AFRICAN UNION
INTERAFRICAN BUREAU
FOR ANIMAL RESOURCES

Permanent Mission of
Norway to the African Union

Information Note on Blue Accounting in the Context of African Union Blue Economy Strategy

Prepared by: Pierre Failler

Edited by: Mohamed Seisay

Citation: AU-IBAR, 2022. Information Note on Blue Accounting in the Context of African Union Blue Economy Strategy

ISBN 978-9966-1659-5-4

The Director
African Union – Interafrican Bureau for Animal Resources (AU-IBAR)
Kenindia Business Park
Museum Hill, Westlands Road
P.O. Box 30786-00100,
Nairobi, KENYA
Email to: ibar.office@au-ibar.or

Table of Contents

Acknowledgement

The Director of AU-IBAR wishes to acknowledge the expertise of the consultant who prepared this Information Note on Blue Accounting. The Director extends appreciation to all stakeholders on the continent (AUC Departments, AU member states, RECs and specialized regional institutions, development Partner, NSAs and other all other stakeholders) that have been supportive of AU-IBARs' interventions in the fisheries, aquaculture and blue economy sector in Africa. The Director also wish to express profound gratitude to H.E. Amb. Josefa Sacko for her unfailing support to AU-IBAR in delivery of the institution's mandate with regards to fisheries, aquaculture and support to blue economy development in Africa. Special thanks go to the Kingdom of Norway; the information note was developed with funding from Kingdom of Norway under the Project 'Support to Implementation of Africa Blue Economy Strategy' Finally the Director acknowledge the technical team at AU-IBAR for the editorial work

Acronyms

ABES	Africa Blue Economy Strategy
AU	African Union
AU-MS	African Union Member States
BE	Blue Economy
BAU	Business as usual
CBD	Caribbean Development Bank
CBD	Convention on Biological Diversity
CC	Climate Change
COMESA	Common Market for Eastern and Southern Africa
EAC	East Africa Community
EC	European Commission
ECCAS	Economic Community of Central African States
EEZ	Exclusive Economic Zone
ESA	Eastern and Southern Africa
EU	European Union
FAO	Food and Agriculture Organization
IGAD	Inter-Governmental Authority on Development
IOC	Indian Ocean Commission
NGO	Non-Governmental Organization
NDC	National Determined Contribution
NDP	Net Domestic Product
OECD	Organisation for Economic Co-operation and Development
PES	Payment for Ecosystem Service
RECs	Regional Economic Communities
REED+	Reducing Emissions from Deforestation and Degradation
SADC	Southern African Development Community
SDG	Sustainable Development Goal
SEEA	System for Environmental Economic Accounting
SNA	Statistical of National Accounting
STC-ARDWE	Specialized Technical Committee on Agriculture, Rural Development, Water and Environment
ToR	Terms of Reference

Introduction

The Blue Economy encompasses both marine and freshwater environments. It relates to the sustainable use and the conservation of oceans and seas, coastlines and banks, lakes, rivers and groundwater. Driven by the social sustainability, the blue economy consists, on one hand, of the human activities that organise in an integrated, fair and circular manner the production and trade of goods and services resulting from the exploitation of aquatic resources[1] and from the use of supports that constitute aquatic environments[2]. On the other hand, it also consists of the human activities that contribute to improving the health status of aquatic ecosystems by establishing protective and restorative measures. As a result, the Blue Economy revolves around the valorisation of the social, economic and ecological components.

Crucially for African Countries pursuing Blue Economy activities, accounting for Blue Economy components has not yet been undertaken. Socially, many coastal and lacustrine poor communities in Africa lack education and entrepreneurial capacity. They only have few property rights over their livelihood, and they are often excluded from the decision-making process. African Member States must therefore address efforts to implement Blue Economy in order to fight poverty and to include these communities in the process of developing such Blue Economy. Coastal and waterway communities would thus have better access to economic sector, which would positively influence their well-being. This, social sustainability should be properly recorded. From the economic point of view, African countries' accounting of blue economic activities isn't completed in a unified manner. Currently, data are collected from different sources to provide a comprehensive view of blue economic sectors contribution to creating added value and jobs.

Ecological components of the Blue Economy are also inadequately incorporated and critical ecosystem services, like those provided by coastal areas, are improperly and seldom valued. The implementation of a process to track Nationally Determined Contributions (NDC) in order to facilitate 'green' and 'blue' accounting will benefit decision and policy-makers by becoming the cornerstone for evidence-based actions, like those related to climate change. For instance, Blue Economy policies should account for the Nationally determined contributions of 'blue carbon', the CO2 sequestration by mangroves, seagrass beds, mudflats and other coastal ecosystems. To do so requires establishing specific accounting mechanism for blue carbon and other ecosystem services that monitor and measure the evolution of the contribution of coastal ecosystems to carbon sequestration.

[1] *Such as fisheries, mining and petroleum, biotechnologies and alternative energies.*
[2] *Such as maritime transport and coastal tourism.*

Overall, a critical barrier to presenting a comprehensive view of the Blue Economy contribution from the social, economic and ecological point of view is the lack of comparable data which must first be gathered from different sources. Creating an appropriate national accounting framework which embraces social, economic and ecological components will facilitate recording annual changes to identify the contribution made by the Blue Economy.

The need for accounting schemes specific to the Blue Economy has been identified as critical for achieving Blue Economy objectives. The elaboration of Blue Economy Accounting based on the merging of Blue Satellite[3] accounts and Blue Ecosystem account has been inscribed in the strategy and working plans at various scales: Continental (Africa Blue Economy Strategy[4] (ABES)), Regional (Indian Ocean Commission (IOC) and Intergovernmental Agency for Development Strategies[5] (IGAD)), and country, such as Seychelles.

This Note provides a conceptual understanding of blue accounting by showing the nexus between blue accounting and marine ecosystems sustainability and indicating the relevant information and data requirements for socio-economic assessment of blue resources, including goods and services they generate. It further highlights, in generic terms, information required to set-up a baseline for a comprehensive Blue Economy socio-economic assessment. It also indicates some best practices and lessons learned in selected case studies on blue accounting systems as well as outlining key policy messages.

The report starts with an in-depth review of main existing integrated accounting systems to provide a robust background and foundations for a BE accounting development. The review closely looks at the modelling and statistical difficulties and constraints inherent to the development of such complex systems. It highlights the pro and cons of each and provide evidence on the constraints faced (and solutions found) for their implementation. A special attention is given to the way social and environmental components are taken into account individually as well as linkages developed between them and the current system of national accounting (SNA). While the Environment and Economics accounting linkages have been developed significantly these recent years, the social sustainability accounting remains isolated and no intent to link it to the SNA has been made so far. Therefore, further investigations into the modelling and statistical coherence of coupling a socio-economic accounting system will have to be made.

[3] *A satellite account provides a framework linked to the central (national or regional) accounts, allowing attention to be focused on a certain field or aspect of economic and social life in the context of national accounts; common examples are satellite accounts for the environment, or tourism, or unpaid household work. Satellite accounts are one way in which the System of National Accounts may be adapted to meet differing circumstances and needs. They are closely linked to the main system but are not bound to employ exactly the same concepts or restrict themselves to data expressed in monetary terms. Satellite accounts are intended for special purposes such as monitoring the community's health or the state of the environment. They may also be used to explore new methodologies and to work out new accounting procedures that, when fully developed and accepted, might become absorbed into the main system over time. Satellite accounts can meet specific data needs by providing more detail, by rearranging concepts from the central framework or by providing supplementary information. They can range from simple tables to an extended set of accounts in special areas like for e.g. environment or education. See: https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Satellite_account*

[4] *See: https://www.au-ibar.org/strategy-documents*

[5] *Completed for the first one and under completion for the second one.*

1 Overview of existing tools and approaches

Many international institutions and organisations have started developing approaches to take into account both the Economic and the Environmental contribution of the Ocean Economy, or more broadly from the Blue Economy. Recently adapted by the Caribbean Development Bank[6] (CBD), Organisation for Economic Co-operation and Development[7] (OECD) and Food and Agriculture Organisation[8] (FAO) to the Blue Economy, green accounting is yet to be implemented. These initiatives rely on the UN System for Environmental Economic Accounting (SEEA) Central Framework. It is an international statistical standard for measuring the environment and its relationship with the economy. The Central Framework covers measurement in three main areas:

- Environmental flows: the flows of natural inputs, products and residuals between the environment and the economy, and within the economy, both in physical and monetary terms.
- Stocks of environmental assets: the stocks of individual assets, such as water or energy assets, and how they change over an accounting period due to economic activity and natural processes, both in physical and monetary terms.
- Economic activity related to the environment: monetary flows associated with economic activities related to the environment, including spending on environmental protection and resource management, and the production of 'environmental goods and services'.

Within the UNECA/ CBD initiative called "Comparative Analysis of Blue Economy Impacts and Strategies in Seychelles and The Bahamas using Blue Economy Satellite Accounts" it will be applied soon and thus provide better knowledge of the Blue potential, inform policy making and provide a robust support for decision making process.

