further. This could be seen as reflecting a growing understanding of the need to influence human behavior in order to achieve a sustainable management of natural resources (Vlek & Steg, 2007, Ehrlich, Kareiva & Daily, 2012 and Fischer *et al.,* 2012).

Even though the first large-scale MSP efforts were undertaken already in the 1970s (Australian Great Barrier Reef), sea use planning systems are in general at a much earlier stage of development than land use planning systems (EC, 2008; Smith *et al.*, 2011). Most countries already apply sectoral zoning of the ocean, where they designate areas for maritime transport and communications, resource extraction (fish, minerals and energy), waste disposal, research, maritime leisure, conservation, etc. on a sector-by-sector and case-by-case basis (IEA, 2012; UNESCO, 2012). The emergence of MSP processes in many countries is primarily associated with the UNCLOS extension of state jurisdiction to 200 nautical miles to seaward of the coast (Smith *et al.*, 2011) (figure 1). There are several challenges in transferring a land-based approach like spatial planning to the marine environment. The three-dimensional character and more limited availability of data and knowledge on the marine environment can make planning more difficult. Monitoring and enforcement is also a more complex undertaking at sea compared with on land (Schultz-Zehden Gee & Scibior, 2008). The fact that water and some other resources (like fish) cannot be contained within administrative boundaries and often need to be managed in a transboundary context pose specific challenges (cf. Schultz-Zehden *et al.*, 2008; Granit, 2012). Looking at three advanced marine spatial planning initiatives in Belgium, Netherlands and Germany, Douvere & Ehler (2009) found that none of them addressed the transboundary dimensions necessary from an ecological perspective. This may be an indication that marine spatial planning initiatives are primarily driven by interests within national jurisdiction and that more attention is needed for them to consider ecosystems from a transboundary perspective.

There are many linkages between ICM and marine spatial planning – both are adaptive, strategic and participatory approaches integrated across economic sectors and among government agencies. In many parts of the world, ICM has focused on a narrow strip of coastline and rarely extends into the territorial sea or includes inland watersheds. This means that it is usually disconnected from IWRM management plans and other generic land use planning frameworks. ICM efforts have also often shown to have limited institutional support and with few exceptions, limited legal basis. To date, ICM has received little or no recognition in either land or sea use planning (Smith *et al.*, 2011).

Even if the gap between land and sea use planning prevails, recent initiatives in both the United States and the EU, show the increasing focus on spatial planning of both coastal and marine areas. In 2010, a "Framework for Effective Coastal and Marine Spatial Planning" was adopted in the United States as part of a new direction for the stewardship of its ocean, coasts and Great Lakes. Some years later, in March 2013, the European Commission launched a new initiative aiming to establish a framework for maritime spatial planning and integrated coastal management (EC, 2013). Meanwhile, MSP had been acknowledged for recognising the connections between land, freshwater and marine ecosystems and for representing "an essential framework to support ecosystem-based management in these environments" (CBD/STAP, 2012, p. 32).

5 Discussion – Re-assessing the Role of Spatial Planning in Managing Water Resources

This paper has shown how water resources throughout the continuum from land to the coast are being degraded with impacts on life supporting ecosystems, including the high seas. Human activities, both upstream in the terrestrial system and in the coastal zones, are clearly having a strong negative impact on environmental health in estuaries, coastal seas and the oceans in extensive areas of the globe. Neither freshwater nor coastal ecosystems will be able to function properly and provide essential services to a growing world population if fragmented governance of land, water, coastal and marine resources is allowed to continue unabated. An underlying challenge is that freshwater flows from land to the coastal sea are a "common-pool" resource, and as such demands cooperative governance approaches which are able to provide clear management frameworks that deliver tangible and measurable outcomes at all spatial scales.

