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Securing blue wealth: the need for a special sustainable development goal for the ocean and coasts and for future ocean spatial planning

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Abstract

The ocean regulates the global climate, provides humans with natural resources such as food, materials, important substances, and energy, and is essential for international trade and recreational and cultural activities. Together with human development and economic growth, free access to, and availability of, ocean resources and services have exerted strong pressure on marine systems, ranging from overfishing, increasing resource extraction, and alteration of coastal zones to various types of thoughtless pollution. Both economic theory and many case studies suggest that there is no “tragedy of the commons” but a “tragedy of open access”. With high likelihood, structures of open access are non-sustainable. International cooperation and effective governance are required to protect the marine environment and promote the sustainable use of marine resources in such a way that due account can be taken of the environmental values of current generations and the needs of future generations. For this purpose, developing and agreeing on one Sustainable Development Goal (SDG) specifically for the Ocean and Coasts could prove to be an essential element. The new SDGs will build upon the Millennium Development Goals (MDGs) and replace them by 2015. Ensuring environmental sustainability in a general sense is one of the eight MDGs but the ocean is not explicitly addressed. Furthermore, the creation of a comprehensive underlying set of ocean sustainability targets and effective indicators developed within a global Future Ocean Spatial Planning (FOSP) process would help in assessing the current status of marine systems, diagnosing ongoing trends, and providing information for inclusive, forward-looking, and sustainable ocean governance.

Keywords

securing, blue, wealth, need, special, sustainable, planning, spatial, development, future, goal, coasts, ocean

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Securing Blue Wealth: The Need for a Special Sustainable Development Goal for the Ocean and Coasts and for Future Ocean Spatial Planning

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The ocean regulates the global climate, provides humans with natural resources such as food, materials, important substances, and energy, and is essential for international trade and recreational and cultural activities. Together with human development and economic growth, free access to, and availability of, ocean resources and services have exerted strong pressure on marine systems, ranging from overfishing, increasing resource extraction, and alteration of coastal zones to various types of thoughtless pollution. International cooperation and effective governance are required to protect the marine environment and promote the sustainable use of marine resources in such a way that due account can be taken of the environmental values of current generations and the needs of future generations. For this purpose, developing and agreeing on to devote one of the *Sustainable Development Goal (SDG)* specifically to the *Ocean and Coasts* could prove to be an essential element. The new SDGs will build upon the Millennium Development Goals (MDGs) and replace them by 2015. Ensuring environmental sustainability in a general sense is one of the eight MDGs, but the ocean is not explicitly addressed. Furthermore, the creation of a comprehensive underlying set of ocean sustainability targets and effective indicators would help in assessing the current status of marine systems, diagnosing ongoing trends, and providing information for inclusive, forward-looking, and sustainable ocean governance. To achieve this, we propose to establish a global *Future Ocean Spatial Planning (FOSP)* process.

Keywords: blue wealth, sustainable development, sustainable development goal, ocean governance

JEL classification: Q56, Q57, Q58

1 Introduction

It has been said that the major challenge for the future of life on this planet is achieving a species of development that increases wealth and reduces poverty while sustaining the natural resources that such a development is necessarily based on. This challenge has been taken up and institutionalized notably in the framework of the United Nations (UN). *Agenda 21*, an action plan for achieving sustainable development in the 21st century, was a major outcome of the first UN Conference on Environment and Development in Rio de Janeiro in 1992 and has been affirmed and further elaborated at the subsequent conferences devoted to this topic. To accelerate the still rather slow progress being made in achieving sustainable development at the global level, the recent UN Conference on Sustainable Development in 2012 (*Rio+20*) called the *Future We Want* not only emphasized the need for action but also proposed agreeing on a set of measurable Sustainable Development Goals (SDGs) to support focused and coherent action in priority areas at the global level (UN, 2012). The idea is for the SDGs to be based on *Agenda 21* and the *Johannesburg Plan of Implementation* and to build on the Millennium Development Goals (MDGs).

Ensuring environmental sustainability is the seventh of the eight MDGs. But the role played by the environment in development, wealth, and poverty reduction is inadequately foregrounded (e.g., Griggs et al. 2013). Furthermore, the sustainability of the largest, most diverse, and arguably most important ecosystem, the ocean, is not explicitly addressed. The ocean's influence on wealth and development is clearly global in nature, but its role in sustainable development and above all poverty reduction at the regional level is rarely fully acknowledged. The ocean provides humanity with both animate and inanimate natural resources such as food, materials, essential substances, and energy. Furthermore, the ocean is crucial for international trade and recreational activities, thus generating wealth and facilitating development. In addition to its resource abundance and its role in development, the ocean has fascinated humans since time immemorial, providing us with esthetical and cultural values and delighting us with the beauty and variety of marine life. The immense range of seascapes give us a well-defined sense of place. Coastal waters are used for religious rituals and recreational purposes. While such values elude monetization, they contribute significantly to meaningful human life.

Consequently, ocean services are essential for human life on earth, so all development needs must consider *planetary (and ocean) boundaries* (e.g., Rockström et al., 2009). Together with human development and economic growth, the free access to, and availability of, ocean resources and services has exerted major pressures on the ocean, ranging from overfishing and increasing resource extraction to various sources of thoughtless pollution and alterations to coastal zones that often cause the degradation of marine ecosystems (coral reefs, mangroves, etc.). Irrespective of such threats and the overall importance of the ocean in providing these services, the mitigation of marine environmental problems (current and future) and approaches to sustainable use and the development of marine resources have been accorded only very low priority in many states. Accordingly, we argue in this paper that sustaining blue wealth requires a comprehensive approach and that a SDG devoted explicitly to the ocean and coasts would be a crucial factor in achieving sustainable ocean management.

SDG Ocean and Coasts

Secure blue wealth by ensuring a healthy and productive marine environment with all basic provisioning, support, regulation, and cultural services. Provide equitable access to ocean resources, and ensure that neither pollution nor the harvesting and extraction of animate and inanimate resources impair the basic functions of the ecosystem. Facilitate the development of sustainable and resilient coastal communities. Harmonize national and regional maritime policies, and encourage cooperation in coastal and global marine spatial planning.

Such a goal has to be set at the highest international level. A multitude of piecemeal domestic and regional approaches and policies can neither effectively address the difficulties the ocean faces in a coherent manner nor monitor global progress. Given that it is the only international organization with universal membership, the United Nations (UN) must take the lead in supporting ocean sustainability. The largest part of the ocean—the high seas—is a global common with largely unrestricted access to ocean resources and functions for all comers, regardless of nationality and geographical location. Ocean currents connect coastal environments and societies world-wide. Accordingly, environmental sustainability for the ocean is of universal concern, calling for a correspondingly global forum for the formulation of policies and the monitoring of their success. The annual UN General Assembly resolution on oceans and the law of the sea—the longest resolution the UN adopts every year—sets out the transnational and global issues associated with using the ocean sustainably and the need for coordinated action based on policy agreements, international law, and national implementation.

In this paper we first discuss the challenges for blue wealth (Section 2). In Section 3 we argue that an *SDG Ocean and Coasts* with specific targets and instruments would be essential for realizing a sustainable development strategy for the ocean and its coasts. In doing so, we discuss the general objectives of a potential *SDG Ocean and Coasts* (Section 3.1) and the need to appropriately conceptualize sustainable development so as to encompass all the various oceanic resources (Section 3.2). For that purpose, a comprehensive indicator set would be an important instrument for measuring the status and progress of developments over and against the various targets. To properly account for the complexity of the human-ocean system, the targets and the indicator set should be supplemented with *safe minimum standards* (Ciriacy-Wantrup, 1952) to keep development in *safe operating space* (Section 3.3). The derivation of an effective and specific set of targets and the potential for monitoring progress against these targets could be guided by a *Future Ocean Spatial Planning* (FOSP) approach (Section 3.4). Section 4 provides some concluding remarks.

2 Challenges in Securing Blue Wealth

The ocean provides a multitude of services to humankind and a productive and healthy ocean is essential for wealth and well-being. We use the term “blue wealth” to refer collectively to these assets. However, the ocean’s contribution to wealth and development has yet to be properly acknowledged or indeed quantified. In addition, human development and economic growth have exerted major pressure on the ocean and the marine ecosystem.

This is certainly true of the world's fish stocks, where catch levels over the last twenty have only been maintained by expanding to new species and new areas. Although expert calculations of the degree of overfishing vary, official FAO (2010) estimates show that more than a quarter of all stocks are overfished and more than half of all stocks are fished to maximum capacity. However, reliable figures on the state of stocks are only available for roughly 500 of the 1500 stocks currently exploited. The major impediments to sustainable fishery are non-existent or poor management plus absence of compliance with existing regulations due to limited resources for control and enforcement. Illegal, unregulated, and unreported (IUU) fisheries are a major threat, but existing international instruments addressing IUU fishing have been ineffective due to lack of political will, non-prioritization, insufficient capacities, and a lack of resources for ratifying and implementing them. Sustainable management is urgently needed, and it is needed now. Once fish stocks have collapsed, not even stringent protection measures will suffice to enable all the fish stocks to recover spontaneously, as the case of Canadian cod fishing indicates.

Overfishing is just one of a multitude of threats to marine ecosystems and ocean functions that are caused by human activities, both directly at sea and indirectly through land-based changes and poor waste management. Specific examples include pollution by a broad range of chemicals such as heavy metals, oil, carbon dioxide, radioactive substances, and plastics, plus indirect effects like eutrophication. Transported by currents, they can cause harm even in areas quite remote from the source of pollution itself. A significant part of marine litter is made up of plastic with poor degradability (Derraik 2002, Cole et al. 2011). Thompson (2006) estimates that ten percent of the global plastic production of roughly 250 million tonnes ends up in the ocean and either causes problems as large items or (a subject even less thoroughly investigated) accumulates in the food chain in the form of microplastics (Andrady, 2011).

Another serious problem for coastal waters arises from eutrophication (Smith and Schindler 2009). Caused by an accumulation of nutrients in coastal waters originating from agriculture, industry, and sewage discharged into surface waters, marine eutrophication can lead to frequent and long-lasting algae blooms. Such algae blooms may change the turbidity of seawater and limit light penetration into deeper layers of the water. As algae bloom recedes, degradation processes in the plant material stimulated by bacteria consume large amounts of oxygen, which in its turn can cause dead zones in deep-water layers. Furthermore, some microscopic algae can cause harmful algae blooms (HAB) if they occur in large numbers. These have a potential for producing toxins that have impacts on humans and animals (Gilbert et al., 2005).¹ At present, the most seriously affected areas are located in western Europe, the eastern and southern coasts of the U.S., and East Asia, particularly Japan (Selman et al., 2008). We see from this that marine protection also requires changes in agricultural policy and water pollution control. There is clearly a *terrestrial side* to marine protection, notably in connection with agriculture, urbanization, and sewerage services. Although international treaties on marine pollution from land-based sources acknowledge this, these instruments are relatively weak because states lack the political will to agree on standards for regulating agriculture etc.

Furthermore, the continual increase in atmospheric carbon emissions causes significant ocean warming due to climate change and direct chemical stress from ocean acidification. An increase in

¹ Hypoxia and HAB impair the quality of water and can change or reduce species diversity or cause the death of fish, birds, and marine mammals when toxins are produced (Gilbert et al. 2005).

ocean heat uptake leads to changes in the physical properties of the oceans, mainly direct increases in water temperature, stronger stratification, sea-level rise, and changes in ocean currents (IPCC 2003) with major impacts on the marine ecosystem and coastal communities. At the same time, warming and increased stratification lead to ocean deoxygenation and an expansion of subtropical oxygen-minimum zones (Stramma et al. 2008). The oceans provide the most important carbon sink in the global carbon cycle. The price for this, however, is increasingly acidic conditions in the marine environment (e.g., Doney 2010). Ocean acidification has already reached measurability. It has lowered ocean-surface pH by 0.1 compared to pre-industrial values and by 2100 is expected to further decrease it by an additional 0.3-0.4 units (e.g. Doney et al., 2009; Mackenzie et al., 2011; Porzio et al., 2011).