In a more detailed way:

- ***Environmental Satellite Accounts***[9] (also called Integrated Economic and Environmental Accounts) have been developed in European countries in the early 1980 but have been abandoned in the 1990s. They provide physical and economic information of particular relevance for the integration of economic and environmental policies in a form consistent with the normal economic statistics in general and national accounts in particular. The economy and the natural environment interact at many points, and these interactions raise analytical questions [10]. The

[6] See: *https://www.caribank.org/publications-and-resources/resource-library/working-papers/measuring-blue-economy-system-national-accounts-and-use-blue-economy-satellite-accounts*

[7] See: *https://www.oecd-ilibrary.org/sites/d71e8b4d-en/index.html?itemId=/content/component/d71e8b4d-en*

[8] See: *https://seea.un.org/content/system-environmental-economic-accounting-agriculture-forestry-and-fisheries*

[9] See: *https://www.eea.europa.eu/help/glossary/eea-glossary/environmental-satellite-account*

[10] *Such as:*

- *The Nation's wealth includes natural resources, such as oil and gas reserves and timber, that are used in production. At what rate are these resources being used?*
- *The income of producers in the mineral industries includes a return to the drilling rigs, mining equipment, and other structures and equipment engaged in them and a return to the mineral. What share is attributable to the mineral?*
- *Economic activity adds to the proven stock of natural resources by exploration and technological innovation. How much of the use of natural resources in production has been offset by these additions?*

answers to questions such as these about the interaction of the economy and the environment are often based on partial and sometimes even inconsistent information, suggesting the need to identify and quantify the interactions within a systematic framework as a basis for more informed analysis and decision making. The environmental satellite accounts (ESA) are meant to help fill that need. The ESA's are a supplementary set of accounts structured to show the interactions of the economy and the environment more fully than the existing economic accounts. While the ESA's build on the existing economic accounts, they do not replace them; likewise, ESA measures do not replace measures such as gross domestic product (GDP) from the existing accounts. It has been implemented by many countries

- ***Green accounting,*** Green accounting, developed in the 1990s, following the Rio Conference on Sustainable Development, and has been widely proclaimed by international institutions (yet has received lukewarm attention at the national level). The aim of these accounting frameworks is to measure the sustainable income level that can be secured without decreasing the stock of natural assets. It requires adjustment of the System of National Accounts (SNA) to reflect changes in the stock of natural assets[11] (in particular, to account for environmental deterioration, which impairs the quality of life of present and future generations, and hence the sustainability of development). Greening the conventional national accounts introduces environmental impacts and costs into these accounts and balances. The result is a new compass for steering the economy towards sustainability, which may change not only the main measures of economic performance but also the basic tenets of environmental and resource policies.
- ***The UN System of Environmental-Economic Accounting[12] (SEEA)*** is a framework that integrates economic and environmental data to provide a more comprehensive and multipurpose view of the interrelationships between the economy and the environment and the stocks and changes in stocks of environmental assets, as they bring benefits to humanity. It contains the internationally agreed standard concepts, definitions, classifications, accounting rules and tables for producing internationally comparable statistics and accounts. The SEEA framework follows a similar accounting structure as the System of National Accounts (SNA). The framework uses concepts, definitions and classifications consistent with the SNA in order to facilitate the integration of environmental and economic statistics. The SEEA is a multi-purpose system that generates a wide range of statistics, accounts and indicators with many different potential analytical applications. It is a flexible system that can be adapted to countries' priorities and policy needs while at the same time providing a common framework, concepts, terms and definitions.

- *Households, governments, and businesses all make expenditures to maintain or restore the environment. What share of their spending benefits the environment?*
- *The Economic Impact of waste Disposal into the air and water, and the resulting degradation of the environment imposes costs, such as lower timber yields and fish harvests and higher cleaning costs. What are these costs? Which sectors bear them?*

[11] *In SNA, allowance is made for capital consumption or man-made capital while calculating Net Domestic Product (NDP). Net Domestic Product (NDP) =GDP-depreciation.*

[12] See: https://seea.un.org/content/seea-central-framework

- ***Natural Capital Accounting***[13] is a tool to measure the changes in the stock of natural capital at a variety of scales and to integrate the value of ecosystem services into accounting and reporting systems at Union and national level. This will result in better management of the country's natural capital. An integrated natural accounting system for ecosystems and their services and associated data sets is being developed by EU while Rwanda has already implemented a Water Account[14]. It aims to provide a multi-purpose tool that can be used decision making for a range of policies, at different stages of the policy cycle, and that national authorities and research centres can access.
- Ecosystem Services Accounting[15] , which emerged from the Millennium Ecosystem Assessment in the mid-2000, is another accounting mechanism that received an increasing attention in recent years but the interest of countries remains very low. For instance, the IPBES assessment for Africa[16] reported a very weak accountability of natural assets. Its aim is to value, in terms of natural flow units and monetary units, the quantity of services provided by ecosystems (incl. food provisioning, Carbon sequestration, water purification, coastal protection, cultural services, etc.). Thus, it can enable to explicitly account for the range of ecosystems and their services and demonstrate in monetary terms the benefits of investing in nature and the sustainable management of resources. With the implementation of the NDC, its diffusion should be enhanced in the coming years.

[13] See: *https://ec.europa.eu/environment/nature/capital_accounting/index_en.htm*
[14] See: *https://www.wavespartnership.org/en/knowledge-center/rwanda-water-accounting-report-2012-2015*
[15] See: *https://ec.europa.eu/jrc/en/publication/ecosystem-services-accounting-part-i-outdoor-recreation-and-crop-pollination*
[16] See: *https://ipbes.net/policy-support/assessments/regional-subregional-assessment-report-biodiversity-ecosystem-services*

2 Blue Economic, social and environmental accounting

2.1 A need for a conceptual framework and accounting

According to the estimates presented in the Africa Blue Economy Strategy (2020), African BE sectors and components generate in 2020 a value of USD 296 billion with 49 million jobs. It is projected that by 2030, figures will be respectively USD 405 billion and 57 million jobs while in 2063 estimates would respectively be USD 576 billion of value created and 78 million of jobs[17] (see figure 1 and 2 below). The number of jobs would correspond to about 5% of the active population in 2063.

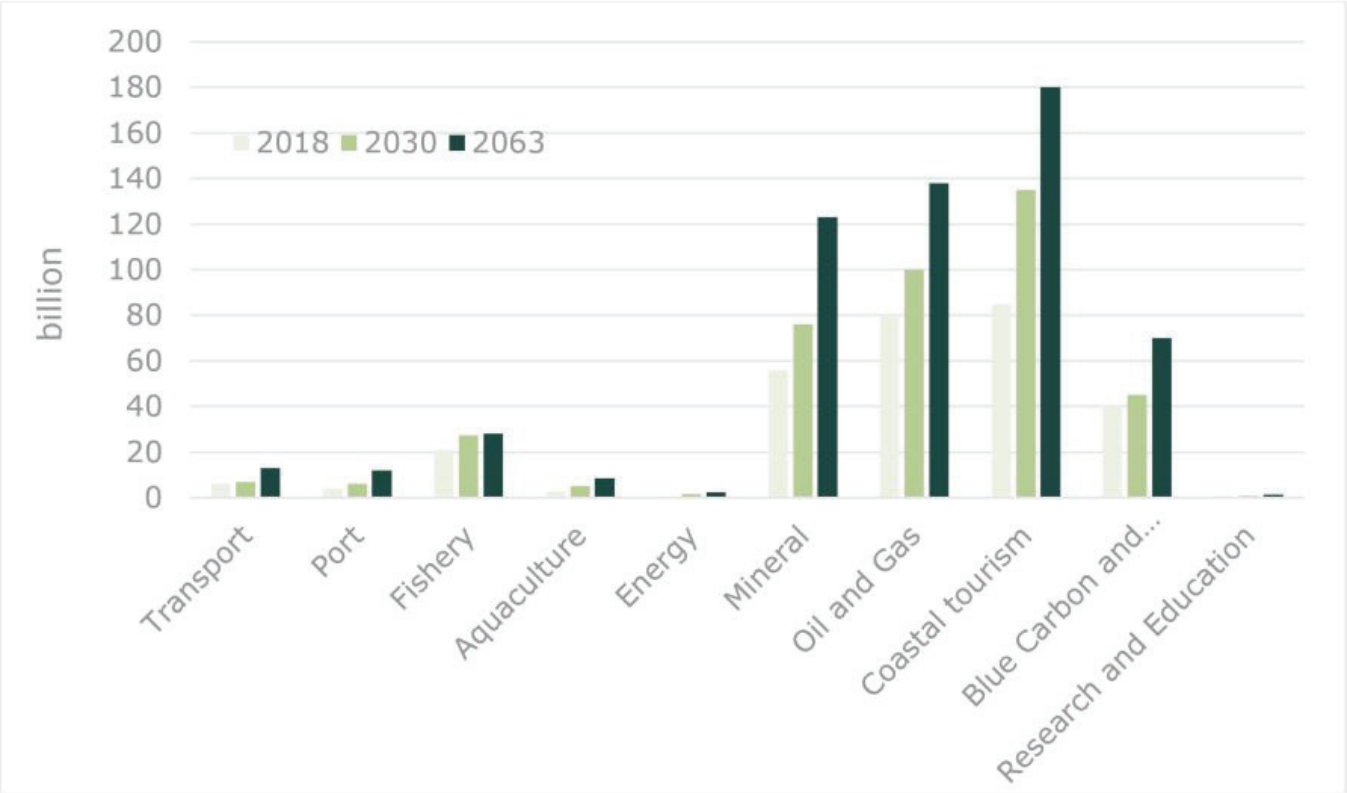

Figure 1: *Value created by BE sectors (value added) and components (value of services)*

The main driving sectors of the BE are tourism, both in term of value added and jobs created; the mineral sector, and the Oil and Gas that have a strong contribution to the value added but a low participation in the job creation process. The fishery sector will remain stable, with a high number of people employed while the aquaculture will continue to grow in next decades. Port and shipping will grow at a constant rate. The value of blue carbon and other ecosystem services generated by coastal, marine and aquatic ecosystems will progressively increase as conservation efforts expand. Education and research will follow the same pattern due to a growing demand for knowledge,

[17] *See Technical Reports (Annexes) for details.*

especially in deep-sea mining, offshore exploration and climate change mitigation and adaptation. A more detailed presentation of each category of BE follows the graphs.

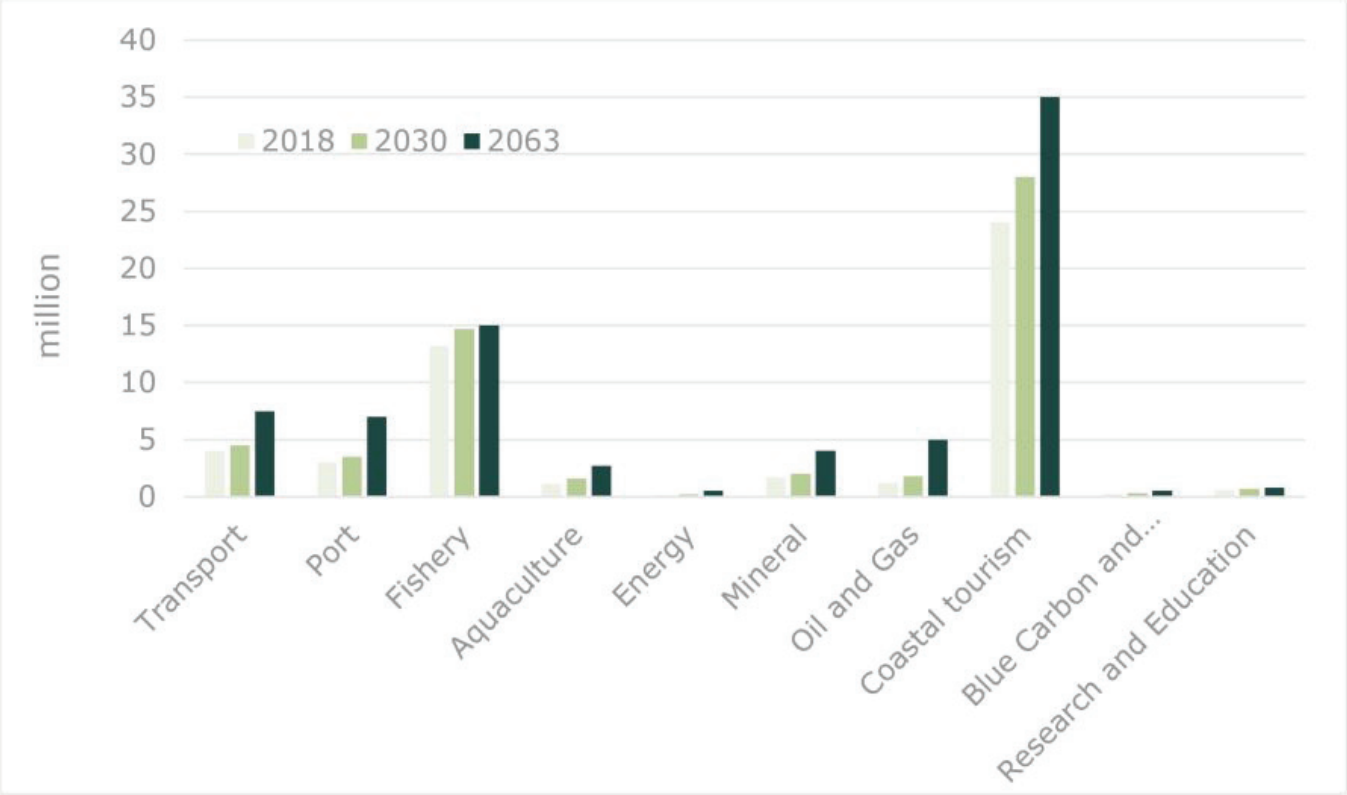

Figure 2: *Employment generated by BE sectors and components*

The accounting of the BE activities and components is not done in a unified way. Data needs to be collected from various sources to provide an overall picture of the contribution of BE to value addition and job creation. A proper national accounting system should be set-up to centrally record annual changes of BE sectors and ecological components. With the implementation of the National Determined Contributions, the green and blue accounting will become a cornerstone for the assessment of the climate change actions.

More globally, the OECD's Ocean Economy in 2030 report (2016) put forward the potential of the development of global ocean economy (i.e. Blue Economy) to a new level. It showed the significance of the global ocean economy as it made the contribution to approximately 2.5% of world gross value added (GVA) in 2010 (based on the OECD's Ocean Economy Database), which is around USD 1.5 trillion. On the basis of a "business-as-usual" scenario from 2010 to 2030, this report indicated that the global ocean economy has the potential to more than double its contribution to the GVA, reaching over USD 3 trillion. This scenario also proposed that around 40 million full-time equivalent jobs are anticipated to be offered in 2030.

To enhance the sustainable development of the ocean economy, this report recommended the future research to "improve the statistical and methodological base at national and international level for measuring the scale and performance of ocean-based industries and their contribution to the overall economy" and further develop the OECD's Ocean Economy Database (OECD, 2016). The World Bank & UN Department of Economic and Social Affairs (2017) focused on the potential of Blue Economy for Small Island Developing States (SIDS) and coastal Least Developed Countries (LDCs). It mentioned that the sustainable management of marine resource requires cooperation between nation-states and the public-private sectors and private sectors, in which the scale has not been achieved before. National investments aimed at predicting and adapting to the effects of climate change (which is a part of Blue Economy approach) must be complemented by regional and global cooperation around common priorities and goals. Also, in order to make the right policy decisions, including with regards to trade-offs amongst different sectors of the blue economy, it is thus requiring countries to apply accurately valuation of the natural oceanic capital's contribution to welfare.

Patil, et al. (2018) aims to synthesize the current theories and practices of the Blue Economy concept to manage marine-related economic activities and provide a framework for the government of Bangladesh to analyse its potential. It highlighted issues regarding how to proceed with the policy planning process to realise Bangladesh's Blue Economy aspirations, including measures to quantify the current economic uses of marine space, identifying clear goals for sustainable growth using that space, and the policy pathways to reach there remain. The report shed a light in how Bangladesh managed to transition its marine economy to a Blue Economy by providing a conceptual framework to guide the country's policymakers. Potgieter (2018) made the contribution of linking the literature on blue economy, security, and governance. It highlighted that due to poor oceans management, climate change, and ruthless exploitation in the world, oceans are under threat and are becoming vulnerable.

2.2 BE Economic Accounting

Up to now, a very few studies have provided a valuation of the economics of the BE activities using the System of National Accounts (SNA). The first one, commissioned by the European union in 2016, was done for the EU outermost regions[18], the second one, initiated by the World Bank[19] was carried out in Bangladesh while the third one was conducted in Jamaica in 2019 by Ram, Ramrattan, & Frederick for the Caribbean Development Bank (CDB) is now used as a starting point for the current UNECA/CDB initiative on blue accounting in Seychelles and in the Bahamas. While the

[18] *For the full set of studies, see: https://ec.europa.eu/regional_policy/en/information/publications/reports/2017/realising-the-potential-of-the-outermost-regions-for-sustainable-blue-growth*

[19] *See: https://openknowledge.worldbank.org/handle/10986/30014*

first two studies collected data from the SNA (value added and jobs), the third one proposed to test the adaptability of the current national accounting systems to respond to changes in the outputs from the industries associated with the Blue Economy. The authors estimated the direct and indirect growth impact of Blue Economy activities in Caribbean by using the data from Jamaica's System of National Accounts (SNA). A Leontief matrix was applied to measure the intermediate and final demand of productive industries and the interlinkages between them to provide an inter-industry analysis used to inform policymakers of potential demand increases in other industries following increases in final demand within the Blue Economy. Through this research, it is possible to quantify the contribution of industries associated to the Blue Economy to total domestic output and the supply of Blue Economy products into other industries' activities. Therefore, it is important to increase the exploitation of marine resources generating economic benefits, while improving statistical systems to monitor and evaluate the resulting impact on national output and supply of other productive sectors. The evidence-based analysis can be helpful for economies to prepare and develop activities as a result of investing in the Blue Economy.

Other studies, such as the ones carried out in the IGAD countries in 2019[20] for the preparation of the regional BE strategy and the one of the African Union in 2020[21] for the Continental Strategy, have used various sources of information to define the value added and the numbers of jobs in the Blue Economy sectors. For instance, fishery data on value added and jobs were sourced from the FAO Fishstat, Deep Sea Mining from the International Deep Sea Mining Authority database, Tourism from the World Tourism Organisation database and reports, etc. In order words, BE data are not available yet in a unique location.

2.3 BE Social Accounting

No social accounting has been developed so far for the Blue Economy. The social dimension solely lies with the principles of the Blue Economy implementation such as:

Social sustainability - The reduction of communities' vulnerability while facing climate change within the framework of Blue Economy is imperative to guarantee food security and livelihood. Furthermore, mining, oil, gas and energy production in deep water should be developed within the National Determined Contribution process following the strict precautionary[22] and compensation principles[23] (avoid, reduce, compensate) and ensuring civil society approval, since healthy ecosystems are of vital importance for the survival of living aquatic resources (both inland and oceanic). Thus, collective reflection and decision making should take place before allowing deep water resource

[20] *Reports not yet available.*
[21] *See: https://www.au-ibar.org/strategy-documents*
[22] *See: https://www.europarl.europa.eu/RegData/etudes/IDAN/2015/573876/EPRS_IDA(2015)573876_EN.pdf*
[23] *See: https://www.europarl.europa.eu/RegData/etudes/IDAN/2015/573876/EPRS_IDA(2015)573876_EN.pdf*

exploitation. In addition, countries must adhere to national, regional and international pollution control standards and practices, including those related to chemicals and plastics[24]. Socially, many communities lack adequate education and entrepreneurial capacity. They only have access to few property rights over their livelihood, and they are often excluded from the decision-making process. The African countries must therefore address the efforts needed to implement Blue Economy policies in order to fight poverty, especially in remote locations and include these communities in the process of Blue Economy development. Communities would thus have better access to the economic sector, which would positively influence their well-being.

Empowerment and inclusive decision-making - In terms of awareness, beneficiaries and human rights, international discussions on the blue economy, we should raise the question on how to better involve the largest group of ocean-users – the women and men who service, fish and trade from small-scale fisheries (SSF) – in the dialogue about blue economy projects and strategies. In an effort to ensure that the rights, interests and voices of SSF are respected in this dialogue, the Food and Agriculture Organization facilitated the production of the Voluntary Guidelines for Securing Sustainable Small-scale Fisheries in the Context of Food Security and Poverty Eradication (FAO, 2015), which incorporated the input of around 4000 fisheries, government and community representatives from more than 120 countries in more than 20 civil-society organizations-led national consultative meetings. These guidelines propose principles that are sensitive to food security and human rights, and that promote empowerment and inclusive decision-making. They are global in scope and with a focus on the needs of developing countries[25]. As such, this initiative will be guided by the FAO guidelines and ensure active, free, effective, meaningful and informed participation of small-scale fishing communities, including indigenous communities, in decision-making process related to any project affecting fishery resources and/or in areas where small scale fisheries operate as well as adjacent land areas, and taking existing power imbalances between different parties into consideration. In that regard, the program will engage with the African Network of Fisher-folk Organizations and Civil Society Consultation groups in each country. It is furthermore in line with the policy framework and reform strategy for fisheries and aquaculture in Africa that identified sustainable small-scale development as a main policy arena with strategic policy action on co-management and inclusive governance. The African BE strategy also stressed the welfare and participation of communities in BE development.

---

[24] *See Cartagena Environmental Strategy on Environmental Pollution and Ban on Styrofoam and plastic bags: https://www.unenvironment.org/cep/news/blogpost/styrofoam-and-plastic-bag-bans-caribbean-interactive-map*

[25] *Cohen et al (2019). "Securing a Just Space for Small-Scale Fisheries in the Blue Economy". Frontiers in Marine Science. https://www.frontiersin.org/articles/10.3389/fmars.2019.00171/full; and FAO Voluntary Guidelines for Securing Sustainable Small-scale Fisheries in the Context of Food Security and Poverty Eradication http://www.fao.org/voluntary-guidelines-small-scale-fisheries/en/*

2.4 BE Environmental accounting

The first marine and coastal economic valuation took place in 1926, when a specialist in fisheries biology, Percy Viosca, estimated the conservation value of Louisiana's coastal wetlands. Recently, accidental marine pollution incidents have increased the need for such valuation: following the 1989 Exxon Valdez oil tanker spill in Alaska[26] in 2008 the American Supreme Court fined Exxon over $1 billion in its final court judgment for ecological losses and compensatory damages. Ecosystem valuations are currently being used to estimate the 2010 Deepwater Horizon oil spill impacts on coastal ecosystems in the Gulf of Mexico.