A brief overview of the evolution and practice of the current governance and management frameworks in the continuum, as demonstrated by IWRM and ICM, has been provided. Overall, these two approaches are weak in terms of defining outcomes and measures but strong on providing principles to guide steps towards procedural integration. Both processes promote integration across socio-economic sectors and the natural systems. Any management system in the continuum needs to establish clear goals and objectives. It is critical that the specific characteristics of the ecosystem being managed and the existing governance context of that area are considered when establishing these goals. Moreover, a continuous learning approach needs to be applied by including strong monitoring and evaluation systems. Change in the physical and socio-economic system has to be monitored over time so that adjustment to the different management approaches can be made. Such adaptive management, including the evaluation of successes, failures, learning and a re-examination, can help establish management cycles that are flexible and can develop with change.

Though both the current IWRM and ICM management frameworks argue that improved coordination in the continuum is needed, neither framework takes the links and repercussions from the development and use of freshwater and terrestrial resources on the downstream coastal and marine systems sufficiently into account. Technical and institutional integration between IWRM and ICM is still not happening. As both fresh and coastal waters are vital for human well-being and development, and are inextricably linked through the hydrological cycle, this fragmented management comes at real costs to people and nature. The same gap exists between current land and marine spatial planning approaches.

In parallel to the IWRM and ICM approaches, this paper also assessed different spatial planning frameworks on land and in the marine environment. It notes that there are unclear spatial jurisdictions, mandates and boundaries between the different management frameworks in the continuum that extend beyond the coastal zone out to the open sea. Land use planning, or terrestrial spatial planning, is a well-established process in most countries. The integration of information on the location and extension of resources joint with the mapping of locations and requirements of activities in spatial planning is a practical tool that must be associated with rules for land and water use with regard to environmental considerations. Such concrete measures facilitate management and monitoring and the mapping of detrimental environmental consequences. Despite widespread acknowledgment of the potential added value of strengthening the linkages between land use planning and IWRM, the connection is still weak in most places. Spatial planning is often based on socio-economic principles and strongly linked to legal and administrative procedures. It takes into account multiple policies, laws and regulations. Problems arise when equally desirable but competing objectives are evolving. Spatial planning could be further enhanced by scientifically defined ranges of the use of land and water resources, i.e. incorporating sound water and natural management usage principles to a larger extent than it usually does today.

The emerging MSP initiatives take the ICM concept one step forward by actually implementing and operationalising ICM in the marine environment. This is an interesting development, which has probably been accelerated by the utilisation of an ecosystem-based approach in marine spatial planning from its onset. Spatial planning on land, which has a longer history and a stronger focus on the economic and social development issues has been slower to connect with IWRM and ICM frameworks. MSP is recognised as one of the priority themes for the further implementation of ICM in European coastal zones (EC, 2007b) and is acknowledged for its potential to make ICM principles more tangible and operational (Douvere & Maes, 2010). The need to complement and align marine spatial planning with other tools and processes, like ICM, is also widely recognised (Schultz-Zehden *et al.*, 2008; EU, 2011).

The often informal collaboration between water managers and spatial planners at the local level would benefit from being further complemented by clearly established mechanisms between water and spatial planning authorities during various stages of planning. In the cases where river basin or coastal management plans are established, they should be closely coordinated with spatial planning processes. Authorities responsible for water resources and coastal management should be encouraged and provided with the required resources to support land use planners with data on the water environment.

6 Conclusions

Spatial planning, both on land and at sea, offers strong mechanisms to integrate water considerations early on during cross-sector policy development and provides an effective management instrument for multiple stakeholders to address common-pool resources within agreed governance frameworks. It can contribute directly to a number of water management measures that are identified through IWRM or ICM plans. In addition, the IWRM and ICM plans and the consultations undertaken during their development can strengthen the spatial planning process by providing information on the potential impacts of development plans on water resources and the aquatic, marine and coastal environments and help ensure these important considerations are adequately accounted for in their planning. For this to happen, spatial planners need to be made aware of the information available through these plans.