Currently, we cannot be sure whether marine species and ecosystems will be able to adapt to changes in ocean physics and chemistry, but there is major concern that ocean acidification may pose a threat to the abundance, health, physiology, and biochemical properties of marine species (e.g., Doney et al., 2009). With a doubling of atmospheric carbon concentration relative to pre-industrial levels, coral calcification, structure, and growth could be reduced by up to forty percent (Hoegh-Guldberg et al., 2007; Wood et al., 2008). Combined with other stress factors affecting coral reefs such as extreme temperatures giving rise to coral bleaching, viral attacks, overfishing, and pollution, this represents a dire prognosis for reef corals, which provide important ecosystem services for millions of people. Their degradation and loss of mass would reduce the protection of shorelines against erosion and flooding and affect local fisheries, tourism/recreation industries, and related maritime economies (Feely et al., 2006). From the perspective of environmental aesthetics, coral reefs are a source of profound and intense experiences.

As many of these ocean services are largely restricted to coastal zones, the implications of reduced ocean health will manifest themselves in terms of the impacts that make themselves felt there.² Accordingly, coastal development is a critical driver of change. It leads to increased utilization or even over-exploitation of natural resources both on land and in the sea and exerts major pressures on the environment at the land-ocean interface (Patterson and Hardy 2008). Ninety percent of global fishing activities actually occur within coastal jurisdiction (WOR, 2010), and physical interactions along coasts and in the hinterland such as dredging, damming of rivers and river deltas, extraction of liquids and gases from the ground, land reclamation, habitat modification, and coastal engineering have a major impact on the coastal environment. Consequences range from changes in sediment supply and coastal dynamics to coastal erosion, subsidence, and decreases in drinking water supplies. Through land reclamation and other human activities, shallow-water coastal areas have also been greatly reduced. These areas are critical for ocean functions as they enable light to penetrate to the sea bed, furthering the growth of plants providing refuge for juvenile marine organisms. Other human interactions with the coastal zone that exert pressure on the environment include tourism and recreational activities.

² There is no standard definition of coasts or the coastal zone. Commonly, the coastal zone is understood as the interface or transitional area between terrestrial and marine environments and their mutual influences (Woodroffe, 2002). Yet the coastal zone is strongly impacted by human activity and thus characterized by functional linkages and interactions between environmental and human systems, both on land and at sea. In our context, we understand the coastal zone as a complex human-environmental system that extends as far into the sea and onto the land as its key functional linkages and interactions extend.

Major seaports like Guangzhou, Shanghai, and Rotterdam are important industrial and maritime terminals for international trade. Here, smooth operation and efficient cargo handling are of major regional and economic importance. Damage or destruction of port infrastructure by extreme weather events can strongly affect regional supply chains, which in its turn poses a threat for the population's food security and health (Hanson et al., 2011). Given that this affects all dimensions of human security, combined effects could induce long-term migration (Black et al., 2011a; Black et al., 2011b; Seto, 2011). Changes in storm patterns (intensity of hurricanes and typhoons, etc.) and storm surges caused by climate change and a rise in sea-level with its associated biophysical and socio-economic consequences impose significant pressures on the coastal zone, especially on low-lying coastal areas, deltas, and small islands (Nicholls et al., 2007; Nicholls and Cazenave, 2010; IPCC, 2012; Brown et al., 2013). Moreover, severe natural disasters such as the hurricanes Katrina in 2005 and Sandy in 2012 not only directly endanger life and limb but can also cause psychological traumas and displacement-related social problems (Legerski et al., 2012). In addition, loss of, and damage to, valuable ecosystems like mangroves, tidelands, or marshes also lead to a reduction of natural coastal protection and may increase the vulnerability of coasts to erosion.

Climate change, natural disasters, and coastal development affect various aspects of human development, including poverty. Regions where observed impacts are especially severe include populated and urbanized coasts and megacities, river deltas, Arctic coasts, low-lying coasts, and small islands (Newton et al., 2012; Syvitski et al., 2009). In Arctic coastal regions, for example, climate change is already affecting the security of the indigenous inhabitants. The melting of permafrost and the withdrawal of sea ice in the Arctic directly threaten infrastructure, traditional livelihoods, and human well-being in coastal communities, cause increasing coastal erosion, and have adverse effects on sensitive coastal habitats (Derksen et al., 2012; Forbes 2011; Lantuit et al., 2012).