During the 1990s, such valuations aimed for a larger scale when a team of researchers led by Robert Costanza estimated the economic value the entire world's ecosystem services. They calculated that marine and coastal ecosystem services contributed $21 trillion dollars annually to human well-being: most of these services (60%) are concentrated along coastlines that make up only 9% of the world's surface area (Costanza 1999). These coastal and marine areas – including coastal wetlands and mangroves – represent 77% of the world's total ecosystem services value (Martinez et al. 2007).

Internationally, studies of marine and coastal ecosystem services valuation are increasing numbers: all underscore the importance of marine areas in providing goods and services. In the Mediterranean, these services are estimated to be worth nearly €26 billion annually, with cultural and leisure services providing two-thirds of that total (Mangos et al. 2010). In the United Kingdom, provisioning services are worth €713 million, cultural services €15 billion, regulating services between €840 million to €10 billion, while supporting services exceed €1 trillion (Beaumont et al. 2008). In these valuations, the estimated worth of "commercial" goods and services proves to be relatively less than that of cultural, supporting and regulating services.

Assigning value to biodiversity undeniably contribute to any efforts towards marine resources conservation and sustainable exploitation[27]. Ecosystem services valuation provides a powerful integrated, multi-sector management tool combining knowledge from different disciplines – ecology, biology, economics and social sciences – while expressed in a monetary form understood by all. It provides two crucial policy tools: means to represent the costs of marine ecosystems' degradation

[26] *The loss estimates were determined through an economic analysis, largely surpassing economic losses directly due to the accident and encompassing non-market losses. The less well-known 1978 Amoco Cadiz case bolstered the need to measure the cost of ecological damage but demands for indemnities based on economic valuations were abandoned during litigation.*

[27] *Public and economic policies have long considered nature as res nullius, something that has no owner. Ecosystem services valuation aims to assign a monetary value to nature and the goods and services environmental resources provide. It rests on a double weakness in current policy-making, which neither gives such services their full economic weight nor accounts sufficiently for environmental damage caused by human activity. Setting monetary values for ecosystem services and for anthropogenic degradation of the environment helps create market-based mechanisms to pay for such services, or to compensate for such damages. Ecological economists currently believe this approach represents the only way to curb biodiversity loss; it situates biodiversity in economics and public policy for efficient spending decisions.*

and destruction, and to define the "good" environmental status that the European Union's 2008 Marine Strategy Framework Directive requires by 2020 (EU 2008).

Nevertheless, ecosystem services valuation has its sceptics regarding both its ability to supply accurate data and the use of such data. On large scales, values are often astronomically high: consequently, they are hard to compare to economic reality or to integrate in a national accounting system. Practitioners debate methodological questions, notably issues surrounding benefit transfer[28] and the aggregation and use of the results. Even the core principle of valuation is questioned, since studies tend to show that the more humans exploit an ecosystem, the more its economic value increases, boosted by direct use values (Failler, 2010). Such results run counter to marine biodiversity management policies that tend to limit some ecosystem uses.

At the African level, a recent work done by Tregarot and al. (2020) to assess the value of the services provided by Large Marine Ecosystems (see figure 3 below).

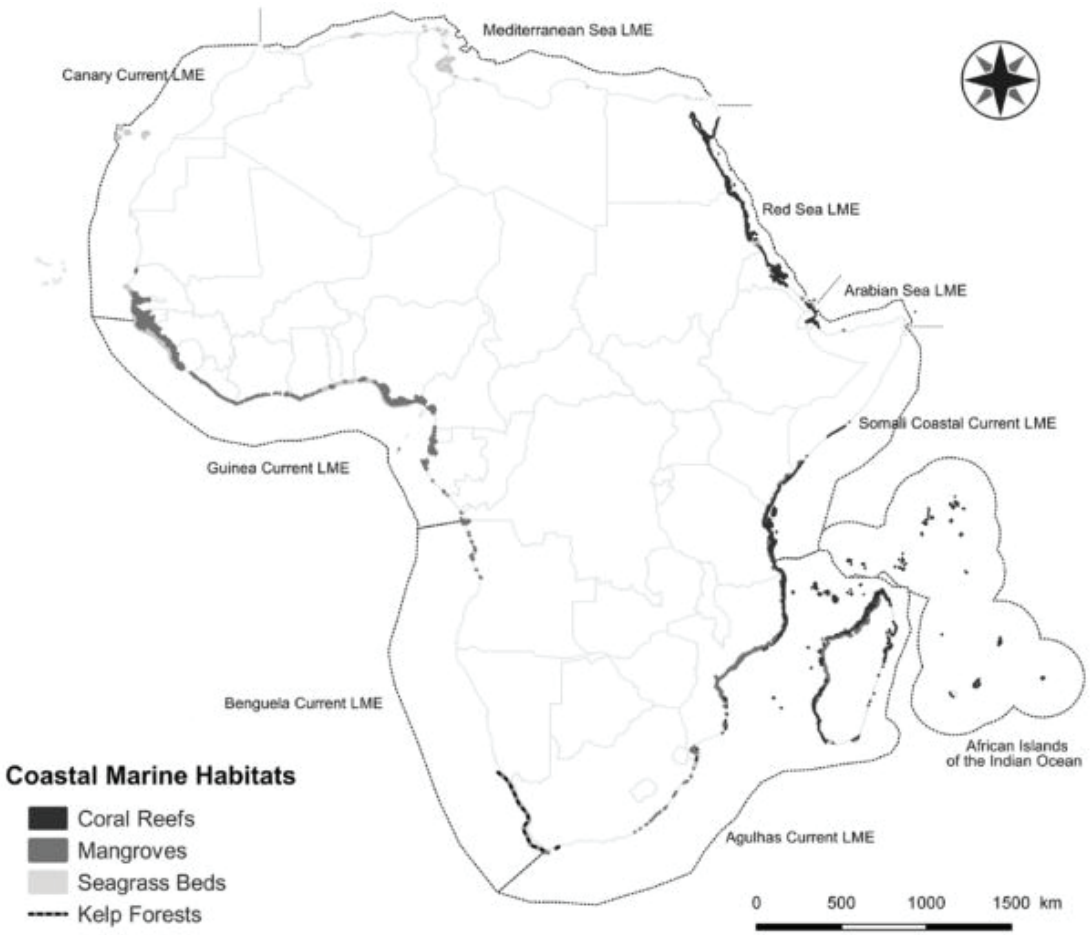

Figure 3: *Distribution of the main coastal marine habitats along African waters, and their divisions into the Large Marine Ecosystems and the additional region (Tregarot et al. 2020)*

[28] *"The benefit transfer method rests on a simple principle: using a valuation conducted on one site, called a 'study site,' to deduce the valuation of a second site, the 'application site'" (Rozan and Stenger 2000).*

The analysis reveals a set of key challenges and monetary losses due to the degradation of coastal habitats and their poor health status in some areas (see table below).

Table 1: *Economic value of marine ecosystem services per African Large Marine Ecosystem, expressed in million USD/year, adjusted by the habitat functionality index for each LME (estimated values), and comparison with reference values (Tregarot et al. 2020)*

Large Marine Ecosystems (LME) and the additional region of Africa	Mangroves	Seagrass beds	Coral reefs	Kelp forests	Total
African Islands of the Indian Ocean	31	279	57,352	–	57,662
Agulhas Current LME	32,491	30,345	242,573	–	305,408
Arabian Sea LME	41	–	10,245	–	10,286
Benguela Current LME	3459	1876	–	445	5780
Canary Current LME	18,017	19,351	–	–	37,368
Guinea Current LME	30,282	45,379	–	–	75,661
Mediterranean Sea LME	–	15,822	–	–	15,822
Red Sea LME	426	21,752	206,411	–	228,589
Somali Coastal Current LME	5813	334	71,388	–	77,535
Total (reference values)	205,422	301,602	876,615	593	1,384,233
Total (estimated values)	90,561	135,137	587,967	445	814,111
%	44%	45%	67%	75%	59%

In that regard, such evaluation exercise should be a starting point for some regions that do not have ecosystem services valuations to rely on. The simple transfer of value of ecosystem services from reference monetary unit values is an approximation at best and must be interpreted with the utmost care. But this method has the advantage of being easily implemented in data-poor regions. The unit reference values of ecosystems can be used locally, with little adjustments, considering the Gross Domestic Product and the socio-economic and environmental contexts.

Valuation estimates can support arguments for establishing Marine Protected Areas when the benefits of such designations outweigh its costs and, more generally, can inform the "preservation versus development" debate in coastal areas. In return, the creation of Marine Protected Areas contributes to achieving the Aichi target 11 and SDG 14 – target 14.5, which is to effectively conserve 10% of coastal and marine areas by 2020 (CBD 2010; United Nations 2015). These results may also support market solutions such as Payment for Ecosystem Services schemes (Palmer and Filoso, 2009). PES schemes, such as 'Reducing Emissions from Deforestation and Degradation' (REDD+), incentivize conservation through 'avoided deforestation', with a service buyer paying a service provider to store carbon that would otherwise be emitted due to land cover change. Payments for avoiding deforestation are rapidly gaining traction in the marine environment, mainly through mangrove research and policymaking under the term 'blue carbon' (Mcleod et al., 2011; Sutton-Grier and Moore, 2016). In fact, many countries are including Blue Carbon in their revised Nationally Determined Contributions (Herr and Landis, 2016) with carbon market makers such as Verra (formerly Verified Carbon Standard; VCS[29]) creating methodologies and standards for seagrass carbon sequestration as well as regional bodies such as IORA (Indian Ocean Rim Association) initiating regional Blue Carbon Think Tanks, among other efforts[30].

[29] See: *https://verra.org*
[30] See: *https://www.iora.int*

More precisely, in the research on "Blue Carbon Accounting" at the international level, Steven, Vanderklift, & Bohler-Muller (2019)'s study found activities that can restore and protect Blue Carbon also offer the potential for developing market-based mechanisms that take advantage of existing frameworks for carbon offsets (also known as carbon credits). Obtaining the monetary value of carbon credits in the international carbon market can provide the basis for Blue Carbon's international trade and cooperation. Ullman et al. (2013) studied the blue carbon market mechanism through the application of the a "climate change policy-regulated cap-and-trade scheme". This scheme specified the maximum allowable green gas emissions that each entity can possess. The limit or cap is allocated or sold to an entity in the form of credits which represent the right to emit a specific amount of gas. It is indicated that the research for Blue Carbon is needed as the existence of carbon credits can be expressed in monetary terms in the economic model. Therefore, this research analysed the Blue Carbon Sequestration from an economic perspective. Moreover, Murray et al. (2011) found that production of Blue Carbon can bring pay off. They built a model that estimated the net return on Blue Carbon development by comparing the value of blue carbon to the cost of conservation. It also provided an estimate of the net economic return (present value of benefits minus present value of costs) of mangroves mitigation for particular countries, from which it can be inferred that if the carbon price is above a certain level, Blue Carbon's Net Payoff can be positive. This approach was extended by using a Cobb-Douglas production function to represent the process of generating value through Blue Carbon protection, ignoring opportunity costs and other costs, and further explore the feasibility of cooperative development of blue carbon. However, the weakness of this study is that it only considered models for individual countries, which may not be comprehensive. Luisetti, et al. (2019) investigated the economic value of the global damage costs to society due to remineralisation following disturbance or loss of the UK's coastal and shelf sea carbon stores. They have applied the case study method. The studied areas include the coastal regions of England, Scotland, Wales and Northern Ireland, and associated UK territorial waters shelf seas (i.e. the Celtic, Irish and North Seas) to the 200m depth contour. They have considered totally three scenarios. The first two future scenarios called "Business as usual (BAU)" and "Continuous growth and climate change (CG&CC)" have considered over 25 years' (2016–2040) environmental change, and the third scenario called "Restoration" is based on Griscom et al. (2017). The results showed that there are large carbon stores in the UK's coastal and shelf sea areas, and the shelf sea sediment store is larger than the coastal store (i.e. saltmarshes and seagrasses combined) in the UK. However, there is a potential for loss of carbon stocks and storage services, both coastal and shelf sea sediment stores can release substantial amount of previously stored carbon when disturbed, this would also apply at the global level. They indicated that in order to establish an equally appropriate carbon accounting framework, transboundary issues related to the location of carbon storage and sequestration in the ocean must also be

addressed within an appropriate governance framework.

The mapping of coastal marine ecosystems is an obvious source of uncertainty, especially seagrass beds, for which the surface area is still a gross approximation. Also, kelp forests are probably not limited to the Benguela Current LME, according to the distribution of laminarian globally (Wernberg et al., 2019), but might also be present in the Canary Current LME and the southern Agulhas Current LME. The distribution of coral reefs and mangroves are considered reasonably representative of the reality at this spatial resolution. Indeed, the surface areas of coral reefs from UNEP-WCMC et al. (2018) is consistent with the ones from The Nature Conservancy in the Red Sea[31], and the work from Fatoyinbo and Simard (2013) and Tang et al. (2018) confirms the surface for mangroves. Other ecosystems present in Africa providing valuable ecosystem services that were omitted, include salt marshes, mudflats, estuaries, sand beaches, and dunes (Barbier et al., 2011; Trégarot et al., 2018). However, ecosystem services are not uniform across a seascape, and considering the surface area alone puts aside any spatial and temporal differences that should be accounted for, such as reef flat width, for their ability to attenuate wave's height (Ferrario et al., 2014), or seasonal fluctuations in the density and biomass of seagrass (Oreska et al., 2017).

In that regard, the assessment of ecosystems' vulnerability is one way to account for spatial variability, and has been developed before at a smaller scale (e.g., Ellison, 2015; Ventura and da Cunha Lana, 2014), with data on environmental and anthropogenic drivers, the adaptive capacity and sensitivity of ecosystems that could not be assessed here. The approach developed in this Tregaro et al. paper is much more simplistic by considering only the demographic pressure but can be easily implemented in other regions. Such an indicator has never been used to adjust the assessment of ecosystem services. Further studies are needed to understand the response of marine ecosystem functioning (and services) to environmental and anthropogenic pressures. In the context of climate change, implementing effective long-term monitoring is fundamental as ecosystems should benefit from actions reinforcing their resilience capacity. It requires identifying tipping points and thresholds of foundation species (Moore, 2018) against the cumulative impact of environmental and anthropogenic drivers (Furlan et al., 2019) and developing models to predict coastal marine ecosystems' trajectories and the benefits that they render to people.

So, ecosystem services valuation's challenge lies in overcoming this services-based approach – so constraining in many ways – and developing an approach based directly on ecosystem functions and their interactions. This calls for an inventory of knowledge from the many disciplines involved in ecosystem valuations, one that establishes connections between fields. Beyond questions of method, however, further work must be done on how to integrate valuations into practical

[31] See: *http://maps.tnc.org/globalmaps.html*

decision-making, making them more relevant and useful for policy-makers. In that regards, assessing the value of ecosystem services is essential to facilitate the dialogue with and between decision-makers and to make choices about public investment. It helps to formulate sound policies for both economic development and nature conservation.

3 Integrated accounting principles and approaches

In 2012, the System of Environmental Economic Accounting Central Framework (SEEA CF) was adopted as an international statistical standard by the UN Statistical Commission to measure the environment and its relationship with the economy (Chow, N/A). It reflects the changing needs of its users, new developments in environmental and economic accounting, and progress in methodological research (United Nations, 2014). The SEEA Experimental Ecosystem Accounting (SEEA EEA), which is currently being revised, complements the Central Framework and represents international efforts toward coherent ecosystem accounting (Chow, N/A). The SEEA CF 2012 has been produced and is released under the auspices of the United Nations, the European Commission, the Organisation for Economic Co-operation and Development, the Food and Agriculture Organization of the United Nations, the World Bank Group, and the International Monetary Fund. It is a statistical framework consisting of a comprehensive set of tables and accounts that can provide guidance for compiling consistent and comparable statistics and indicators for making policies, analysis and research. SEEA describes interactions between the economy and environment, and the stocks and changes in stocks of environmental assets. (United Nations, 2014).

Natural Capital Accounting (NCA) is develop under the 7th Environment Action Programme (EAP) and the EU Biodiversity Strategy, with a focus on ecosystems and their services (include food provision, air and water filtration, pollination, climate regulation and protection against natural disasters such as flooding and many others) (European Union, 2019). The NCA focuses on the part of total wealth generated from mineral, energy, agricultural, soil, timber, and water assets (Rwanda Water Portal, 2020). It is a tool used to measure changes in the natural capital stock at various scales and to integrate the value of ecosystem services into accounting and reporting systems at the European Union and Member States' level (European Commission, 2020). Suggested by European Commission (2015), "It should be seen as a useful tool, as part of a wider toolbox to mainstream biodiversity in economic decision-making and to ensure that natural capital continues to deliver ecosystem services to the economy and society in the long term".

In EU, NCA has emerged as an essential policy support tool for achieving accounting and reporting biodiversity and ecosystem service values and other objectives at the EU and Member State levels. At the EU level, a shared project called the Knowledge Innovation Project for an Integrated system for Natural Capital and ecosystem services Accounting (KIP INCA) was set up to develop an integrated system for natural capital and ecosystem services accounting, aiming to value ecosystem services and integrate them into accounting and reporting systems by 2020 (Ling, King, Mapendembe, & Brown, 2018). The project aims to design and implement an integrated accounting system for ecosystems and their services in the EU by connecting relevant existing projects and data (European Commission, 2020). Badura, Ferrini, Agarwala, & Turner (2017) provided overviews of the main issues surrounding valuation methodologies in the context of ecosystem and natural capital accounting and the possible approaches for valuing crop pollination and recreation within the KIP INCA. It also indicated how NCA can contribute to wider strategy and policy analysis. Turner, Badura, & Ferrini (2019) proposed a framework for considering different evaluation methods within the NCA framework and explored how to evaluate ecosystem services and the benefits they provide. They also reviewed a series of case studies on NCA and illustrates a number of advantages that the systematic application of accounting practices can bring to the policy process. Following the reports mentioned above, the NCA report (2019), published by the European Union, provides a brief overview of natural capital accounting, and more specifically, ecosystem accounting. It highlighted that NCA can contribute to the better management of the European Union's natural capital as it can help mainstream biodiversity and ecosystems in economic decision-making and ensure that natural capital continues delivering ecosystem services to our economy and society in the long-term.

4 In Practice and Way forward

Despite efforts over the last decade, integrated accounting is still in its infancy. The main reason for this very slow progress at the international level (lead by SEEA) is the lack of interest by States who are still mainly looking at the economic growth without fully considering the Environmental and Social dimension.

The development of the Blue Economy in Africa is suffering from the same lack which consist in ignoring or failing to give as much attention to Environmental and Social dimensions as they do to the Economic one. In that regards, Blue Economy strategies and policies should be built around an equal consideration of the environmental, social and economic dimensions that can be shaped into a Blue Economy Integrated Accounting mechanism.

4.1 UNECA Blue Economy Valuation Toolkit

The UNECA Blue Economy Valuation Toolkit (BEVTK) recently paved the way for the development of an African national BE accounting system. The BEVTK was developed as a valuation toolkit to guide sub-regional and national in-depth socio-economic assessments that will support informed decision-making[32]. It complements the multisectoral approach and step-by-step methodology for policy development highlighted in the Blue Economy Policy Handbook for Africa (UNECA, 2016). As such, BEVTK can be used for socio-economic assessments aimed to provide an accurate snapshot of the potential of the Blue Economy of African countries. The quality of any country's assessment using BEVTK depends on the amount of data available and usable and as such it is crucial that such data be collected as completely and timely as possible. The more relevant data are available and can then be inputted into the BEVTK, the better the tool will be able to draw an accurate picture of the country's contribution to the Blue Economy.

With the UNECA BEVTK, the intent was to build a tool capable of capturing the various dimensions of human interactions with our "Blue environment" (ocean, lakes, rivers, etc..) and capable of recording the various types of benefits (utilitarian, hedonistic and/ or monetary) people gained from it.

The 3 main dimensions looked at and focused on are therefore:

- Any Economic Activities associated with the Blue Economy,
- Any Social Dimension of human interaction with the Blue Economy and
- Any Ecosystem Services related to the "Blue economy"

The Toolkit is flexible and comprehensive enough to represent any country within UNECA scope (coastal, insular or landlocked). To do so, classifications and nomenclatures systems widely accepted among international experts, compatible with systems used nationally have been used (SNA, NCA, SEEA, …). They are easily comprehensible by all stakeholders. The BEVTK is organised around 3 modules:

- Economics Activities associated with the blue economy,
- Social Dimension associated with the blue economy
- Ecosystem Services associated with the blue economy

[32] *See P. Lallemand and P. Failler (2020).*

The flows of information coming in and coming out of the tool are as follows:

1. Collection of data for each module from various sources (e.g. SNA, NCA, LME organisations, UNDP, UNEP, AU-IBAR, World Bank, etc.)
2. Data entry in the tool using predefined tabular templates and customized nested list of categories following specific nomenclatures for each module.
3. Automatic production of summary tables and charts for each module dynamically linked to the corresponding tabular data.
4. Consolidation of the summary tables and charts from the 3 modules into a "snapshot" summarising the country's contribution to the blue economy with some sensitivity analysis capabilities such as:
   a. Simulating a change in the state of the economy through changes in inflation, exchange rates,
   b. Simulating a change in the country's state of the environment through changes in the quality of the ecosystem and
   c. Simulating a change in the country's social dimension through changes in, for example, unemployment level, level of poverty, gender inequality, fair trades, etc.

To facilitate the comparison and the consolidation of the collected data in each of the three modules, the BEVTK includes a utility facility composed of historical exchange rates for each country going back 10 years and a table of deflators by country covering the same period. The facility also stores basic information on each country's physical and geographic characteristics, flags, national currency, GDP, etc. To control how data are entered into the tool, templates were used incorporating internationally accepted systems of standards used by experts across the globe in each relevant dimension and following a system of nested categories and sub-categories:

- Economic Activity: International Standard Industrial Classification or ISIC Nomenclature (revision 4)
- Social Dimension: Social Indexes from UNDEP (Human Development Indexes such as (Gini, MPI, GII, ...) ,World Bank and from other Internationally recognized organizations.
- Ecosystem Services: IUCN Habitats Classification Scheme (version 3.1) to describe each relevant Ecosystem and Common International Classification of Ecosystem Services or CICES Nomenclature (version 5.1)

Figure below shows the flows and various stages in the BEVTK from when the data are collected to when there are transcribed, standardised, calibrated, summarised and finally presented.

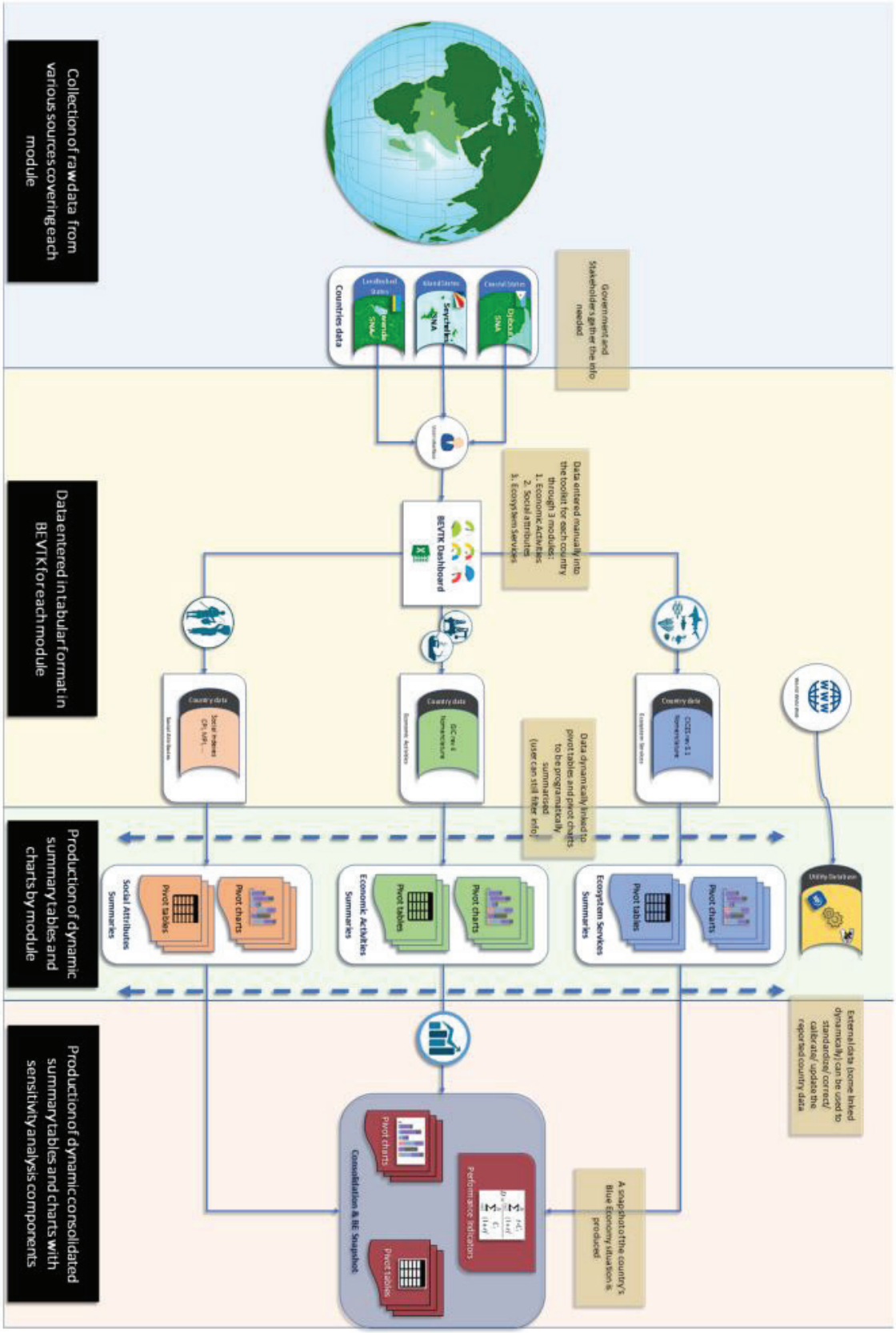

Figure 4: *Diagram showing the final module-based structure of the Blue Economy Valuation Toolkit*

4.2 Seychelles Blue Economy Accounting

Seychelles began to adopt the UN SNA in 2007[33], just prior to defaulting on interest payments on a $230M Eurobond due to its foreign exchange reserves having been exhausted[34]. By 2013 Seychelles had transitioned to a market-based economy, with the assistance of the International Monetary Fund. Since then, Seychelles' National Bureau of Statistics (NBS) has captured accounts from most sectors of the economy, coding them with the International Standard of Industry Classification (ISIC Revision 4)[35].

Seychelles was an early adopter of the Blue Economy concept, being an advocate since the Rio+20 Conference on Sustainable Development in 2012. The government established a Blue Economy Department in 2015, which forms part of the Ministry of Finance, Trade and the Blue Economy, with the department being under the portfolio of the Vice-President[36].

The capturing of, and accounting for, blue economy activities is in its infancy in Seychelles. Like other countries, Seychelles' current SNA does not account for stocks and flows of natural capital, nor does it account for activities that are solely applicable to the Blue Economy. This should be addressed urgently as the country's economy, particularly its two primary industries tourism and fisheries, is heavily dependent on the health and quality of its marine natural capital[37] as well as the world sanitary situation that constraints the tourism activity. Traditionally, the management of coastal and marine ecosystems have been compromised by "insufficient financing, capacity, and legal and institutional frameworks"[38].

Yet, Seychelles has and is conducting several projects in to better understand the economic importance of its industries; some of the projects are in line with progress toward Blue Economy accounting. A fisheries satellite account (FSA)[39] has been piloted and currently a tourism satellite account (TSA) is being developed[40]. The United Nations Development Program's Biodiversity Finance Initiative (BIOFIN) conducted a series of investigations in Seychelles with a view to assist with implementing biodiversity financing, however Seychelles' graduation to high income status saw them lose the development assistance of this program, as well as many others. Nonetheless,

[33] *https://www.nbs.gov.sc/statistics/national-accounts*
[34] *https://www.cia.gov/library/publications/the-world-factbook/geos/se.html*
[35] *https://www.nbs.gov.sc/statistics/national-accounts*
[36] *Republic of Seychelles. 2019. Seychelles Blue Economy: Strategic Policy Framework and Roadmap Charting the future (2018-2030). The Commonwealth Secretariat. http://www.seychellesconsulate.org.hk/download/Blue_Economy_Road_Map.pdf*
[37] *Ministry of Finance Trade and Economic Planning. (2017). Third South West Indian Ocean Fisheries Governance and Shared Growth Project (SWIOFish3): Environmental and Social Management Framework for SWIOFish3 Project. Victoria, Mahé. http://www.finance.gov.sc/uploads/resources/170504%20SWIOFish3%20-%20Final%20ESMF.pdf*
[38] *Ibid.*
[39] *Tsuji, S. 2019. Progress Report of the IOTC-OFCF Collaborative Project, Phase V. Overseas Fishery Cooperation Foundation of Japan. https://www.iotc.org/sites/default/files/documents/2019/11/IOTC-2019-WPDCS15-INF03.pdf*
[40] *https://www.unwto.org/africa/news/2019-07-10/mission-develop-tourism-satellite-account-kicks-start-seychelles*

BIOFIN identified a series of possibilities for financing biodiversity protection and management[41] . The Seychelles Fishing Authority (SFA) has strategic management initiatives aimed at enhancing the management and reporting of fisheries, such as the Fisheries Economics Intelligence Unit which has been under development since 2015, the Fisheries Economic and Information Division[42], as well as Seychelles being party to the Fisheries Transparency Initiative and the Extractive Industries Transparency Initiative.

Under the UNECA BEVTK project, Blue Economy activities have been captured as well as environmental and social elements. Outcomes of the BEVTK is presented in the figure bellow.

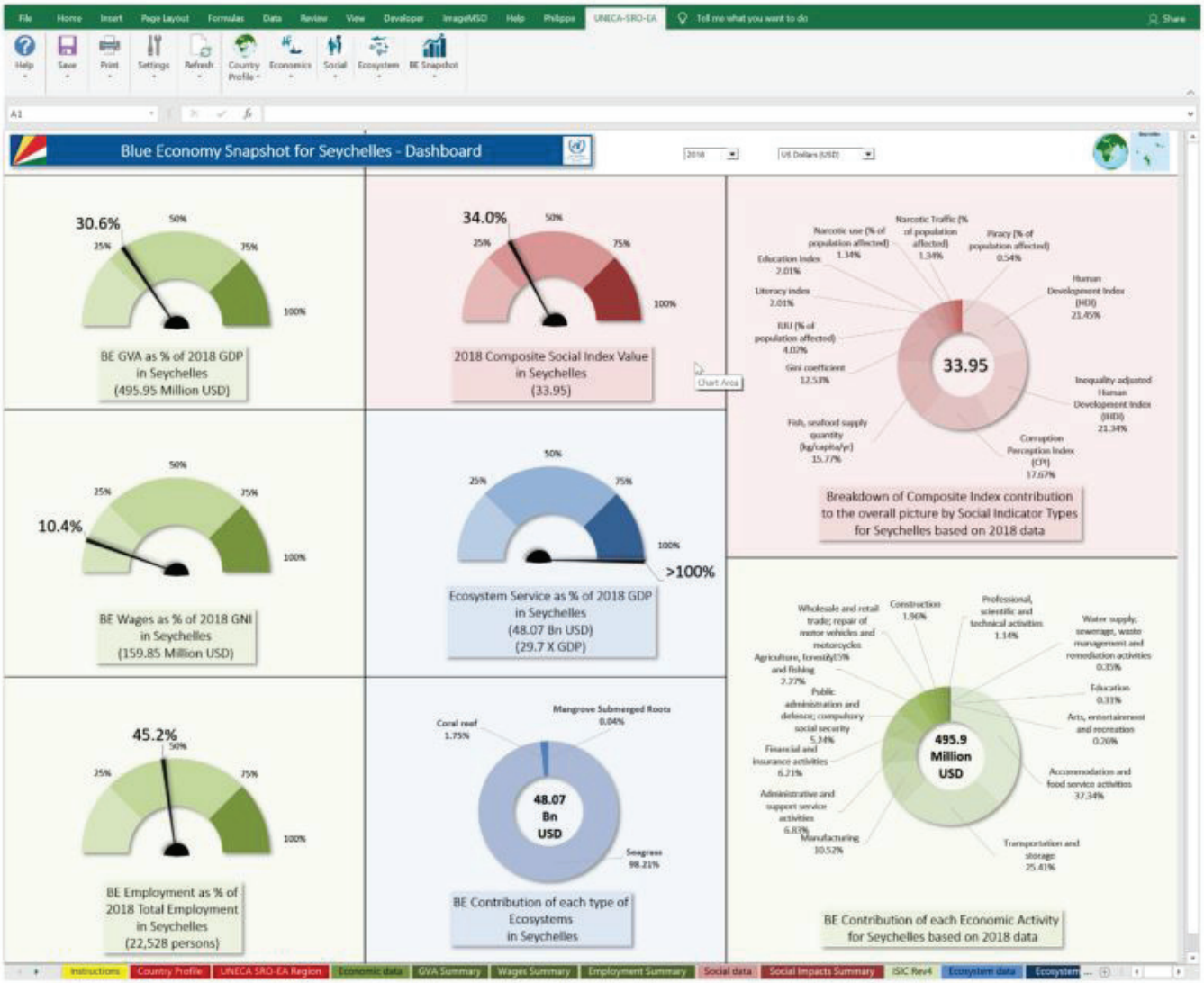

Figure 2: *UNECA BEVTK outcomes for Seychelles*

The BEVTK has provided for the first time a meaningful overview of the blue economy in the country from the 3 angles. UNECA intends to develop a more sophisticated BE satellite account, allowing for accurate reporting of this portion of the economy on a yearly basis. The project is currently under development as a pilot project with Jamaica and the Caribbean Development Bank.

[41] *BIOFIN. 2015. BIOFIN Seychelles: Policy and Institutional Review. UNDP. http://www.biodiversityfinance.org/index.php/knowledge-product/seychelles-policy-and-institutional-review*

[42] *Lallemand, P. 2015. Supporting the improvement of marine fisheries governance and management in Seychelles: Economic study on major trends in the tuna industry and its impact on the Seychelles economy over the 5 year period, 2009-2013. Smart Fish: Indian Ocean Commission. http://www.fao.org/3/a-bl764e.pdf*

Despite the lack of current BE accounting system in place, the small island developing state has been highly successful in attracting funding for its transition to a sustainable blue economy mainly because of its ability to show and monitor economic and environmental achievements. Investment in the Blue Economy has come through the Seychelles Debt for Nature Swap which resulted in the protection of 30% of Seychelles EEZ and grant funds for BE innovation, disbursed by the Seychelles Conservation and Climate Adaptation Trust (SeyCCAT)[43]; Seychelles innovative and first of its kind Blue Bond with proceeds to be used specifically for improvements in priority fisheries governance, expanding the current marine protected areas (MPAs) and the development of the Blue Economy[44]; development funding through the World Bank Group's Third South West Indian Ocean Fisheries Governance and Shared Growth Project (SWIOFish3) with funding and guarantees from the Global Environment Facility, the International Bank for Reconstruction and Development and Seychelles Blue Bond[45]; an independent public-private trust fund, SeyCCAT, which disburses the grant money received from the Debt for Nature Swap and Blue Bond, as well as attracting philanthropic funds and additional grant funding and capital; , EU Fisheries Grant, Possibility of future funding

Seychelles is also investigating the feasibility of including its Blue Carbon (BC) resources, which in Seychelles comprise of seagrass meadows and mangrove forests, in its revised Nationally Determined Contribution[46] and the likelihood of trading BC credits in the future, whilst there have also been discussions surrounding investment into marine biotechnology as a future prospect. Despite the positive progress Seychelles has made, many of these projects are yet to be realized. Additionally, aside from the Blue Economy valuation toolkit and formal economic accounts, many gaps still exist in capturing the impact of the Blue Economy, and little progress has been made toward establishing a sound natural capital accounting system which should capture changes in stocks and flows of natural capital and ecosystem services, as well as monitoring the underlying health of the habitats that support the natural capital.

4.3 Way forward

The main challenge for the implementation of the BE accounting in African countries lies within the set-up of a national framework that should preceded any BE development process. Without recording progresses in economics, environment and social aspects, it is not possible to guide the policy and provide recommendations on the measures to be taken to correct and improve the

[43] *Hindle, J. 2019. Investing in the Blue Economy: How should impact be measured? Imperial College Business School. https://imperialcollegelondon.app.box.com/s/yjlasicw8jf9vtcpldakdhacqr8ujxcq*

[44] *Roth, N., Thiele, T. & von Unger, M. 2019. Blue Bonds: Financing Resilience of Coastal Ecosystems – Key points for enhancing finance action. IUCN. https://www.4climate.com/dev/wp-content/uploads/2019/04/Blue-Bonds_final.pdf*

[45] *Ministry of Finance Trade and Economic Planning. (2017). Third South West Indian Ocean Fisheries Governance and Shared Growth Project (SWIOFish3): Environmental and Social Management Framework for SWIOFish3 Project. Victoria, Mahé. http://www.finance.gov.sc/uploads/resources/170504%20SWIOFish3%20-%20Final%20ESMF.pdf*

[46] *Cabo Verde also aims to include blue carbon into its NDC in 2022.*

current situation. The data coverage, access, collection, etc, should be led by the national statistical office that have to coordinate the agencies and departments in charge of the implementation and monitoring of policies/measures and as such of the key data.

For the UNECA toolkit, that is ready to use right now, the main challenge remains to collect the necessary information needed to run it. Some missing information require surveys to be conducted to collect them. The toolkit was designed as a dynamic decision-making tool and as such is flexible enough to accommodate user defined categories in each of the 3 modules and for any user to add items to the predefined list which are easily accessible by the user throughout the BEVTK. As such the application of toolkit can be seen as a preparatory phase for the development of a proper BE accounting. From its application in Djibouti and Rwanda, alongside with Seychelles, the key identifies challenges the lack of governance structure and a lack of understanding of blue potential, especially biodiversity and how much it can contribute to the BE development. From a socio-economic perspective, the valuation faced some challenges in several areas. Firstly, a lack of socio-economic data made it difficult to fill in several gaps of the toolkit. Secondly, data from national accounts are not properly harmonised, where some sectors have major contribution to informal sector, others the more formal sector, creating incongruencies of their contribution, thus not all sectors that contribute to the BE could be included due to lack of data of their contribution. From the environmental angle, the lack of knowledge of blue ecosystems is a key issue: no proper indications on their coverage, their ecosystem services, their ecological condition, etc. that reduce considerably their considering[47]. The same issue exist with the social data as there is no specific framework dedicated to data collection on gender, work condition, etc. for the BE sectors.

From a practical perspective, the development of the BE accounting should be done in a unified way and coordinated by a supra-national institution such as the African development Bank that is already in charge of the production of the African country outlook[48]. In that way, it will ensure that all situations are taken into consideration within a modulable framework. It will also allow comparisons between countries as data collection, treatment and presentation will be standardized.

[47] *For a review of the BE coastal and marine ecosystem services, see Trégarot et al. (2020), Valuation of coastal ecosystem services in the Large Marine Ecosystems of Africa. https://www.sciencedirect.com/science/article/pii/S2211464520301068*

[48] See: *https://www.afdb.org/en/knowledge/publications/african-economic-outlook*

References

1. Ahmed, Z. O. (2020). Djibouti, rapport Intérimaire d'évaluation de l'économie bleue et développement de boite à outil. Commission Economique pour l'Afrique (UNECA), unpublished report.
2. Alkire, S., & Jahan, S. (2018). The New Global MPI 2018: Aligning with the Sustainable Development Goals, HDRO Occasional Paper. United Nations Development Programme (UNDP). Retrieved from http://hdr.undp.org/sites/default/files/2018_mpi_jahan_alkire.pdf
3. Alongi, D. M. (2018). Blue carbon: Coastal sequestration for climate change mitigation. Cham, Switzerland: Springer.
4. Atwood, T. B., Connolly, R. M., Ritchie, E. G., Lovelock, C. E., Heithaus, M. R., Hays, G. C., Macreadie, P. I. (2015). Predators help protect carbon stocks in blue carbon ecosystems. Nature Climate Change, 5(12), 1038-1045. doi:https://doi.org/10.1038/nclimate2763
5. AU-IBAR, 2019. Africa Blue Economy Strategy. African Union – Interafrican Bureau for Animal resources, Nairobi, Kenya. https://www.au-ibar.org/strategy-documents (accessed June 8, 2020).
6. AU-IBAR. (2020). Africa Blue Economy Strategy. Nairobi, Kenya.
7. AUC and NPCA (2014). The Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa.
8. Bacon, E., Gannon, P., Stephen, S., Seyoum-Edjigu, E., Schmidt, M., Lang, B., Sandwith, T., Xin, J., Arora, S., and Adham, K.N. 2019. Aichi Biodiversity Target 11 in the like-minded megadiverse countries. Journal for Nature Conservation 51, 125723.
9. Badura, T., Ferrini, S., Agarwala, M., & Turner, K. (2017). Valuation for Natural Capital and Ecosystem Accounting. Synthesis report for the European Commission. Norwich: CSERGE, University of East Anglia.
10. Barbier, E. B., Hacker, S. D., Kennedy, C., Koch, E. W., Stier, A. C., Silliman, B. R. 2011. The value of estuarine and coastal ecosystem services. Ecological monographs, 81, 169-193.
11. Beaumont, N.J., Austen, M.C., Mangi S.C. and Townsend, M. (2008). Economic valuation for the conservation of marine biodiversity. Marine Pollution Bulletin, 56(3), 386-396
12. Binet, T., Doumbouya, A., Sall, A. 2012. Évaluation de la valeur socio-économique des écosystèmes marins et côtiers des Aires marines protégées de l'Afrique de l'Ouest. Report for PRCM. 200 pp.
13. Blamey, L.K., Bolton, J.J. 2018. The economic value of South African kelp forests and temperate reefs: past, present and future. Journal of Marine Systems 188, 172-181.
14. Bolton, J.J. 2010. The biogeography of kelps (Laminariales, Phaeophyceae): a global analysis with new insights from recent advances in molecular phylogenetics. Helgoland Marine Research, 64, 263-279.
15. Bonnin, M., Failler, P., Laë, R. 2015. Des AMP pour la résilience des écosystèmes. In : Bonnin, M., Laë, R., Behnassi, M. Aires Marines Protégées Ouest-Africaines : défis scientifiques et enjeux sociétaux. IRD. Paris, France, pp. 197–209.
16. Braat, L.C., ten Brink, P.E., Klok, T.C. 2008. The Cost of Policy Inaction: The case of not meeting the 2010 biodiversity target. Wageningen, Alterra, Alterra-rapport 1718. 312 p.
17. Bryan, T., Virdin, J., Vegh, T., Kot, C.Y., Cleary, J., Halpin, P.N. 2020. Blue carbon conservation in West Africa: a first assessment of feasibility. Journal of Coastal Conservation 24, 8.
18. Bunting, P., Rosenqvist, A., Lucas, R., Rebelo, L., Hilarides, L., Thomas, N., Hardy, A., Itoh, T., Shimada, M., Finlayson, C. 2018. The global mangrove watch—a new 2010 global baseline of mangrove extent. Remote Sensing 10, 1669.
19. Cabral, P., Augusto, G., Akande, A., Costa, A., Amade, N., Niquisse, S., Atumane, A., Cuna, A., Kazemi, K., Mlucasse, R. 2017. Assessing Mozambique's exposure to coastal climate hazards and erosion. International journal of disaster risk reduction 23, 45-52.
20. Cardinale, B.J., Duffy, J.E., Gonzalez, A., Hooper, D.U., Perrings, C., Venail, P., Narwani, A., Mace, G.M., Tilman, D., Wardle, D.A. 2012. Biodiversity loss and its impact on humanity. Nature 486, 59-67.
21. CBD 2010. Aichi biodiversity targets. In : COP 10 Decision X/2: Strategic Plan for Biodiversity, 2011-2020.
22. CBD 2018. Pan-African Action Agenda on Ecosystem Restoration for Increased Resilience. Convention on Biological Diversity. https://www.cbd.int/doc/c/274b/80e7/34d341167178fe08effd0900/cop-14-afr-hls-04-final-en.pdf (accessed 5 June 2020).
23. POSEIDON. (2017). Study on the establishment of a framework for processing and analysing of maritime economic data in Europe. MARE/2014/45. European Union, Department A - COSME, H2020 SME and EMFF. Unit A3.1 EMFF – Integrated Maritime Policy. Brussel: Executive Agency for Small and Medium-sized Enterprises (EASME). doi:10.2826/97472
24. Chen, D. (2015). Construction and Application of Marine Ecological-Economic Model. Beijing: People's Publishing House.
25. Chevassus-au-Louis, B., Salles, J.-M., Bielsa, S., Richard, D., Martin, G. and Pujol, J.-L. (2009). Analyse économique de la biodiversité et des services liés aux écosystèmes: Contribution à la décision publique. Paris: Centre d'Analyse Stratégique.
26. Chow, J. (N/A). Natural Capital Accounting and Valuation of Ecosystem Services (NCA&VES) project. Retrieved from System of Environmental Economic Account (SEEA): https://seea.un.org/sites/seea.un.org/files/documents/overview_of_ncaves_project_in_china.pdf
27. Chukwuone, N.A., Ukwe, C.N., Onugu, A., Ibe, C.A. 2009. Valuing the Guinea current large marine ecosystem: Estimates of direct output impact of relevant marine activities. Ocean & Coastal Management 52, 189-196.
28. Cicin-Sain, B., Balgos, M., Appiott, J., Wowk, K., & Hamon, G. (2011). Oceansat Rio+20: How Well Are We Doing in Meeting the Commitments from the 1992 Earth Summit and the 2002 World Summit on Sustainable Development? Summary for Decision Makers. Global Ocean Forum.
29. Clark, C.W. 1990. Mathematical Bioeconomics: the Optimal Management of Renewable Resources. Wiley Interscience, New York.

30. CMAE, UA, UNEP 2019. Conférence ministérielle africaine sur l'environnement – Promouvoir l'économie bleue/océanique en Afrique : Note du secrétariat. 17th session by African Ministerial Conference on the Environment, African Union and UNEP, Durban, South Africa, 14-15 November 2019.
31. Cole, S.G., Moksnes, P.-O. 2016. Valuing multiple eelgrass ecosystem services in Sweden: fish production and uptake of carbon and nitrogen. Frontiers in Marine Science 2, 121.
32. Conathan, M., & Moore, S. (2015). Developing a Blue Economy in China and the United States. Center for American Progress. Retrieved from https://cdn.americanprogress.org/wp-content/uploads/2015/05/ChinaBlueEcon-report-final.pdf
33. Costanza, R. (1999). The ecological, economic, and social importance of the oceans. Ecological Economics, 31, 199–214.
34. Costanza, R., De Groot, R., Braat, L., Kubiszewski, I., Fioramonti, L., Sutton, P., Farber, S., Grasso, M. 2017. Twenty years of ecosystem services: how far have we come and how far do we still need to go? Ecosystem services 28, 1-16.
35. Creed, J.C., Engelen, A.H., Bandeira, S., Serrão, E.A. 2016. First record of seagrass in Cape Verde, eastern Atlantic. Marine Biodiversity Records 9, 1-4.
36. Creel, L., 2003. Ripple effects: population and coastal regions. Washington, DC: Population Reference Bureau, pp. 1-7.
37. Crooks, S., von Unger, M., Schile, L., Allen, C., & Whisnant, R. (2017). Understanding Strategic Blue Carbon Opportunities in the Seas of East Asia. Quezon City, Philippines: PEMSEA.
38. Culhane, F.E., Frid, C.L., Gelabert, E.R., Piet, G., White, L., Robinson, L.A. 2020. Assessing the capacity of European regional seas to supply ecosystem services using marine status assessments. Ocean & Coastal Management 190, 105154.
39. Cullis-Suzuki, S., & Pauly, D. (2010). Failing the high seas: a global evaluation of regional fisheries management organizations. Marine Policy, 34(5), 1036-1042. doi:https://doi.org/10.1016/j.marpol.2010.03.002
40. Czúcz, B., Arany, I., Potschin-Young, M., Bereczki, K., Kertész, M., Kiss, M., Aszalós, R., Haines-Young, R. 2018. Where concepts meet the real world: A systematic review of ecosystem service indicators and their classification using CICES. Ecosystem Services, 29, 145-157.
41. Dawson, T. P., Rounsevell, M. D., Kluvánková-Oravská, T., Chobotová, V., Stirling, A. 2010. Dynamic properties of complex adaptive ecosystems: implications for the sustainability of service provision. Biodiversity and conservation, 19(10), 2843-2853.
42. Devi, S. 2019. Cyclone Idai: 1 month later, devastation persists. The Lancet 393, 1585.
43. Dewsbury, B.M., Bhat, M., Fourqurean, J.W. 2016. A review of seagrass economic valuations: gaps and progress in valuation approaches. Ecosystem Services 18, 68-77.
44. Di Marco, M., Santini, L. 2015. Human pressures predict species' geographic range size better than biological traits. Global Change Biology 21(6), 2169-2178.
45. Ellison, J. 2015. Vulnerability assessment of mangroves to climate change and sea-level rise impacts. Wetlands Ecology & Management 23(2), 115-137.
46. Emerton, L. 2013. Using valuation to make the case for economic incentives: promoting investments in marine and coastal ecosystems as development infrastructure. In: Essam, M. (ed) Economic Incentives for Marine and Coastal Conservation: Prospects, Challenges and Policy Implications. Earthscan, London.
47. European Commission. (2012). Blue Growth, Scenarios and drivers for Sustainable Growth from the Oceans, Seas and Coasts: Third Interim Report. Rotterdam/Brussels: European Commission, DG MARE.
48. European Commission. (2015). The Added Value of Natural Capital Accounting for EU policies. European Commission.
49. European Commission. (2020). Natural Capital Accounting. Retrieved from European Commission: https://ec.europa.eu/environment/nature/capital_accounting/index_en.htm
50. European Union (EU) (2008). Marine Strategy Framework Directive 2008/56/EC. Brussels: European Commission. Retrieved from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF
51. European Union. (2019). Natural Capital Accounting: Overview and Progress in the European Union. Luxembourg: Publications Office of the European Union. doi:10. 2779/819449
52. Failler P., Petre, E., Charrier, F. and Marechal, J.-P. (2010). Détermination de la valeur socio-économique des récifs coralliens et écosystèmes associés (mangroves, herbiers de phanérogames, zones littorales envasées) de Martinique, Plan d'actions national IFRECOR 2006-2010.Fort-de-France, Martinique: Ecology Ministry.
53. Failler, P., (2010) Déterminer la valeur socio-économique des récifs coralliens et écosystèmes associés de la Martinique, un préalable à la conception de politiques publiques. Conference presentation, AFD Conference "Du vert dans l'Outremer," 23 June 2009.
54. Failler, P., Pètre, É., Binet, T., Maréchal, J.-P. 2015. Valuation of marine and coastal ecosystem services as a tool for conservation: The case of Martinique in the Caribbean. Ecosystem services, 11, 67-75.
55. Failler, P., Pètre, É., Maréchal, J.-P. 2010. Détermination de la valeur socio-économique des récifs coralliens des mangroves et herbiers de phanérogames de la Martinique. