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Andrew D. L. Steven, Mathew A. Vanderklift & Narnia Bohler-Muller

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EDITORIAL

A new narrative for the Blue Economy and Blue Carbon

The terms *Blue Economy* and *Blue Carbon* are, it seems, popping up everywhere, but what do they mean, and are they linked? They are usually considered separately in discussions about policy and action, which has resulted in confusion about the relationship between the two concepts. Here we clarify the terminology and intent of both Blue Economy and Blue Carbon and present a narrative to propose that Blue Carbon should be considered an intrinsic part of the Blue Economy, a theme that will carry through this special issue of the *Journal of Indian Ocean Research*.

What is the Blue Economy?

Human use of the ocean, especially in the context of the economic benefit we derive from it, has been recently reframed under the term *Blue Economy*. There is strong interest in sustaining and expanding a Blue Economy in the Indian Ocean, driven in particular by the Indian Ocean Rim Association (IORA) and individual countries, as previously highlighted in the JIOR special issue on the Blue Economy (Volume 14, Issue 1) and the recently released Blue Economy Handbook of the Indian Ocean Rim (Attri & Bohler-Muller, 2018).

A Blue Economy embraces economic, social and environmental benefits, and as such is also considered an alternative development paradigm (Attri & Bohler-Muller, 2018). These triple pillars reflect the Sustainable Development Goals (SDGs), which is now the primary instrument that frames the international policy context. The unique importance of the ocean, and the challenges it faces, is reflected in SDG14 'Conserve and sustainably use the oceans, seas and marine resources for sustainable development,' and the seven targets that underpin it.

However, the concept of the Blue Economy remains fluid and opaque (Voyer, Quirk, & McIlgorm Azmi, 2018) and there are differences both in terminology (for example the terms Blue Growth, Ocean Enterprise, and Sustainable Ocean Economy are often used to refer to the same or similar concepts) and definition – shades of blue – that are used by nations and organizations that reflect whether they view the Blue Economy primarily as good business, natural capital, to sustain livelihoods or to drive innovation (Voyer, Schofield, et al., 2018).

Irrespective, one aspect that these terms have in common is that all attempt to integrate the need for marine-based economic development that leads to improved human well-being and social equity, while simultaneously reducing environmental risks and ecological scarcities. We use the term Blue Economy. Although the World Bank (2017) acknowledges the various different aspects of the Blue Economy, it settles on the following definition:

> Although the term "blue economy" has been used in different ways, it is understood here as comprising the range of economic sectors and related policies that together determine whether the use of oceanic resources is sustainable. An important challenge of the blue economy is thus to understand and better manage the many aspects of oceanic sustainability, ranging from sustainable fisheries to ecosystem health to pollution.

Reflecting this international policy context, the Blue Economy encompasses activities that explore, develop and use the ocean's resources, that use the ocean's space and that protect the ocean's ecosystems. It incorporates traditional maritime industries (such as fisheries, coastal tourism, energy and mineral production, boat building, shipping and ports) as well as new and developing industries such as blue carbon (the carbon stored in mangrove, seagrass and saltmarsh ecosystems, which we will return to), new aquaculture products, marine renewable energy (which in turn includes wind, wave and tidal energy), bio-products (pharmaceutical and agrichemicals), desalination and more.

Globally, the figures for the Blue Economy (BE) are impressive and are supported by a number of recent reports for Australia (2016), Europe, the U.S.A. (2016), China, Africa (2016) and small island developing states (SIDs) (Roberts & Ali, 2016). The OECD reports (2016) that the Blue Economy is currently conservatively valued at USD $1.5 trillion (2.5% of world gross value added) and employs 31 million people. By 2030 this is projected to increase to USD $3 trillion, with the growth primarily driven by aquaculture (8.5% per annum currently), offshore wind, fish processing, and shipbuilding and repair. The blue economy is particularly important for the future of island nations.

The Indian Ocean Rim Association has established a Blue Economy Working Group, led by South Africa, that will focus on the priority areas identified by the Member States. These priority areas include fisheries and aquaculture; renewable ocean energy; seaports and shipping; offshore hydrocarbons and minerals; biotechnology, research and development; and tourism. These areas lean towards job creation and economic growth. For instance, Findlay and Bohler-Muller (2018) (in Attri & Bohler-Muller, 2018) emphasize the potential of South Africa's Operation Phakisa (OP) to ensure economic and social gains by exploiting the ocean. This Initiative began in 2014 inspired by Malaysia's Big Fast Results Methodology. OP aims to increase South Africa's ocean economy contribution from 54 billion ZAR to 177 billion ZAR; and aims to create between 800 000 to 1 million jobs by 2033. However, they also emphasize that this 'blue growth' should be tempered by the fact that there are 'limits to growth.'

