The Blue Economy in the Indian Ocean – A Literature Review

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Introduction

Oceans cover roughly two-thirds of our Earth's surface, and contribute to poverty reduction by creating sustainable livelihoods and jobs, food, generating oxygen, absorbing greenhouse gases and mitigating the impacts of climate change, determining weather patterns, and providing international trade routes (World Bank, 2017). With an estimated 80% of the volume of world trade carried by sea, international shipping and ports provide crucial linkages in global supply chains and are essential for the ability of all countries to gain access to global markets (UNCTAD, 2014). The European Commission estimates that the Blue Economy globally represents over 5 million jobs and contributes €500 Billion per year – a figure which is roughly equivalent to 4% of the EUs total economic output – to global Gross Domestic Product (GDP).

The Blue Economy (BE) concept has come to particular prominence for coastal Indian Ocean (IO) countries, as well as Small Island Developing States (SIDS) in the region such as Seychelles and Mauritius. It has gained traction in recent years, primarily due to the recognition of the vital role the Indian Ocean plays in the region's economic growth; increased globalization and interconnection of nations will only increase the future prominence of Blue Economy industries. While there is significant interest in better understanding the Blue Economy and opportunities for growth, to date there is no comprehensive review of academic literature focused specifically on Indian Ocean Blue Economy activity. This paper aims to address this gap by reviewing the comprehensive body of literature available in this area.

History of the term 'Blue Economy'

The term 'Blue Economy' is not wholly new; origins of this concept can be traced back to the 90's. The term 'Green Economy' had become frequently used before the coining of Blue Economy, and referred to economic growth that did not contribute to environmental degradation of land, air, or sea (Brand, 2012). Pauli (2010) was one of the first to use to use the term Blue Economy, although not specifically in relation to a global ocean-based sustainable development agenda. The term gained further prominence after the 2012 United

Nations Conference on Sustainable Development (Rio+20). While this conference covered all aspects of sustainable development, island states at this conference identified a need for a specific focus on ocean-based development, as this was deemed most relevant to their future growth and actions (Sakhuja, 2015).

Subsequently, the resolution from this conference stated: 'oceans, seas and coastal areas form an integrated and essential component of the Earth's ecosystem and are critical to sustaining it…' (United Nations General Assembly, 2012). Further, this conference recognized that oceans significantly affect many nations, and that international cooperation is crucial for Blue Economy goals (Silver et al., 2015). Currently, the focus on Blue Economy concepts is prioritized by many nations, and has received focus for all oceans and bodies of water worldwide (Silver et al., 2015). Within the Indian Ocean, groups such as the Indian Ocean Rim Association (IORA) aim to facilitate international cooperation and multinational action to improve capabilities in the region (Sakhuja, 2015). The African Union and the UN Economic Commission for Africa have also prioritized the Blue Economy, and have created policies aimed at promoting cooperation between Eastern African nations and their BE activity in the Western Indian Ocean (United Nations Economic Commission for Africa, 2016).

Elements of the Blue Economy and current development efforts

There is no single definition or consensus for the term Blue Economy, or the economic sectors that it entails (Park and Kildow, 2014). However, a comprehensive analysis of academic literature identifies many common sectors and industries, which are listed below:

- Fisheries and aquaculture
- Marine resource extraction (oil and gas, minerals)
- Shipping and transportation of goods
- Ocean-dependent leisure and tourism
- Conservation of biodiversity
- Government actions (both national and multinational) to manage these economic sectors.

Many IO nations do not prioritize all of these industries equally, and will emphasize certain ones based on a variety of factors, including development goals, prominent domestic industries, and unique multinational partnerships (Llewellyn, English, and Barnwell, 2016). Further, recent discussions about the BE place significant emphasis on sustainability, and ensuring that all economic activity uses ocean resources in a way that prevents long-term negative environmental or economic consequences (Llewellyn, English, and Barnwell, 2016). BE industries are highly interconnected and activity in one industry can have a lasting effect on others (for example, hydrocarbon extraction can affect fish stocks and

fishery production) (OECD, 2016). Therefore, this focus on sustainability is especially important for a diversified, multi-sector ocean economy.

Ocean-Dependent Leisure and Tourism

Coastal and ocean-dependent tourism is an important industry for many IO countries. In 2016, global arrivals to Indian Ocean nations reached 1.2 billion, a figure which is projected to rise to 1.4 Billion by 2030. Further, tourism is worth more than US$1 Billion in GDP per year for over a dozen IORA countries. In many IO SIDS, it is a major contributor to economic development, and in countries like Seychelles and Mauritius represents >10% of the country's total GDP (Rogerson, Benkenstein, and Mwongera, 2018). Further, it is often the only industry in these countries to demonstrate consistent growth in recent years (Scheyvens and Momsen, 2008).

The IORA Action Plan (2017 – 2021) identified tourism, and specifically cultural exchanges within the Indian Ocean region, as a strategic priority (IORA, 2017a; IORA 2017b). The region is rich in culture, heritage and tradition, and thus perfectly positioned to supply tourism-related products that are in demand by the current tourist population (Van Wyk, 2008). However, small island nations of IORA are facing many challenges, including threats such as terrorism, piracy, climate change and health-related outbreaks that limit the success of a national or inter-governmental association (Manning, 2016).

Small island tourism economy (SITE) in the Indian Ocean

Tourism is often a vital element in the economic development of small island states in the Indian Ocean (Ghosh and Siddique, 2017). For many SITEs, tourism is also the main engine of growth (Manning, 2016). Also, the number of tourists on the island can greatly outnumber residents during peak tourist season (Manning, 2016). In addition to the direct employment generated in the industry through SITEs, tourism expenditure adds additional employment due to the flow of tourist spending throughout the economy (Gabbay and Ghosh, 2017). Often, tourism is the most important source of foreign exchange for SITEs (Manning, 2016). For example, it provides more than 70% of foreign currency earnings in Seychelles (Shareef and McAleer, 2006).

Despite their many similarities, Indian Ocean islands are not interchangeable. Development of a SITE can be significantly influenced by conscious government effort (or, alternatively, government inaction), which can in turn have a significant effect on the type of industry created (Gabbay and Ghosh, 2017). In their assessment of tourism demand and uncertainty models between the Maldives and Seychelles, Shareef and McAleer (2006) note the

significant differences in the types of tourism products on offer in these SITEs, despite their similar geography, climate and environment.

Further, SITEs are especially vulnerable to exogenous shocks that are outside their control, and several instances in recent decades have highlighted this vulnerability. Sharp drops in IO tourism were experienced due to the Gulf War, 9/11, SARS, piracy and the 2004 tsunami (Shareef and McAleer, 2006). These shocks had an impact beyond the tourism industry as well, and had serious ramifications for every sector within SIDS (Shareef and McAleer, 2006).

Tourism and climate change – vulnerability and responses

The tourism industry, particularly nature-based tourism, is seen as especially sensitive to the effects of climate change. Many IO nations have expressed concern that climate change would drastically affect not only their tourism industries, but also have a domino effect on the wider economy by damaging resources and infrastructure that is critical to their people, economy and development (Payet, 2013). In particular, SIDS are among the most vulnerable tourist destinations as they contain the most tourist infrastructure in susceptible zones (Manning, 2016). The United Nations warned that rising sea levels affecting the world's 52 small island states – including many in the Indian Ocean – will be as much as four times higher than the rest of the world (Amla, 2014a).

Additionally, unsustainable tourism growth can contribute to the depletion of essential freshwater resources (Zolfani et al., 2015). Many small island nations have experienced a rapid growth in their tourism industry, which has put additional pressure on their freshwater supplies. The consequences of overexploitation can include the lowering of the groundwater table, land subsidence, deteriorating groundwater quality, and saltwater intrusion (Gössling, 2001; Gössling et al., 2012). Water scarcity is already being felt in many Indian Ocean tourist destinations. For example, despite recording an average 2,300 millimetres of rain annually, Seychelles experiences persistent water shortages and nation-wide rationing (Fardial and Bonnelame, 2015). The Maldives is also described as being in a permanent water crisis, with annual water-related emergencies declared during the dry season (Hamid, 2015).

Management of waste on SIDS requires special attention because of their small size and isolation. SIDS often lack waste disposal sites owing to the natural limitations of the island, insufficient capacity, suboptimal locations, or unskilled management (Gonçalves and Kapmeier, 2018). For example, the Maldives' government started ferrying waste to the Thilafushi Island lagoon in the 1970s, converting a whole island into a waste dump (Gonçalves, and Kapmeier, 2018). Such initiatives have clear expiry dates in the near future,

and Gonçalves and Kapmeier (2018) argue that SIDS could instead opt to become zero-waste environments, where waste is treated as a resource that is composted, incinerated to create energy, repurposed, or sorted for export. Such integrated solid waste management plans might provide long-term economic benefits, reduce landfill management and pollution mitigation costs, while adding revenue through waste-disposal fees (Gonçalves and Kapmeier, 2018).

Ecosystem regulation

Most IO developing countries have not adequately planned for the rapid growth of their tourism industry, and consequently have suffered from degradation and depletion of essential natural resources (Zolfani et al., 2015). Managing ecosystems important to ocean-based tourism tends to encounter many challenges, including difficulties in establishing a profitable and ecologically sustainable industry, while simultaneously achieving a satisfying experience for visitors and increasing standards of living in the tourist destination (Zolfani et al., 2015).

IORA member states vary in terms of their approach to governance of the tourism ecosystem, largely due to the variances in their political systems and levels of development (Van Wyk, 2008). In many IORA countries, governments play a heavy role in dictating and implementing national tourism policies, budgets and regulations. These countries primarily focus on four main policy priorities: the development of high-quality tourism experiences; domestic tourism; minimizing bureaucracy; and collaborating with the national tourism industry to produce the required infrastructure (Van Wyk, 2008).

Customer trends in IO tourism

Several emerging customer (i.e. those who visit IO nations as tourists) trends will affect the IO BE tourism in the future. Technology and social media are playing greater roles in the travel choices of consumers, and social media has eased the planning process for many, including the communicating and post-trip experience (Bricker, n.d.). Experiences and learning are also increasingly popular with travellers, and consumers are demanding more individual and authentic travel experiences. Bricker (n.d.) concludes that human powered activities will remain a growing trend. Finally, the extended life span of humans has led to the growth of elderly travellers, which will increase demand for sufficient facilities that cater to the elderly and disabled (Bricker, n.d.).

Ecotourism

Ecotourism refers to tourists travelling to a location because of the recreational value derived from having contact with some aspect of the natural world (Steele, 1995, p29).

Picard (2007) also outlines ecotourism as a particular type of tourism activity that attempts to integrate principles of sustainable environmental management, and equitable local participation and benefit-sharing. It incorporates the guiding values elaborated by the United Nations World Tourism Organisation (UNWTO) and works towards the United Nations Sustainable Development Goals (Wetzel and Chiramba, 2018). Ecotourism also aligns with UNESCO's goals to employ tourism as a means for heritage preservation, intercultural dialogue, and sustainable development (Robinson and Picard, 2006).

Ecotourism has been hailed as a way to fund conservation research, preserve fragile ecosystems and promote development of poor countries. Honey (2008) notes that 'real' ecotourism includes minimization of environmental and cultural consequences, and contributes to conservation and environmental education. It is also viewed as a way to decrease the environmental impact of existing tourism operations (Zolfani et al., 2015). Subsequently, many IO SIDS such as Maldives and Mauritius have embraced Ecotourism as part of their economic growth strategy (United Nations Department of Economic and Social Affairs, 2010; Honey, 2008). However, while ecotourism is a rapidly growing phenomenon, its growth does not always aim for minimal environmental impact, and much of this growth is currently seen as unsustainable (Steele, 1995).

Sustainable tourism

Sustainable tourism aims to reduce the negative effects of this industry, such as pollution, deforestation, and human sex trafficking. The concept has become almost universally accepted as a desirable approach to tourism development (Zolfani et al., 2015). Countries promoting sustainable tourism seek to strike a balance between protecting the environment, maintaining cultural integrity, advocating economic benefits, and helping local populations through employment opportunities and improved living standards (Zolfani et al., 2015). It is therefore in the interests of the tourism industry to sustain the very destinations it targets (Manning, 2016).

According to the Grains Research and Development Corporation (GRDC), sustainable tourism can be defined as 'the commitment to making a low impact on the environment and local culture, while helping to generate future employment for local people'. Other advocates have argued that sustainable tourism should also include consideration of human and social factors such as reducing economic inequality or improving health and wellbeing (Butler, 1999). Zolfani et al (2015) note sustainable tourism goals are now seen as adaptable according to different contexts and changing circumstances over time. Because of these differing interpretations of what sustainable tourism entails, many consider the idea of sustainable tourism as a useful focus for dialogue, conflict and negotiation among a range of actors (Bramwell, 2017).

Sustainable tourism has increasingly been adopted by SIDS, though they face a number of specific challenges in the quest to become more sustainable. Their location, size and institutional weaknesses may act as barriers to adoption and regulation of best environmental and social practices in their tourism industry (Manning, 2016). However, there are many success stories from SIDS where international hotels and resorts have adopted methods to reduce energy and water consumption through renewable uses and awareness (Manning, 2016). SIDS are also being assisted in this task through the rise of the 'eco-friendly' and 'socially conscious' tourist.

Growth potential

In recent years, the growth of tourism in some SIDS has also helped reduce entrenched economic inequalities and contribute to national poverty reduction initiatives (Scheyvens and Momsen, 2008). It can also contribute to sustainable development, particularly through job creation, including employment for women and marginalized groups (Manning, 2016). Bakker (2013) notes the steady growth of the tourism industry in Comoros, Madagascar, Seychelles, and Mauritius, as well as the benefits this growth has generated. However, to attain these goals, a broad approach that values social and environmental factors is necessary. Government intervention in the tourism industry might also be required to ensure that sustainable, equity-enhancing tourism will emerge (Scheyvens and Momsen, 2008).

The key to effective tourism growth lies in destination planning and development. For many SIDS, the promotion of their tourism image becomes the national brand. Most SIDS are at a size and scale where it is realistic to involve all of the country's stakeholders into an integrated tourism planning process, including the private sector, civil service, and wider sectors of society (Scheyvens and Momsen, 2008; Manning, 2016). Moreover, intra-regional IO cooperation on tourism continues to remain under-developed (Van Wyk, 2008). Bakker (2013) notes that regional cooperative actions, like increasing air connectivity and creating regional tourism packages and marketing, would have a significant impact on growing IO tourism as well. The Indian Ocean Commission (2007) noted that 'the countries share often more common issues than they are aware of' (e.g. waste management, heritage management, energy use, problems with fisheries and scarce resources).

Fishing and Aquaculture

Fisheries in the Indian Ocean have been an important source of food for centuries, and can serve as the primary source of protein for many. Today, industrial fisheries extract large quantities of many different species, including tuna, mackerel, bonito, and sea cucumbers, both for domestic consumption and export to international markets (Kimani, Okemwa, and

Kazungu, 2009; Conand, 2008). Due to rising populations and incomes, it is believed that there will be an increased demand for Indian Ocean fish, encouraging industrial fishing vessels to pursue increased production (Food and Agriculture Organization, 2014).

Overfishing and responses

However, there is significant scientific data documenting that many of the world's wild fisheries are currently being exploited in an unsustainable manner, including a large percentage of those in the Indian Ocean (Food and Agriculture Organisation, 2018). This problem is aggravated by illegal, unregulated, and unreported (IUU) fishing, a problem which costs billions of dollars per year worldwide, and further draws from these fish stocks, making it harder to replenish naturally (Agnew et al., 2009). Much of this IUU fishing occurs in the high seas and other remote areas, making it difficult to monitor and address this activity (Hughes, 2011). In addition, fish stocks are not stationary, and can move between multiple EEZs, requiring international cooperation to be monitored adequately. While there have been some attempts at multinational collaboration (like the Indian Ocean Tuna Commission), limited government capabilities and competing interests can make this difficult to implement (Andriamahefazafy, Kull, and Campling, 2019).

In response to this overfishing, there have been diverse actions that attempt to make wild fisheries more sustainable. One approach has been employment of technology to better monitor fishing production (Chang, 2011). There have also been attempts to establish Marine Protected Areas (MPAs), also designated as 'no-take zones', where fishing boats cannot extract any wild stocks. These aim to counter stock depletion by allowing an area for various species to breed and grow (Maggs, Mann, and Cowley, 2013). However, despite these efforts, overfishing still remains a problem in the Indian Ocean.

Aquaculture

Another response to address overfishing has been aquaculture, or the raising of fish in captivity for food production. This has seen significant interest in recent decades, due to its potential to increase fish production without affecting wild fish stocks. Further, aquaculture can lead to regular, reliable fish production, which is not always possible with wild fisheries (Frankic and Hershner, 2003). Aquaculture can even enhance some ocean ecosystems by contributing to biodiversity, or even bolstering fish stocks through re-stocking. Aquaculture continues to grow rapidly in the Indian Ocean, and currently exists in many different countries in the region (Rönnbäck, Bryceson and Kautsky, 2002). For example, in the Western Indian Ocean, there are many documented successful aquaculture projects in African nations for various products including seaweed, shrimp, oysters, and finfish (Ateweberhan, Hudson, and Rougier, 2018). In addition to helping preserve wild fish

stocks, these aquaculture initiatives have led to other benefits including increased income, food security, and economic opportunities for women (Msuya and Hurtado, 2017).

However, aquaculture is still a relatively new industry, and there are many challenges that currently limit its growth in a sustainable manner. Aquaculture requires increased technology and worker capabilities compared to wild fishery extraction, which can limit its success in developing nations (Kobayashi et al., 2015; Brummett, Lazard, and Moehl, 2008). Further, variations in fish price can incentivize aquaculture operations to raise exotic species that are not necessarily native to the region where they are located. As a result, it can be difficult to have secure and cost-effective sources of feed for these species. Further, the potential for exotic species escaping farms and severely affecting wild ecosystems must be considered as well (Savini et al., 2010). In order for future aquaculture to grow in a sustainable manner, it must consider multiple factors beyond just fish production to ensure it does not negatively affect other Blue Economy resources (Costa-Pierce, 2008).

Resource Extraction

Oil and gas

There are significant oil reserves in the Indian Ocean, and 40% of ocean-based oil production is located in the Indian Ocean (Jaishankar, 2018). While much of this production currently comes from India and Australia, many countries have identified or are exploring oil and gas reserves in the Indian Ocean (Llewellyn, English, and Barnwell, 2016). Development of portable oil platforms means that some offshore sites can be exploited in a commercially viable manner without requiring permanent infrastructure. ONGC, the national oil and gas company of India, currently uses portable oil platforms for a variety of hydrocarbon extraction projects in the Indian Ocean (Mahanta, 2019).

Minerals

In addition to energy reserves, there is potential for deep-sea mining in the Indian Ocean. Oceanic crust is a potential source of metals such as copper, nickel, cobalt, and manganese. Further, there is potential for mining rare earth metals, which are crucial to renewable energy generation (Sharma, 2011; IBM, 2010). As land-based sources for these resources decrease, the commercial viability of seabed mining will rise (Kraska, 2012). Several locations in the IO, such as the Carlsberg Ridge and the Central Indian Basin, have already been identified as promising sites for seabed mineral extraction. Further, the International Seabed Authority, which oversees the seafloor outside of EEZs, has allotted several areas

within the Indian Ocean to various countries for further exploration and extraction (Sharma, 2011).

However, there are many technical challenges that hinder deep seabed mining, and commercial-scale mining operations are not yet widespread. Machinery that collects samples for identification of underwater mining sites is slow, and identifying suitable mining sites is a long and expensive endeavour (Sharma, Khadge, and Sankar, 2013). Further, the process for collecting resources is complex, and machinery needs to collect minerals on the ocean floor, lift minerals thousands of meters to a mining ship and, after processing these minerals, return unwanted debris to the ocean. All of this requires complex, expensive infrastructure, much of which has not been developed before (Llewellyn, English, and Barnwell, 2016).

Finally, environmental concerns are prominent when discussing seabed mining. It is important that this resource extraction doesn't damage other natural resources in the ocean like fish stocks and coral, which is important to other industries of the Blue Economy. Some have raised concerns about sediment dispersal that can occur during resource collection, as well as spillage when lifting resources to the surface. Further, at-sea processing of minerals creates unwanted debris that is dumped back into the ocean, creating a sediment cloud that can hinder photosynthesis and other biological processes (Sharma, 2011). There is some attempt to measure the environmental impact of seabed mining, and develop guidelines to minimize this negative impact (Jaekel, 2016). While research has shown that biological life around mining sites can recover after mining operations, it can take decades, and it is currently unknown how to minimize this impact (Jones et al., 2017).

Shipping and Transportation

Transportation and goods

The Indian Ocean is home to many of the world's most significant shipping lanes, and nearly 100,000 ships traverse this ocean annually (Albert, 2016). This includes transportation of multiple types of cargo (most notably, container traffic and liquid bulk). Further, as a percentage of global trade, cargo transported through the Indian Ocean is increasing (Tournadre, 2014). Due to geography and increasing economic output, transportation within the Indian Ocean will remain an important part of the Blue Economy in the future.

A majority of the world's oil and gas products are transported through the Indian Ocean, representing over 35 million barrels of oil/day (Albert, 2016). Much of this oil comes from

major oil producers in the northwest corner of the Indian Ocean, though there is also significant oil production in the Indian Ocean (Jaishankar, 2018). Natural chokepoints such as the Strait of Malacca and the Strait of Hormuz see a high density of shipping traffic, and many have identified the need to keep these chokepoints secure and open so as to maintain global energy production (Llewellyn, English, and Barnwell, 2016; US Energy Information Administration, 2017).

One noteworthy finding is that much of this cargo is destined for ports outside of the Indian Ocean, and only 25% of all cargo transportation is between IORA nations (Rana, 2016). Past research has identified many possible explanations for this trend, including underdevelopment (IORA nations contains 35% of the world's population, but only 10% of the world's GDP) (World Bank, 2018). This underdevelopment can cause limitations in communications, logistics, and supply chains, leading to trade friction and limited trade integration. Moreover, there is steadily increasing competition between China and India for regional dominance. While this competition has caused both countries to invest in transportation infrastructure projects, it also causes some regional fragmentation and limitation of multinational collaboration (Albert, 2016).

Piracy and shipping security

In 2008, after years of relative stability, piracy near the Horn of Africa (HOA) began to rise drastically. In Somalia, the lack of functioning government, long and isolated coastlines, wide availability of light weapons, and limited alternative economic opportunities, all contributed to this rise in pirate activity (Middleton, 2008). Many ships were attacked, with cargo and hostages seized. In addition to costing shipping companies hundreds of millions of dollars in ransoms, this negatively affected IO shipping by causing rerouting of ships, increasing shipping insurance premiums, and disrupting petroleum shipments (Chalk, 2010). It was concerning, too, that this piracy would also contribute to funding terrorist organizations like Al-Shabaab (Sullivan, 2010).

There was a significant, multinational response to this piracy. 25 nations participated in Combined Task Force 151, with the mission of reducing HOA piracy. This task force completed actions, including escorting cargo shipping in the area, repelling pirate attacks, rescuing hostages and captured vessels, and searching for pirate fleets. (Percy, 2016). While most combat operations were completed by ships from the US, India, and the EU, other IO countries like Seychelles and Bahrain contributed to this operation through the use of national ports as a staging area for this task force. (McKnight and Hirsh, 2012). By 2012, these efforts had lowered piracy to pre-2008 levels. However, to this day, increased monitoring and security efforts continue in the region to prevent a similar rise in piracy from occurring again (Vespe, Greidanus, and Alvarez, 2015).

Ports and infrastructure

Naturally, ports play a major role in shipping and transportation infrastructure. There is a large disparity in port activity in the region, and a majority of cargo in the Indian Ocean passes through just three ports – Singapore, UAE, and Port Kelang in Malaysia (Pandya et al., 2011). Also noteworthy is that a majority of states in the region are net importers. For these nations, ports play a major role in access to imported goods. This is especially prominent for nations that have no domestic energy-refining capabilities, and must import refined petroleum products for energy (Pandya et al., 2011). Investment in upgrading and expanding ports will remain a prominent issue to maintain this infrastructure necessary for shipping and transportation.

The Maritime Silk Road Initiative (MSRI), which is one part of China's overall Belt and Road Initiative, will also have a strong influence on future IO shipping and transportation. China has invested tens of billions of dollars on projects related to shipping infrastructure; examples include the ports of Colombo and Hambantota in Sri Lanka, (Blanchard and Flint, 2017). The country has also invested in military projects, like a naval base in Djibouti, to secure shipping lanes and fight IO piracy (Kieven, 2015). While some of this investment is aimed at promoting transportation of goods to Europe, it will also positively affect goods destined for IO nations.

Beyond infrastructure developments, technological advancements can also promote future IO shipping. First, technological increases in mapping of climate, including weather and ocean currents, could allow ships to optimize travel routes, saving money on fuel and operating costs. Advances in telecommunications and digital information could also allow for increased shipping integration, and multinational supply chains (Llewellyn, 2015). The continued growth of shipping and transportation within the Indian Ocean will make it remain a prominent part of the Blue Economy, and many have identified future opportunities to grow this segment.

Environmental Conservation and Biodiversity

The Indian Ocean (IO) has several characteristics which distinguish it from other oceans and seas. In total, IO nations have a combined coastline length of 66,526 km, which is only about half that of the Pacific and Atlantic Oceans (Keesing, 2005). Further, it is landlocked to the north and the resultant differential heating between the landmass and the sea causes a wind circulation that reverses direction twice a year (Wafar et al., 2011). This monsoon effect has a direct bearing on the climatology of the northern IO, which in turn affects the

biological productivity and economy of the receiving regional countries. As such, the area has received interest of researchers and policy makers alike.

Overview of Indian Ocean biodiversity

Currently, about 80% of all marine species occur in the coastal zone (Keesing, 2005). This concentration of diversity is associated with the complex habitats created by dominant benthic primary producers and the productive shallow waters fuelled by terrestrial inputs. Other habitat types of coastal ecosystems include coral reefs, mangrove mangals, seagrass meadows, algae and kelp forests, subtidal rocky reefs and intertidal rock platforms, as well as the pelagic. Of these coral reefs, mangroves, algae dominated rocky reefs and seagrass meadows have the most complex community assemblages and thus the highest biodiversity. Corals, mangroves and seagrasses are also among the taxa whose biodiversity is best known (Keesing, 2005).

Threats to Indian Ocean biodiversity

The rich biodiversity of the Indian Ocean faces a number of critical threats, notably from habitat loss, uncontrolled developmental activities in the coastal zone, over-extraction of resources, and coastal pollution. These threats are especially prominent in SIDS, where most environmental regulations are weak (Wafar et al., 2011). The IO states have approximately double the population per square kilometre of continental shelf but just 1/10th of the GDP of the Atlantic and Pacific states, placing great pressure on IO coastal regions (Keesing, 2005). The loss of marine biodiversity is therefore the highest in coastal areas of the world (Keesing, 2005).

The International Union for Conservation of Nature (UICN) has documented these threats for many years. In Reunion, the island nation's greatest threats to biodiversity come from forest fires, infrastructure development (particularly roads), wild harvesting of rare plants, invasive alien species (IAS), tropical cyclones, volcanic activity, pollution of coastal waters, and overfishing (UICN, 2015). Mayotte has suffered significant soil loss, poor agricultural practices, fires, uncontrolled urban development, water sewage and lack of sanitation network, illegal harvesting, lack of enforcement of environmental laws, lack of waste management (UICN, 2015). Other island nations, such as Seychelles, have faced the threats of poaching, piracy, illegal fishing, climate change and coral reef bleaching (UICN, 2015).

Pollution poses another significant threat to IO biodiversity, and the pollutants enter coastal waters primarily in two forms – as nutrients from domestic sewage and agricultural runoff, and as industrial effluents, inevitably killing the local fauna and flora. Dead zones in coastal

waters due to pollution have been exponentially increasing since 1960, and approximately 10 are catalogued to exist in the IO region (Wafar et al., 2011).

Coral reefs of the Indian Ocean are particularly threatened by land reclamation, coral mining, bleaching, disease and destructive fishing methods (Keesing, 2005); and increasing degradation of coral reefs has led to reduction in biodiversity, productivity and other utilitarian functions of reefs such as wave barriers for shorelines (Sheppard, 1998). Given the great habitat complexity reefs provide, the loss of reef structures also leads to a loss of many other reef-dwelling biotic groups (Sheppard, 1998).

Additional threats to biodiversity come from other Blue Economy industries. Mineral and petroleum exploitation in the Indian Ocean has resulted in heavy maritime transport of petroleum from the Persian Gulf and Indonesia. Approximately 40% of the world's offshore oil comes from the Indian Ocean, and beach sands, heavy in minerals, are currently mined in India, South Africa, Indonesia, Sri Lanka and Thailand (Keesing, 2005). The area also experiences exploitation from fishing fleets of non-Indian Ocean countries (particularly Russia, Japan, South Korea and Taiwan) that add to the pressure exerted by countries within the region (Wafar et al., 2011). Many mangrove habitats have already been lost as a result of mangroves being harvested for building material, firewood, animal fodder, fish traps and production of pulp and particle board. Seagrass habitat loss is also attributed to vessel damage, trawling, dredging, high nutrient and sediment loading (Wafar et al., 2011).

Efforts to improve knowledge of IO biodiversity and conservation

Despite ongoing research, the biodiversity of the Indian Ocean region remains largely unknown (Keyton and Hammer, 2019). There is a need for Indian Ocean region countries to take the lead in increasing knowledge and understanding of the coastal biodiversity of the region and strengthen the taxonomic capacity throughout the region (Keesing, 2005; Sheppard, 1998).

There are several efforts to address this through research and capacity building. The British-led Nekton Mission aims to document changes taking place beneath the Indian Ocean (Keyton and Hammer, 2019). The International Indian Ocean Expedition (IIOE), notably enabled collection and use of oceanographic parameters to explain the abundance and distribution of planktonic species and their productivity in the region. It also laid the foundation for modern-day biodiversity research in most IO countries (Wafar et al., 2011). Moreover, some IO countries have undertaken research in marine fields to further develop national capacity, a process frequently aided by international, regional and bilateral training and collaborative programs. These initiatives have been driven by the need to address

biodiversity changes in response to anthropogenic forces prevailing locally (Wafar et al., 2011).

Kumar (2002) notes that ocean-based tourism continues to be vital for SIDS, but most seem unprepared policy-wise for the environmental side-effects tourism and other activities produce. In response, several IO SIDS have launched important conservation activities. (UICN, 2015). For example, through the COREXERUN program, Reunion Island is running a conservation, restoration and reconstitution program of semi-dry forest, through inventories, harvest, and multiplication of 48 species (UICN, 2015). Through the MIROMEN project, the island is also studying the migratory routes and populations of humpback whales visiting Reunion islands in the Indian Ocean, leading to new datasets about humpback whale paths throughout the Western Indian Ocean (UICN. 2015). Mayotte's Biodiversity strategy for sustainable development is seeing the establishment of a reference baseline document and a roadmap to better integrate biodiversity in Mayotte's development (years 2013-2020), and collectively engage stakeholders into activities having a positive impact on biodiversity. Seychelles has demarcated over 50 percent of its land territory as a protected area, the second largest percentage worldwide (Amla, 2014b).

Beyond the actions elaborated above, the following have also been proposed to further biodiversity conservation:

- Establishment of an agreed IO bio-regionalisation base on which to base biodiversity assessments
- Synthesis of existing bioregional information into an open, accessible, well-managed database
- Conducting a biodiversity 'gap' analysis (both geographic and taxonomic) that identifies and prioritizes areas containing the least knowledge for future biodiversity assessment projects
- Linking biodiversity assessment efforts to established conservation programs such the UNEP Regional Seas Program, as well as initiatives of individual countries (Keesing, 2005).

Indian Ocean Blue Economy Policy Frameworks

Oceans are not the domain of any single country or entity. As a result, there are many global organizations and meetings that have aimed to promote cooperation around the Blue Economy. Those which are most significant to the Indian Ocean BE are elaborated below.

Relevant global entities

The United Nations

The United Nations has played a significant role in influencing member states to protect and restore the health and resilience of oceans in order to maintain their diversity, thus enabling their conservation and sustainable use for the future (Sharif, 2018). Today, there are several United Nations agencies, conventions, conferences and bodies that deal with various issues around oceans (Wetzel and Chiramba, 2018). For instance, the Nairobi Convention (2018) has recognized the role that UN-Habitat can play in protecting the marine environment in the West Indian Ocean through targeted urban coastal policies and interventions. The UN-Habitat arm and its partners support states in harnessing the potential of cities to benefit from the Blue Economy through improving sustainable livelihoods, 'green' and 'blue' job creation, housing and infrastructure, waste management, ecological protection and preservation of coastal areas (Sharif, 2018).

The Agenda 2030 for Sustainable Development

The preservation of marine resources is central to the delivery of the United Nations Agenda 2030 for Sustainable Development, including the Sustainable Development Goals (SDG) (Wetzel and Chiramba, 2018). SDG 14 recognizes the 'contribution of oceans to sustainable development by seeking to conserve and sustainably use the oceans, seas, and marine resources for sustainable development'. This sentiment was later reinforced at the first United Nations Oceans Conference in 2017. Other SDG are also linked to the Blue Economy, including SDG 6 (water) and SDG 11 (cities).

United Nations Convention on the Law of the Sea (UNCLOS)

UNCLOS is an international agreement that defines the rights and responsibilities of nations for use of oceans. Enacted in 1994, it covers a range of issues of territorial waters, EEZ's, resource extraction in international waters. It also led to the creation of the International Seabed Authority, which works to oversee, regulate and control mineral-related activity located in international seabed areas.

Today, all IO nations are parties or signatories to this treaty, and it plays a key role in multinational regional cooperation. For example, a joint proposal from Mauritius and Seychelles submitted in 2008 led to the expansion of recognized Continental Shelf limits, allowing these countries to explore new BE opportunities (Commission on the Limits of the Continental Shelf, 2011).

European Union (EU)

The EU has long recognized the Blue Economy as a driver for Europe's welfare and future prosperity. In the EU, the Blue Economy sector generates €174 Billion of value, supports nearly 3.5 million jobs, and in the last decade, has grown faster than the overall EU

economy. In 2012, the Blue Growth Strategy was adopted with the aim of undertaking initiatives related to oceanic resource utilization, facilitating cooperation between maritime businesses and securing the sustainability of the marine environment.

The EU has also committed to a global approach by proposing several policy measures designed to improve the way oceans are managed, reducing human pressure on the oceans and investing in science (Commission Staff Working Document, 2017). The 2014-2020 EU research programme (Horizon 2020), for instance, aims to transform the way that marine and maritime research is done within the EU (Commission Staff Working Document, 2017). Through such measures, the EU hopes to ensure that marine resources are used sustainably, for healthy marine ecosystems and a strong Blue Economy.

The Commonwealth

The Commonwealth Secretariat (2018a) sees the Blue Economy as an 'emerging concept' which encourages better stewardship of our ocean resources. The body has long been a supporter of Blue Growth, noting the concept inspired the Commonwealth Blue Charter, highlighting in particular the close linkages between the ocean, climate change, and the wellbeing of the people of the Commonwealth (Commonwealth Secretariat, 2018b).

The Commonwealth has been instrumental in assisting member states with Blue Economy initiatives, both within and beyond the Indian Ocean. For example, an expert in ocean governance provided assistance to develop Seychelles' Blue Economy including the development of its 2018 Blue Economy Strategic Policy and Roadmap (Commonwealth Secretariat, 2018a).

Indian Ocean regulating entities

The Indian Ocean Tuna Commission (IOTC)

The Indian Ocean Tuna Commission (IOTC) is an intergovernmental organization responsible for the management of tuna and tuna-like species in the Indian Ocean. It was formed under the Food and Agricultural Organisation (FAO) of the United Nations, and is aligned with the UN Fish Stocks Agreement. Based in Seychelles, the organization currently has 31 member countries, and works to promote cooperation among its Contracting Parties (members) and Cooperating Non-Contracting Parties in order to ensure appropriate utilization of fish stocks and to encourage the sustainable development of fisheries. The organization regulates fish species which are highly migratory and can move throughout many different EEZ's. Subsequently, this intergovernmental organization is crucial to ensuring all countries work together to utilize these stocks in a way that does not damage future food production capabilities.

The Indian Ocean Rim Association

The IORA is an inter-governmental organization which was established on 7 March 1997. In 2017, the organization celebrated the 20th Anniversary of the Association as a proactive inter-governmental organization with an ever-growing importance within the Indian Ocean region. IORA members remain committed to building and expanding understanding and mutually beneficial cooperation through a consensus-based evolutionary and non-intrusive approach in the rapidly changing environment faced by the region. Today, IORA is party to 22 Member States and 9 Dialogue Partners, with an ever-growing momentum for mutually beneficial regional cooperation.

Other significant entities

The Seychelles Blue Bond

In 2016, Seychelles completed a debt-for-nature conversion with The Nature Conservancy, raising funds to buy US$21 million of Seychelles' sovereign debt, directing the funds to climate change adaptation, sustainable fisheries, and marine conservation projects (Lau, 2018). The Seychelles Blue Bond is partially guaranteed by a US$5 million guarantee from the World Bank (IBRD) and further supported by a US$5 million concessional loan from the GEF. The bond raised US$15 million from international investors and its development was assisted by the World Bank. Seychelles was the first country in the world to launch a sovereign blue bond, in October 2018. It is viewed as a pioneering financial instrument designed to support sustainable marine and fisheries projects. It is hoped the bond can serve as a model for other SIDS and coastal countries and signal that investors are increasingly interested in supporting the sustainable management and development of oceans.

The Seychelles Conservation & Climate Adaptation Trust (SeyCCAT) was established as a vehicle to manage blue funds comprised of debt restructuring proceeds, and aims to disperse approximately US$750,000 per annum (Financing Sustainable and Climate-Resilient Ocean Economies in Africa, 2018). The proceeds from the bond include support for the expansion of marine protected areas, improved governance of priority fisheries, and the development of the Seychelles' Blue Economy. As part of the swap, the Seychelles rolled out a comprehensive domestic strategy within the Marine Spatial Plan, which aimed to cover the entire marine area of almost 1.4 million km^2.

Conclusion

The development of the Blue Economy in the Indian Ocean Region has gained prominence due to its potential to positively disrupt the many countries' current development paths. However, this potential to develop is currently limited by numerous challenges. The World

Bank (2017) outlined the rapidly degrading ocean resources through unsustainable development, climate change, pollution, marine resource extraction and destruction of habitats as the biggest threats facing most BE nations. It also noted a second set of challenges existing around the need to invest in the human capital required to innovate BE sectors, causing resulting job creation and development benefits. Lastly, a third set of challenges revolves around overcoming sectoral management of activities in the oceans. Many stakeholders do not fully understand what a sustainable BE entails, instead focusing on individual ocean-related sectors. They often fail to consider the cumulative impacts of these activities or the conditions under which the BE is most likely to develop (World Bank, 2017).

Stimulating new market opportunities and transforming national economies for green and blue growth requires new legal and regulatory instruments designed to promote new investments and encourage entrepreneurship. Recommendations in this context range from implementing minimum standards, making the requirements and standards legal, transparent and accessible and publishing allowable, approved Blue Economy activities (Rimmer, 2017). Many countries have also called on the private sector to engage and play a bigger role in the development of their Blue Economy. In this context, integrating such groups into the Blue Economy will mean a marked change in poverty levels and education for the better.

The oceans and seas are essential for social wellbeing – over 3.1 billion people live within sight of an ocean or sea in about 150 coastal and island nations. An effective BE emphasizes much more than GDP growth (Kelleher, 2015). It requires acknowledgement and mitigation of environmental effects of industry. It also requires investment in, and use of, the best available science, data, and technology for shaping management decisions to enact long-term change. Realizing the full potential of the Blue Economy also requires the effective inclusion and active participation of all societal groups, especially women, young people, local communities, indigenous peoples, and marginalized or underrepresented groups (World Bank, 2017). It is only by considering all of these elements comprehensively that a sustainable Blue Economy can be implemented in the Indian Ocean.

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