There is strong potential for water resource and coastal zone management to be more firmly integrated within generic spatial planning processes and to improve coordination between actors working in each field. In places where spatial planning is not taking place, IWRM and ICM planning approaches will benefit from the legal and administrative legitimacy and rigor that engaging in spatial planning processes would provide. Applying spatial planning would facilitate the development and implementation of concrete measures to address the degradation in the continuum. IWRM and ICM processes can also strengthen the spatial planning process by providing information on how water resources and ecosystem will be impacted by different development options.

A number of institutional, administrative and capacity challenges have to be overcome for this to happen in reality. Differences in the geographical boundaries and timing of the development of IWRM, ICM and spatial plans are one central challenge. Capacity constraints (knowledge, time and resources) among spatial planners on how to effectively incorporate water considerations is another.

Regardless of which planning process is followed, the linkages between natural resource flows from land, to the coast and to the open sea need to be taken into account. Any effective planning framework in the continuum must understand what the possibilities and constraints of ecosystems are to deliver economic, social and ecosystem benefits. These values are needed to provide a baseline for further planning and to set clear short-, medium-, and long-term objectives. These goals should be created in dialogue with people who will be affected by development decisions and include structured monitoring and evaluation systems. This will help enable adaptive management and continued learning to guide effective planning throughout the continuum within societies and governance systems that continue to evolve and transform.

7 References

Adams, N., Alden, J. & Harris, N. (2006). Regional Development and Spatial Planning in an Enlarged European Union. Ashgate Publishing, Ltd. pp. 283.

Ast van, J.A. & Bouma, J.J. (2009). Value Chains in water cycles; innovations in water governance. Delft University of Technology.

Biswas, A. (2008). Integrated Water Resources Management: Is it working? Water Resources Development, 24,1 (March 2008), 5-22.

Blomquist, W. & Schlager, E. (2005). Political pitfalls of integrated watershed management. Society & Natural Resources 18(2):101-117.

Carter, J. (2007). Spatial planning, water and the Water Framework Directive: Insights from theory and practice. The Geographical Journal, Vol. 173, No. 4, December 2007, pp. 330-342.

Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel – GEF. [CBD/STAP]. (2012). Marine Spatial Planning in the Context of the Convention on Biological Diversity: A study carried out in response to CBD COP 10 decision X/29, Montreal, Technical Series No. 68, 44 pages.

Cicin-Sain, B., Vandeweerd, V., Bernal, P.A., Williams, L.C. & Balgos, M.C. (2006). Meeting the commitments on oceans, coasts, and small island developing states made at the 2002 World Summit on Sustainable Development: How well are we doing? Co-Chairs' Report – Volume 1, Third Global Conference on Oceans, Coasts and Islands, June 2006.

Cid, G., Lewsey, C. & Jønch-Clausen, T. (2008). Policy brief: Linking the management of freshwater, oceans, and coasts. Working Group on Linking the Management of Freshwater, Oceans, and Coasts Global Forum on Oceans, Coasts, and Islands.

Cummins, V., O 'Mahony, C. & Connolly, N. (2004). Review of Integrated Coastal Zone Management and principals of best practice. Cork, The Heritage Council.

CZMA (1972). Coastal Zone Management Act of 1972. Pub.L. 92-583, 86 Stat. 1280, enacted October 27, 1972, 16 U.S.C. §§ 1451–1464, Chapter 33.

Diaz, R. & Rosenberg, R. (2008). Spreading dead zones and consequences for marine ecosystems. Science, 321 (AAAS): 926-929.

Dombrowsky, I. (2007). Conflict, cooperation and institutions in International Water Management – An economic analysis. Cheltenham-Northampton, MA: Edward Elgar.

Douvere, F. & Ehler, C. (2009). New perspectives on sea use management: Initial findings from European experience with marine spatial planning. Journal of Environmental Management, 90, 77-88.

Douvere, F. & Maes, F. (2010). The contribution of marine spatial planning to implementing integrated coastal zone management. In: Green D. (ed) Coastal zone management. Thomas Telford. London. 13-30.

Ehler, C. & Douvere, F. (2009). Marine spatial planning: a step-by-step approach toward ecosystem-based management. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC Manual and Guides No. 53, ICAM Dossier No. 6. Paris: UNESCO.

Ehrlich, P. R., Kareiva, P. M., & Daily, G. C. (2012). Securing natural capital and expanding equity to rescale civilization. Nature. Volume 486. Pp 68-73.

European Commission [EC]. (1997). Compendium of European planning systems. Regional Development Studies Report 28. Office for Official Publications of the European Communities, Luxembourg.

European Commission. [EC] (2007a). Commission staff working document: Accompanying document to the communication from the Commission to the European Parliament and the Council. Towards sustainable water management in European Union – First stage in the implementation of the Water Framework Directive 2000/60/EC. Brussels. 22.3.2007 COM(2007)128 final.

European Commission [EC] (2007b) Report to the European Parliament and the council: An evaluation of Integrated Coastal Zone Management (ICZM) in Europe. Brussels. COM (2007) 308 final.

European Commission. [EC]. (2008). Communication from the Commission. Roadmap for maritime spatial planning: Achieving common principles in the EU. Brussels, 25.11.2008 COM (2008) 791 final.

European Commission. [EC]. (2010). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Commission Work Programme 2010 – Time to act. Brussels, 31.3.2010 COM(2010) 135 final. Vol I.

European Commission. [EC]. (2013). Proposal for a Directive of the European Parliament and of the Council establishing a framework for maritime spatial planning and integrated coastal management. SWD(2013) 64 final. SWD(2013) 65 final.

European Union. [EU]. (2000) Establishing a framework for community action in the field of water policy. Directive 2000/60/EC of the European Parliament and of the Council. Official Journal of the European Union, L 327, 1-72.

European Union. [EU]. (2011). Study on the economic effects of Maritime Spatial Planning. Final report. European Commission. Maritime Affairs and Fisheries. ISBN: 978-92-79-19791-8.

Evans B. (1997). From town planning to environmental planning. Blowers A and Evans B eds Town planning into the 21st century, Routledge, London.

Executive Office of the President of the United States. 2010. Final Recommendations of the Interagency Ocean Policy Task Force July 19, 2010. The White House Council on Environmental Quality.

Fischer, J., Dyball, R., Fazey, I., Gross, C., Dovers, S., Ehrlich, P.R., Brulle, R.J., Christensen, C. & Borden, R.J. 2012. Human behavior and sustainability. Frontiers in Ecology and the Environment. 10: 153-160.

GESAMP. (1996). The contributions of science to coastal zone management. IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection. Rep.Stud.GESAMP, (61):66 p.

Giordano, M. & Wolf, A. (2003). Sharing waters: Post-Rio international water management. Natural Resources Forum, 27 (2003), 163-171 United Nations: Blackwell Publishing.

Granit, J. (2011). Reconsidering Integrated Water Resources Management: Promoting economic growth and tackling environmental stress. In Brauch, H.G., Spring, U. O., Mesjaz, C., Grin, J., Kamere – Mbote, P., Chourou. B., Dunay, P. & Birkman, J. (Eds.), Coping with global environmental change, disaster and security. Threats, challenges, vulnerabilities and risks. Hexagon series on human and environmental security and peace (HESP Vol. 5).Berlin, Heidelberg, New York: Springer-Verlag.

Granit, J. (2012). The collective action dilemma in managing transboundary freshwaters – An analysis of an outcome-driven framework. Dissertations from the Department of Physical Geography and Quaternary Geology, No 33. Stockholm: Stockholm University.

GWP. (2000). Integrated Water Resources Management, TAC background papers No. 4. Global Water Partnership Technical Advisory Committee (TAC), 2000.

GWP. (2008). Planning for a water secure future – Lessons from water management planning in Africa. Stockholm: GWP.

Halpern, B.S., Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., D'Agrosa, C., Bruno, J.F., Casey, K.S., Ebert, C., Fox, H.E., Fujita, R., Heinemann, D., Lenihan, H.S., Madin, E.M.P, Perry, M.T., Selig, E.R., Spalding, M., Steneck, R. & Watson, R. (2008). A global map of human impact on marine ecosystems. Science, 319, 948-952.

HELCOM. (2005). Airborne nitrogen loads to the Baltic Sea. Helsinki: Helsinki Commission, Baltic Marine Environment Commission, HELCOM Environmental Focal Point Information.

Howarth, R.W., Sharpley, A. & Walker, D. (2002). Sources of nutrientpollution to coastal waters in the United States: Implications for achieving coastal water quality goals. Estuaries 25:656-676.

IEA. (2012). Retrieved May 4, 2012 from www.ocean-energy-systems.org/ocean_energy/in_depth_articles/marine_spatial_planning.

International Task Force on Global Public Goods. (2006). Meeting global challenges: International cooperation in the national interest. Final Report. Stockholm: Sweden.

IUCN. (2008). International News and Analysis on Marine Protected Areas. Vol. 10, No. 5.

Lesson 3: Integration – what does it mean?. (n.d). In United Nations University Open Course Ware. Retrieved July 4, from http://ocw.unu.edu/international-network-on-water-environment-and-health/introduction-to-iwrm/modules/lesson3.pdf.

Lääne, A., Kraav, E. & Titova, G. (2006). Baltic Sea. GIWA regional assessment 17. Kalmar, Sweden: University of Kalmar.

Martinez, M.L., Intralawan, A., Vazquez, G., Perez-Maqueo O., Sutton P. & Landgrave, R. (2007). The coasts of our world: Ecological, economic and social importance. Ecological Economics, 63, pp. 254–272.

Matson P.A., Parton W.J., Powers A.G. & Swift M.J. (1997). Agricultural intensification and ecosystem properties. Science 277(5235):504-509.

Medema, W., McIntosh B. S., & Jeffrey, P. J. (2008). From premiseto practice: a critical assessment of integrated water resources management and adaptive management approaches in the water sector. Ecology and Society 13(2): 29.

Millennium Ecosystem Assessment. (2005). Ecosystems and human well-being: Synthesis. Washington, DC: Island Press.

Nellemann, C., Hain, S. & Alder, J. (Eds). (2008). In dead water – Merging of climate change with pollution, over-harvest, and infestations in the world's fishing grounds. United Nations Environment Programme, GRID-Arendal, Norway, www.grida.no.

Nicholls, R.J., P.P. Wong, V.R. Burkett, J.O. Codignotto, J.E. Hay, R.F. McLean, S. Ragoonaden & C.D. Woodroffe, (2007). Coastal systems and low-lying areas. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 315-356.

NRC. (2008). Increasing capacity for stewardship of oceans and coasts: A priority for the 21st century. National Research Council, Committee on International Capacity-Building for the Protection and Sustainable Use of Oceans and Coasts. ISBN: 978-0-309-11376-2. 154pp.

Olsen, S.B., Page, G.G. & Ochoa, E. (2009). The analysis of governance responses to ecosystem change: A handbook for assembling a baseline. LOICZ Reports & Studies No. 34. Geesthach: GKSS Research Center.

Ostrom, E. (2000). Collective action and the evolution of social norms. The Journal of Economic Perspectives, Vol. 14, No. 3. (Summer, 2000), 137-158. American Economic Association.

Rabalais, N. N., Turner, R. E., Díaz, R. J., & Justic, D. (2009). Global change and eutrophication of coastal waters. ICES Journal of Marine Science, 66: 1528–1537.

Schultz-Zeden, A., Gee, K. & Scibior, K. (2008). Handbook on Integrated Maritime Spatial Planning: Experience, tools & instruments. Case studies from the INTERREG III B CADSES PlanCoast Project.

Seitzinger, S. P., Kroeze, C., Bouwman, A. F., Caraco, N., Dentene, F., & Styles, R. V. (2002). Global patterns of dissolved inorganic and particulate nitrogen inputs to coastal systems: recent conditionsand future projections. Estuaries, 25: 640-655.

Shipman, B. & Stojanovic, T. (2007). Facts, fictions, and failures of Integrated Coastal Zone Management in Europe. Coastal Management. Vol 35. Issue 2-3. pp. 375-398.

Smith, H.D., Maes, F., Stojanovic T. A., & Ballinger, R. (2011). The integration of land and marine spatial planning. Journal of Coastal Conservation. Volume 15, Issue 2. Publisher: Springer. pp 291-303.

Snellen, W.B. & Schrevel, A. (2004) IWRM: For sustainable use of water 50 years of international experience with the concept of integrated water management. Background document to the FAO/Netherlands Conference on Water for Food and Ecosystems. Ministry of Agriculture, Nature and Food Quality, Wageningen: Ministry of Agriculture, Nature and Food Quality.

Spokes, L.J. & Jickells, T.D. (2005). Is the atmosphere really an important source of reactive nitrogen to coastal waters? Continental Shelf Research, 25: 2022-2035.

STAP. (2011a). Marine debris as a global environmental problem: Introducing a solutions based framework focused on plastic. A STAP Information Document. Global Environment Facility, Washington, DC.

STAP. (2011b). Hypoxia and nutrient reduction in the coastal zone. Advice for prevention, remediation and research. A STAP Advisory Document. Global Environment Facility, Washington, DC.

Stratton Commission. (1969). Our Nation and the Sea. A Plan for National Action. Report of the Commission on Marine Science, Engineering and Resources. United States Government Printing Office, Washington, DC, 305 pp., January 1969.

Taussik, J. (2007). The opportunities of spatial planning for integrated coastal management. Marine policy 31 (2007) pp 611-618.

Tilman, D., Fargione, J., Wolff, B., D'Antonio, C., Dobson, A.,Howarth, R., Schindler, D., Schlesinger, W. H., Simberloff, D. & Swackhamer, D. (2001). Forecasting agriculturally driven global environmental change. Science, 292: 281-284.

UN. (1992). The Dublin Statement on Water and Sustainable Development. Adopted January 31, 1992 in Dublin, Ireland. International Conference on Water and the Environment. UN Documents: Gathering a Body of Global Agreements.

UN. (1993). Agenda 21: Earth Summit – The United Nations Programme of Action from Rio. UN Department for Economic and Social Affairs Divison for Sustainable Development.

UNCLOS. (1982). United Nations Convention on the Law of the Sea of 10 December 1982: Overview and full text. Retrieved June 30, 2012 from www.un.org/Depts/los/convention_agreements/texts/unclos/closindx.htm.

UNEP. (2012). The UN-Water status report on the application of integrated approaches to water resources management. UNEP, Division of Communications and Public Information, Nairobi, Kenya.

UNEP/GPA. (2006). The State of the Marine Environment: Trends and processes. UNEP/GPA, The Hague.

UNESCO. (2012). Retrieved May 15, 2012 from www.unesco-ioc-marinesp.be/msp_faq.

UN Water. (2009). The United Nations World Water Development Report 3 – Water in a Changing World. Paris. UNESCO Publishing – London: Earthscan.

Van Dolah, F. M. (2000). Marine algal toxins: Origins, health effects, and their increased occurrence. Environ Health Perspectives:133–141.

Vlek, C., Steg, L. 2007. Human behavior and environmental sustainability: Problems, Driving Forces and Research Topics. Journal of Social Issues, Vol. 63, No. 1, 2007, pp. 1-19.

Vörösmarty, C.J., McIntyre, B., Gessner, O.M., Dudgeon, D., Prusevich, A., Green, P., Glidden, S., Bunn, S.E., Sullivan, C.A., Reidy Liermann, C. & Davies, P.M. (2010). Global threats to human water security and river biodiversity. Nature 467:7315. pp 555-561.

Walline, M. & Granit, J. (2011). Collective Action in the Baltic Sea Basin – Options for Strengthening Implementation of the Environmental Pillar of the EU Strategy for the Baltic Sea Region. SIWI Report 19. Stockholm: SIWI.

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