> If the present growth trend in the world population, industrialization, pollution, food production and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable declining in both population and industrial capacity. (Meadows, Meadows, Randers, & Behrens III, 1972, p. 23)

The above statement made 47 years ago has been widely debated, and is inconsistent with the trajectory of history. Whilst not going into the merits and demerits of limits to growth, we may hypothesize that the Blue Economy has emerged as an alternative model of development to ensure inclusive growth and prosperity in the world. It is for this reason that there has been an increased focus on the environment, pollution, climate change and its mitigation.

Thus, growth presents many challenges, not least of which is juggling the many, potentially competing, uses of the ocean while simultaneously lifting people out of poverty and protecting the environment that supports such riches. Economic growth comes with a set of attendant environmental and social challenges that need to be solved, so science, technology and innovation will be essential to developing a socially equitable and sustainable Blue Economy. If we do it well, we can address many of the issues that threaten the coast and ocean (Halpern et al., 2012).

As nations pursue different approaches to realizing their own blue economies, science and technology plays a central role in the innovation of these industries, and also in providing the tools to ensure that the other pillars of the blue economy – improved human well-being and social equity, reducing environmental risks and ecological scarcities – are met.

Marine Spatial Planning (MSP) and Ecosystem Based Management (EBM) are now recognized internationally as the primary tools for effective protection and sustainable development of coastal and ocean resources – even to the deepest reaches of the ocean Danovaro et al., 2017, pp. 452–454). These require data. Access to data, and the information that we extract from it, will be essential for decision-makers of all kinds to take advantage of these tools — resource managers, environmental experts, potential investors and more. In many cases such data is lacking; in others the data exist but platforms for integrating the data and making it available do not.

Demand for data – the digital ocean — to support the blue economy is already harnessing key technologies of the fourth industrial revolution (such as artificial intelligence and automation; advanced materials and manufacturing; sensors, platforms and vehicles; bio-technologies) to solve problems such as how to fish sustainably, prevent catchment and ship-based pollution, protect habitats and species and build resilience to climate change (World Economic Forum, 2017). However, many issues remain (IOC/ UNESCO, 2017) and the forthcoming UN Decade of the Ocean (Visbeck, 2018) provides further motivation for science, technology and innovation to develop breakthrough technologies and better inform the development and implementation of policies relating to coastal and ocean development and use.

Blue Carbon as a part of the Blue Economy

Blue Carbon is organic carbon that has been captured and sequestered by coastal marine plants, which include seagrasses, mangroves and tidal marshes (Nellemann et al., 2009, Vanderklift, Gorman, & Steven, 2019). These habitats can be highly productive and support remarkably high carbon burial rates. This buried carbon — Blue Carbon — can be much greater than terrestrial ecosystems, and if undisturbed is sequestered for much longer. In Blue Carbon habitats, a large proportion of the carbon is stored below ground, typically in low-oxygen sediment where decomposition is extremely slow. These low decomposition rates, combined with high growth rates, allow these habitats to build up large, persistent carbon stocks. This below-ground biomass is what generates such disproportionate value in a carbon accounting context.

Blue carbon habitats are being lost at rates that rank them among the most threatened habitats on Earth. Yet, there is hope. Efforts towards restoring and protected these threatened habitats are gaining momentum, and they offer economic, social and environmental payoffs for coastal communities — the same triple pillars that support the Blue Economy. The payoff includes increased in carbon sequestration (and the wide benefits that offers), but also the opportunity to change from perverse practices that degrade ecosystems, and ultimately the societies that depend on them.

Activities that restore and protect Blue Carbon also offer the potential for developing market-based mechanisms that take advantage of existing frameworks for carbon offsets (also called carbon credits). European estimates of coastal blue carbon (seagrass, mangroves, saltmarsh) have an accounting stock value of about US $180 million (Luisetti, Jackson, & Turner, 2013). The development of robust and rigorous non-market estimates will be further hastened with a deeper understanding of carbon stocks and flows. Such financial incentives for Blue Carbon might also offer a way to protect and capitalize on the other ecosystem services provided by these habitats, such as fisheries. Doing so will reap rewards beyond the immediate benefits of carbon sequestration. For example, the value of ecosystem services provided by mangroves and tidal marshes is hundreds of thousands of dollars per hectare.

In Australia, the CSIRO Blue Carbon collaboration cluster has produced arguably the most comprehensive estimates of blue carbon sequestration. This body of work has been used to inform policy development for national reporting and emissions. The International Partnership for Blue Carbon, the Blue Carbon Initiative and the Blueprint for Ocean and Coastal Sustainability are international programs that promote protection and restoration of Blue Carbon habitats. These programs call for the development of global blue carbon markets (Vanderklift et al., 2019). Quantifying coastal carbon stocks found in mangroves, saltmarsh and seagrass is a vital step toward establishing this market, but there remain several obstacles. For example, the transient nature of some seagrass meadows (some of which fluctuate seasonally and spatially), poses particular challenges for understanding the extent and permanence of carbon stocks. Accordingly, understanding boundaries and carbon fluxes for each blue carbon habitat are crucial factors required for both policy and market development.

There are several lenses to look at Blue Carbon:

(1) As a mechanism to move to low carbon economies, through
   (a) national carbon inventories, in which Blue Carbon is an emerging component that can assist countries to meet their National Determined Contributions,
   (b) market-based mechanisms that allow industries to offset carbon emissions as a way to achieve carbon neutrality;
(2) As a mechanism to create economic value through
   (a) formulation of carbon as a commodity that can be bought and sold,
   (b) creation of wider set of livelihood options, particularly in developing countries;
(3) As a component of a broader set of ecosystem services that are provided by vegetated coastal ecosystems, which has value that might or might not be transformed into units of currency.

We argue that Blue Carbon meets all of three of the essential elements of sustainability – economic, environmental and social – and should thus be framed as an essential component of the Blue Economy. Together with the renewable energy sector and carbon capture and storage industries, Blue Carbon is emerging as an industry in its own right that is assisting the global move to progress towards 'low carbon' economies whilst creating economic and livelihood opportunity and options, most fundamentally for developing countries, but also for developed countries or established industries.

This special issue of the Journal of Indian Ocean Research contains six papers that investigate different aspects of blue carbon, from livelihoods to carbon sequestration. Vanderklift et al. (2019) provide an overview of blue carbon in the Indian Ocean, presenting maps and estimates of the area of the two main blue carbon ecosystems — mangroves and seagrasses. They highlight some of the global agreements that establish the framework for actions that nations can take, such as the Sustainable Development Goals, the Paris Agreement and the Sendai Framework for Disaster Risk Reduction. Enhanced protection and restoration of blue carbon ecosystems can help implement each of these. Some are reasonably well understood — for example the IPCC Wetlands Supplement outlines how nations can incorporate blue carbon ecosystems into their national greenhouse gas inventories, providing a policy impetus that can stimulate action. Other urgently need better knowledge, for example the contribution of coastal ecosystems to sustainable livelihoods can help reduce poverty and enhance food security, meeting two fundamental SDGs — this is perhaps nowhere more critical than the Indian Ocean, where a high proportion of people still live in poverty (ourworldindata.org).

The contribution to livelihoods is investigated by Musembi, Fulanda, Kairo, and Githaiga (2019), who report that a very diverse range of fishes are captured by fishers from mangroves and seagrass in Gazi Bay, Kenya, although a relatively small number (eight species) comprise most of the catch. Fisheries were small in scale and used multiple gear types, including basket traps, hook and stick, handlines, nets and spearguns. Blue carbon ecosystems contributed substantially to catches of fishers, and so to the livelihoods of the people of Gazi Bay.

Given their contribution to climate mitigation and livelihoods, degradation and destruction of blue carbon ecosystems can generate impacts that ramify at several levels. Mungai et al.

(2019) examine the changes in mangrove abundance in Kenya and Tanzania. Using data generated by satellite-borne sensors, they measured change over a 30-year period in a large proposed transboundary conservation area. They found a 20.7% decrease in mangrove area over this period, with an average rate of loss of 104 ha (0.69%) per year.

One of the main causes of loss of mangroves is clearing for shrimp ponds, which have a relatively short productive life. It is therefore of particular interest to know whether abandoned shrimp ponds can be restored. Sidik, Fernanda Adame, and Lovelock (2019) examined the restoration of shrimp ponds in Bali, Indonesia. They measured a range of parameters in mangroves that had been restored 8–10 years previously through planting and tidal restoration. Restored mangroves had similar rates of carbon sequestration into living biomass and soil of restored and natural mangroves, a result that provides encouragement for mangrove restoration efforts.

Effective restoration and protection needs good governance. Moraes (2019) reviews policy mechanisms including marine protected areas and other types of conservation measure. Such mechanisms will be important tools, but clearly understanding how each contributes, and how they can complement each other in an international arena where government-sponsored actions and carbon market financed activities both have a role will be critical. Contreras and Thomas (2019) review a range of governance types, including market-based instruments, public investment, partnership initiatives, and community-centred management. One key outcome of their review is the importance to outcomes of ensuring that local communities have a central role in governance, whatever model is used.

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Andrew D. L. Steven
CSIRO Oceans & Atmosphere, Queensland Biosciences Precinct, St Lucia, Australia

Mathew A. Vanderklift
CSIRO Oceans & Atmosphere, Indian Ocean Marine Research Centre, Crawley, Australia
mat.vanderklift@csiro.au

Narnia Bohler-Muller
Human Sciences Research Council, Democracy, Governance and Service Delivery, Pretoria, South Africa

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