Along with climate change and coastal hazards, these manifold human interventions, complex interactions, and effects significantly increase the levels of risk, exposure, and sensitivity for coastal communities and their environment and thus exacerbate their vulnerability (Kron, 2013; Nicholls et al., 2007). At the same time, there is increasing human dependence on coastal resources, albeit with a globally unequal distribution of demands, provisioning, vulnerabilities, and threats. There is an urgent need for sustainable coastal development to address the various threats by increasing the resilience and adaptive capacity of both the human and natural coastal sub-systems, especially in developing countries.

3 Working Out a Sustainable Development Strategy for the Ocean

At the Rio+20 Conference, the decision was taken to establish a new set of SDGs as an "inclusive and transparent intergovernmental process on sustainable development goals that is open to all stakeholders, with a view to developing global sustainable development goals to be agreed by the General Assembly" (*The Future We Want*, UN, 2012: § 248). SDGs "should be action-oriented, concise and easy to communicate, limited in number, aspirational, global in nature and universally applicable to all countries..." and "... address and be focused on priority areas for the achievement of sustainable development..." (UN, 2012: § 247).

Accordingly, the number of SDGs should be limited, and the definition of extra SDGs is associated with cost in the sense that it lowers the attention devoted to the existing targets. For that reason,

there needs to be thorough and scrupulous discussion to determine which of the various global problems should be addressed by establishing a corresponding SDG. By definition, ocean management requires a global approach because to a very large extent the ocean is a global common that connects coastal and non-coastal societies on the planet. While many other global problems can be addressed by coordinating local action, sustainable ocean governance is too complex and involves too many potentially conflicting interests to be left to piecemeal approaches. States should stop acting solely as flag states, as coastal states, as port states or as fishing nations. Interests involve such crucial issues as fishing, offshore oil and gas exploitation, alternative energy from the ocean, shipping and tourism, but also actions undertaken on land to deal with the terrestrial side of ocean issues. Many of these aspects have already been addressed at an international level either by non-binding policy instruments or by international treaties. Any new approach to solving the remaining problems will have to be undertaken at the same global level.

Agreement on an international policy framework should encourage regional efforts implementation efforts and management schemes. Moreover, it will provide an impetus for change in national policies to support a set of common goals. Regional coordination and national implementation are prerequisites for effective change.

For these reasons, any definition of an *SDG Ocean and Coasts* would need to cover the essential elements of a prudent and morally responsible ocean development strategy. The objectives of the SDG need to be institutionalized in terms of specific targets. An adequate set of indicators for measuring sustainable ocean and coast development should comprehensively monitor and assess progress over and against both the overall objective and the specific targets. An additional requirement is appropriate reflection of the interdependence between human development and blue wealth based on productive ocean ecosystems. To this end, the indicator set should reflect the ecosystem approach and address with great care the substitution between human-made and natural capital stocks in order to capture the complexity of the *human-ocean system*³ with its various forms of interaction and feedback. Accordingly, additional *safe minimum standards* should supplement the targets so as to keep future development trajectories within a safe operating space. The definition of specific targets at global, regional, and national levels and the measurement and monitoring of progress over and against these targets by the comprehensive indicator set could be achieved by a *Future Ocean Spatial Planning* (FOSP) process.

3.1 Objectives of the *SDG Ocean and Coasts*

The primary objectives of the proposed *SDG Ocean and Coasts* should be to

- 1) Ensure the basic life-sustaining and regulating functions of the oceans (oxygen production, key processes in the climate system and in the hydrological cycle).
 - a) Limit activities that alter these functions.
 - b) Limit CO₂ emissions to slow down and limit ocean warming, sea-level rise, acidification, and de-oxygenation.
- 2) Ensure a healthy and productive marine environment to sustain all provisioning and non-provisioning (i.e. supporting and regulating) services of oceans and coasts.

³ With the term *human-ocean system* we summarize all interactions and linkages between humankind and the entire oceanic sphere, including coasts.

- a) Exploit animate resources within safe biological limits and in accordance with the ecosystem approach and the precautionary principle.
 - b) Exploit inanimate resources in accordance with the ecosystem approach and the precautionary principle.
 - c) Limit use and degradation of marine space in accordance with the ecosystem approach and the precautionary principle.
 - d) Develop and distribute technical and institutional capacities for the sustainable use of ocean resources.
 - e) Provide access to marine and coastal information and data and build global capacity for the assessment of oceans and for the management of ocean-related activities.
 - f) Report on the status of the oceans and coasts regularly against a set of ocean and coastal indicators.
- 3) Use mitigation and adaptation strategies, innovation, and sustainable development to build resilient coastal communities by sharing benefits and responsibilities.
- 4) Engage in integrated, multi-level, transparent, and effective ocean governance.
- a) Develop a globally consistent framework for marine spatial planning within exclusive economic zones (EEZs) and in areas beyond national jurisdiction, including links to coastal planning and management.
 - b) Improve and harmonize legal frameworks for oceans and coasts to take into account current and future uses and a balancing of interests.
 - c) Improve and harmonize the governance of ocean and coastal regimes.

3.2 Indicator set for ocean sustainability

Progress towards the realization of overall objectives and specific targets should be monitored by a set of indicators equal to the task of measuring sustainable ocean and coastal development. Comprehensive assessment of the state of the marine environment and its future development is still in its infancy. There are several initiatives under way, such as the World Ocean Assessment (UNEP/UNESCO-IOC, 2009. Regular Process for Global Reporting and Assessment of the State of the Marine Environment Including Socioeconomic Aspects, UNGA resolution 64/71); the Oceans Compact launched by the Secretary-General in 2012 to promote UN-wide coherence in the delivery of ocean-related mandates and encourage synergies within the UN system; and the Global Partnership for Oceans also launched in 2012, an alliance of more than 100 governments, international organizations, civil society groups and private sector interests committed to addressing threats to the health, productivity and resilience of the world's oceans. There are also numerous regional organizations like HELCOM and OSPAR, which have been elaborating objectives and targets for the North Atlantic and the Baltic Sea.

However, none of these initiatives has yet come up with a comprehensive measure that would cover human-ocean systems and internal ocean interactions. A notable exception is the Ocean Health Index introduced by Halpern et al. (2012). The authors define ten public ocean-related goals and assess the performance of 171 states, including their EEZs, against these goals. Their assessment is not only based on the present status of the ten goals but also includes the future status derived from the assessment of the pressures on, and the resilience of, the human-ocean system. For that reason, the authors claim that their index also provides important information regarding the sustainability of the human-ocean system. Considering the large amount of data collected and applied, the study by Halpern et al. (2012) represents a unique tool for assessing the human-ocean system. Nevertheless, the index as applied leaves out important issues such as the sensitivity of the result to the

aggregation of conflicting goals and should therefore be seen as only one possibility for assessing the state of the human-ocean system.

Developing a comprehensive indicator set for measuring the sustainability of the human-ocean system requires profound discussion of how the term sustainability can be operationalized in the context of the ocean. The seminal work by Meadows et al. (1972) emphasizes that in the presence of finite resources a broad concept of growth and wealth is necessary. From an economic perspective, sustainable development can be measured by determining whether the economy's productive capacity is maintained or growing so that the wealth of future generations will not decrease (e.g., Arrow et al., 2003; Alfsen and Greaker, 2007; Dasgupta, 2009; Arrow et al., 2012). However, the role and value of the ocean for this productive capacity has not yet been appropriately considered.

In defining a sustainability concept that encompasses the ocean, we need to bear in mind that in the *weak sustainability* approach referred to earlier the economic performance of a given society is sustainable if there are genuine savings and investments in productive capacity (e.g., Atkinson et al., 1997). This approach, however, allows for substitution between man-made and natural capital stocks. This means that the services of natural capital can be replaced to some degree by services stemming from machinery and artefacts. Consequently, it is necessary to pay attention to the limits of substitution between the various capital stocks (Victor, 1991) because sustainable development trajectories might otherwise be identified that do not adequately account for the underlying trade-offs. It is for this reason that the distinction between *strong* and *weak* sustainability was introduced in the early 1990s (e.g., Pearce et al., 1989; Hartwick, 1990; Daly and Cobb, 1989, Ott et al. 2004). This is however currently not reflected in the Halpern et al. (2012) index framework. In principle, the concept of *strong sustainability* does not allow for substitution between different capital stocks. Accordingly, the requirement is that the remaining stocks of natural capitals be maintained independently of the way in which other capital stocks develop. The concept of strong sustainability implies a set of management rules with respect to natural capital that can make conservation and even restoration mandatory in many cases. For political purposes, these rules must be specified in terms of objectives and indicators. At all events, sustainability requirements are constraints on possible pathways for increased economic activities ("development"). This is also true of other similar approaches, such as *planetary boundaries* or *safe minimum standards*, to which we now turn.

3.3 Definition of safe minimum standards

The human-ocean system is characterised by a high degree of complexity. But humankind does not yet properly understand all the various kinds of interaction and feedback involved. The capital approach outlined above does not cover all possible linkages between economic capital and other capital stocks, for example environmental capital stocks, which have yet to be properly defined in terms of ocean-related capital stocks. The Earth, with its oceans, continents, ice masses, currents, animate and inanimate resources forms an extremely complex system whose sub-systems and interactions are as yet poorly understood (Van der Sluijs 2012). With its preference for linear projections, science is limited in its ability to reproduce the non-linear and interactive system dynamics that characterize the ocean of the future.

The general concept of *planetary (and ocean) boundaries* defines constraints on future development options within a *safe operating space* (Rockström et al., 2009). The boundaries discussed in Rockström et al. are clearly not natural or *objective* boundaries but normatively defined limits

imposed on human interference with nature. From the viewpoint of *strong sustainability*, such limits seem quite plausible, if not prudent. It is very unlikely that probabilities can be unanimously assigned to the consequences of all current actions pertaining to the future status of the oceans, and in some cases these consequences may in fact be completely unknown. System dynamics entail the possibility of irreversible development, which may be associated with significant losses. Accordingly, prudent management of the human-ocean system has not only to deal with reliable cause-and-effect relations, but it is also confronted with a contingency of effects as a consequence of human intervention to be guarded against (Ciriacy-Wantrup, 1952). Ensuring sustainable development under uncertainty therefore requires attributing sustainability criteria to current actions instead of unknown future conditions (Baumgärtner and Quaas, 2010). *Safe minimum standards* always enable us to ask how safe things have to be in order to be safe enough. Thus *safe minimum standards* provide more latitude for risk assessment and trade-offs than the rules of *strong sustainability*, even if both approaches may converge toward similar objectives. If our diagnosis is correct, then more ambitious safety standards are a close approximation of the rule of maintaining the natural capital of oceans and coastal zones.

For that reason, *safe minimum standards* of conservation can be achieved by avoiding potential critical zones for certain actions (Ciriacy-Wantrup 1952). Proper timing and appropriate management imply relatively small costs for the maintenance of *safe minimum standards*—compared, at least, to the potential losses they are designed to obviate. The inclusion of such minimum standards is particularly important in view of the fact that neither complete understanding of the human-ocean system nor complete data availability for measurement will be available. For that reason, the process of developing suitable indicators to measure the human-ocean system should be supplemented by the discussion and definition of such *safe minimum standards* for interventions in the system.

Finally, the selection of appropriate indicators is restricted by data availability and processability. Accordingly, this selection is invariably a normative choice with important implications for the results (e.g. Krellenberg et al., 2010). These limitations need to be balanced against the requirement that the status and development of the human-ocean system should be measured for the purpose of determining appropriate management activities. Consequently, the process of selecting, weighting, and aggregating appropriate indicators requires the involvement of various stakeholders in addition to the experts. For that reason, the inclusion of the initiatives referred to in Section 3.3 and the UN ocean initiative is essential.

3.4 Future Ocean Spatial Planning (FOSP): deriving, implementing, and monitoring specific targets

For the broad objectives of the *SDG Ocean and Coasts*, specific targets need to be developed, negotiated, and implemented at global, regional, and national levels. Furthermore, progress needs to be monitored against these targets and safe minimum standards need to be defined. A guiding framework for the development of specific targets can legitimately be modelled on the *Marine Spatial Planning* (MSP) approach but needs to be applied to development scenarios at the global level. According to the UNESCO's Intergovernmental Oceanographic Commission (IOC), MSP seems suitable for achieving scientifically-based sustainable development by meeting social, economic, and ecological objectives (Douvere, 2010). MSP can be realized in an ecosystem- and area-based fashion, while allowing for integrated, adaptive, and participatory strategies (Douvere, 2010). Building on the successes of the MSP methodology, a global *Future Ocean Spatial Planning* (FOPS) process would

focus on the potentialities and risks of future ocean use and development. Such a framework would assemble all planned future requirements for the ocean and coasts and facilitate the identification both of crisis hotspots and of new potentialities. It would encourage a global perspective on the need, size, and number of protected marine areas and current and new ocean use levels and pinpoint areas in need of special regulation. FOSP will enable states to express and negotiate their ambitions and concerns in the context of regional and global developments. Furthermore, linking FOSP to MSP and *Integrated Coastal Management*⁴ (ICM) would facilitate the incorporation of the transitional nature and interdependencies of coastal and marine systems on the national and regional scale. FOPS would inform MSP and ICM by providing longer-term perspectives and common goals, thus providing useful policy arenas to identify, frame, and resolve current and future spatial conflicts and conflicting interests in the pursuit of transparent and effective ocean governance and coastal resilience.

4 Conclusion and Outlook

Developing and agreeing on an *SDG Ocean and Coasts* is essential for securing blue wealth by promoting a robust, healthy, and productive marine environment and encouraging the development of sustainable and resilient coastal communities. A specific *SDG Ocean and Coasts* is in fact a crucial component in the bid to accomplish the Millennium Development Goals 1 (Eradicate extreme poverty and hunger), 7 (Ensure environmental sustainability), and 8 (Develop a global partnership for development). Given all the pressures exerted on the ocean and the many indispensable services it provides for the Earth system and humankind, there is an urgent need to make progress in coming to terms with specific rules, targets, and indicators. Last but not least, ocean sustainability is a global task.

The establishment of an *SDG Ocean and Coasts*, although legally non-binding, would be crucial in giving a new impetus to the international cooperation and negotiations required to protect the marine environment and use marine resources in such a way as to meet the needs of future generations. To be effective, an *SDG Ocean and Coasts* must be specific with respect to targets and instruments. Potential examples of specific targets are: i) establishing protected marine areas covering 10-30 percent of the ocean by 2025, ii) reducing marine pollution, iii) harmonizing local and regional MSP and ICM by 2020, and iv) developing adequate ocean governance, or, more ambitiously, to establish a "World Ocean Public Trust"⁵ by 2030. The process of setting specific targets is an essential aspect of any SDG and needs to be accomplished via consultation between states, scientific and technical advisory bodies, and civil society. In this way, an effective set of targets could be developed in the broader context of a *Future Ocean Spatial Planning* (FOSP) approach to the evaluation of future development options in pursuit of the global goal of sustaining blue wealth.

⁴ Integrated coastal (zone) management (ICM/ICZM) aims to foster sustainable coastal development by integrating planning, decision-making, and concrete action in the coastal zone in a holistic way. The objective of ICM is to avoid one-dimensional or overly sectorial approaches and to facilitate participative management and consensus-building (cp. Sterr & Colijn 1999, Glavovic 2006, Bruns 2010).

⁵ As early as 2002, Michael Orbach (Nicholas School of the Environment at Duke University) called for an urgent reappraisal of the freedom of high seas fishing, a call that has since been confirmed and supported by a growing number of ocean conservation and marine biology experts. In essence, Orbach espouses a new ocean ethic, a "World Ocean Public Trust" by virtue of which large sections of the high seas should be "enclosed" for the purpose of protecting the marine life therein through the adoption of public trust doctrines such as those applied to the protection of terrestrial wildlife.

One essential instrument would be the derivation of a suitable set of oceanic and coastal indicators to monitor status, progress, and future development. To properly account for the high degree of complexity in the human-ocean system with its various forms of interaction and feedback, the specific targets and the indicator set should be supplemented with *safe minimum standards* to keep ocean and coastal development within a *safe operating space*.

The implementation of an *SDG Ocean and Coasts* would encourage the development of new binding instruments of international law, the modification of existing ones, and the monitoring of the implementation of, and compliance with, current and future international commitments for all maritime zones, explicitly including the high seas. From the perspective of environmental sustainability, governance of the high seas suffers from international legal regulation shortcomings caused by certain basic legal principles like the freedom of the high seas and the focus on flag-state jurisdiction. An *SDG Ocean and Coasts* could trigger greater international cooperation towards an agreed framework for improved compliance and management practices that can be implemented at the national level.

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