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comment

Making sure the blue economy is green

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Given the growing and seemingly limitless capacity to industrialize the oceans, there is a need to reimagine how to effectively measure, monitor and sustainably manage this seventy-one per cent of the Earth's surface.

We are now at an inflection point in history, where we no longer look to the ocean solely for protein and waterways, but also as a source for many more aspects of our increasingly industrialized society[1–3]. While much of our focus has been terrestrially based where impacts are easier to identify, greater attention is needed to the industrialization of our oceans, which have long been considered as a source of inexhaustible resources and reservoirs for unwanted terrestrially generated waste. We are increasingly using the oceans in all of the ways we have historically used the land. With the extension to constructing built environments, as evidenced by the creation of islands for human habitation, our capacity to industrialize the oceans seems limitless.

By 2030, provision of protein for a rapidly growing population will result in two out of three fish on our plates probably farmed at sea; by 2050, seaborne trade will have quadrupled, and marine mining is likely to move from the continental shelf to the deep sea[4,5]. In 1980 offshore oil and gas production provided 20% of consumption needs. By 2014 it had risen to 30% and is expected to grow further as most of the new discoveries globally are primarily offshore, in waters three kilometres deep. Compare this with one kilometre just 20 years ago[6].

As our capacity to industrialize the ocean grows, our capacity to govern ocean use is becoming stretched (Fig. 1). Increased industrialization challenges the traditional paradigm of jurisdictional control of waters and seabed features within national exclusive economic zones (EEZs) 200 nautical miles from the coast and limited controls in international waters known as areas beyond national jurisdiction (ABNJs). This strain is currently becoming apparent in three different spheres: (1) nations' capacity to govern the waters within their EEZs; (2) the international community's capacity to regulate international waters; and (3) the ability of industrial and financial institutions to reach consensus on forms of self-governance.

Sustainable ocean industrialization requires the applicable and appropriate human institutions updated and, possibly, reimagined so that we can effectively measure, monitor and manage the oceans as complex adaptive systems[7]. One governance approach that has emerged since the Earth Summit's twentieth anniversary is the 'blue economy', which is increasingly being used to discuss and reimagine the institutional frameworks governing growing ocean use — based on concept of the 'green economy' on land[8]. While the term blue economy is broadly defined and used in a range of different contexts, we refer to the imperative for a sustainable ocean economy, where economic activity is in balance with the long-term carrying capacity of ocean ecosystems[9]. If a blue economy is to emerge, where economic and ecological considerations are much more closely intertwined, we suggest the following policy recommendations for key stakeholders, falling into three key areas: governance, finance and industry and the supply chain.

Governance

In the oceans, humans are now carrying out all of the activities we traditionally associate with terrestrial industrial uses and processes (Table 1). This means that whereas the latter part of the twentieth century was characterized by efforts to make terrestrial development more sustainable, the early part of the twenty-first century is likely to give rise to governmental policies that address the industrialization of the oceans.

One response is for states to attempt to expand territorial claims through the extension of EEZ boundaries (for example, the South China Sea) or through extended continental shelf claims (for example, the Arctic and elsewhere). A second response is the development of a new and legally binding implementation agreement for the sustainable management of ocean biodiversity under the Law of the Sea (UNCLOS). In 2015 the UN General

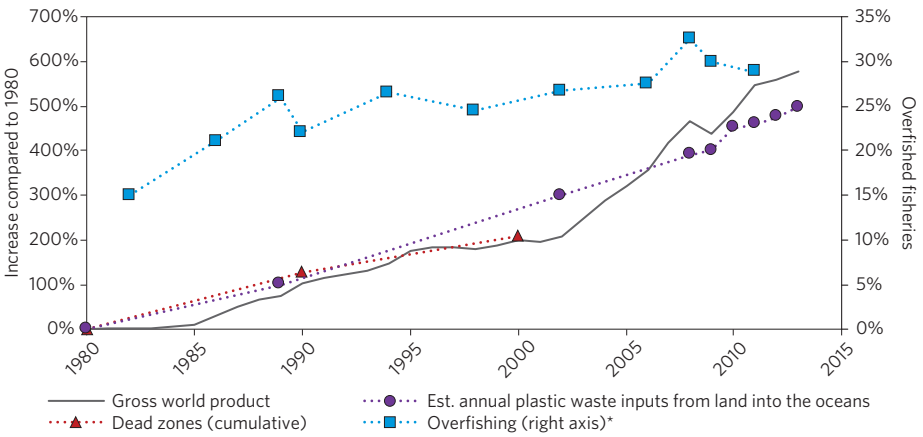

Figure 1 | Can they decouple? Trends in gross world product, overfishing and ocean pollution. *Percentage of assessed fish stocks that are fished at biologically unsustainable levels according to FAO[16,23].

Table 1 | Components of the ocean economy.

Type of activity	Ocean service including R&D	Economic sector or industry	Indicative annual gross revenues (US$ bn)
Harvesting of living resources	Seafood	Fisheries and aquaculture	154
	Marine biotechnology	Pharmaceuticals, chemicals, etc.	3
Extraction of non-living resources, generation of new resources	Minerals, sand and gravel	Seabed mining	1,000
	Energy	Oil and gas	
		Renewables	12
	Freshwater	Desalination	N/A
Construction of the built environment excluding ports		Airports, defence structures (South China Sea), cities (Palm Island), bridges	Undisclosed
Commerce, tourism and trade	Transport and trade	Shipping	400 in 2011
		Port infrastructure and services	54 in 2011
	Tourism and recreation	Tourism	996
		Coastal development	N/A
Ocean observation and forecasting	Instrumentation and personnel	Electronics, research	7
Indirect contribution to economic activities and environments	Carbon sequestration	Blue carbon (that is, coastal vegetated habitats)	Market still in development
	Coastal protection	Habitat protection, restoration	Market does not exist
	Waste disposal for land-based industry	Assimilation of nutrients, solid waste	Market does not exist
	Existence of biodiversity	Protection of species, habitats	Market does not exist
Total			2,626

Table adapted from refs [3,8,16–22].

Assembly approved the preparation of a new agreement to cover a number of aspects concerning the future of sustainable oceans management, access and benefits sharing, and processes for managing ocean areas beyond national jurisdictions, to be ready for review by the end of 2017. Also, for the first time an international process under the Convention on Biological Diversity has been actively identifying ecologically or biologically significant areas (EBSAs) in ABNJs[10], which is an important step.

At both the national level for ocean spaces under countries' jurisdictions and in ABNJs, governance could be strengthened to keep pace with industrialization and transition to a blue economy through harnessing new technologies to increase data on ocean activities. Shipping vessel tracking systems such as automatic identification systems and vessel monitoring systems data, fisheries fleet monitoring data, new remote sensing technologies, unmanned aircraft systems, and citizen science data are emerging at an accelerating rate and are rapidly changing our capabilities to monitor ocean use. These technological innovations promise to yield new data to monitor even the most distant areas of the global oceans which will streamline management and efficiency of ocean activities, and develop more integrated regulations for shared ocean spaces. Additionally, area-based management tools such as marine spatial planning processes and large marine protected areas need to be implemented within the EEZs of numerous countries.

Going forward, we believe that given the recent elevation of ocean issues within the UN and its established framework UNCLOS will remain the most logical institution with the highest likelihood of success to integrate ocean industrialization with other ocean priorities to meet established global Sustainable Development Goals (for example SDG 14). That said, the capacity of national government agencies to utilize the UNCLOS and exercise control over the use of the ocean under their jurisdiction, including multiple and overlapping uses of the same three-dimensional space, will need to be strengthened in much of the world in order to keep up with industrialization.

Finance

After more than three years of effort, the OECD recently released its long awaited report on the ocean economy[3]. The report supports the notion that our oceans will serve as the new 'economic frontier'. With an estimated US$1.5 trillion or 2.5% of global gross value added in 2010, the ocean economy is expected to more than double to over US$3 trillion by 2030, likely outperforming the pace of growth of the overall global economy between now and then[3]. Capital will play a significant role in ocean industrialization, from both the public and private sectors, and could also help drive a transition to the blue economy.

One such example of the flow of capital is the World Bank which recently valued its portfolio of public sector investments in sustainable ocean use and conservation at some US$6.4 billion[11]. While public finance will be critical for the introduction of sustainable policies, private capital will help finance much of the industrialization and must play an active role.

In 2002 the International Finance Corporation (IFC) convened a group of commercial banks to discuss the importance of environmental and social issues in project finance, and in the following year ten leading banks from seven countries agreed to use IFC's environmental safeguard policies as the basis for a voluntary risk-management known as the Equator Principles[12]. Now over 70 per cent of international project finance debt in emerging markets is provided by 83 banks and organizations that have committed to follow the Equator Principles for incorporating environmental and social considerations into finance. This process has helped spur the development of more specific practices in the financial sector and banking industry, such as the Carbon Principles, and could be the basis for a set of 'Ocean Principles' to be developed for the blue economy. Such principles could help guide the significant financial flows to the growing ocean economy as it doubles from 2010 to 2030.

Industry and the supply chain

Efforts by industry to reduce the environmental impacts from the manufacturing and use of products has reached new heights as witnessed by the rapid increase in corporate sustainability reports, certifications, eco-labels as well as industry consortia[13]. While industry's efforts to reduce the environmental footprint for the goods and services it provides are commendable, there exists the very real risk of replicating unintended environmental consequences as we have witnessed on land. To overcome this challenge, in addition to government policies, private sector governance structures must be put in place to address the emergence of harvesting energy, mineral and biological resources from the oceans. This includes investments by industry to develop and make publicly available essential environmental data and life cycle assessment models[14] that examine environmental impacts and trade-offs. These include exploration activities such as noise impacts[15] as well as the environmental implications of feedstock selections sourced from the oceans which are used in the manufacturing of goods, as well as enhanced traceability of ocean products such as wild-caught fish.

Additionally, public–private partnerships will need to be enhanced as industry expands the industrialization of oceans. We recommend improved data collection for fisheries (FAO, regional RFMOs), seabed mining (ISA), shipping and transportation (IMO), and oceanographic data (IOC). These data can be integrated with existing open access data sites such as the Ocean Biodiversity Information System (OBIS), remote sensing data by the GEOBON (Marine WG5), the emerging Marine Biodiversity Monitoring Network (MBON), and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). By leveraging the power of global brands and manufacturers there can be greater open access to ocean-use data and new methods for balancing access and liberating historically proprietary information, as we have seen with land-based life cycle assessment data combined from companies engaged in specific sectors of the economy such as clothing, dairy and mining.

Finally, the oceans are truly an international resource and, as such, require international cooperation and support, such as we have seen with Intergovernmental Panel on Climate Change (IPCC) and the Large Hadron Collider. A similar public–private partnership focused on the oceans could be established under UNCLOS. This step would be consistent with the recently published UN World Ocean Assessment, which was borne out of a recommendation adopted by UN General Assembly to improve understanding of the oceans and to develop a global mechanism for delivering science-based information to decision-makers and public.

In summary, making sure the blue economy is green requires avoidance of the mistakes made in managing terrestrial based resources. We need to reimagine the oceans as a shared space and resource capable of providing social, environmental and economic good but only if transparency, coordination, and commitment to balancing competing goals are at the core of public policy and governance, finance and the management of global supply chains. ❐

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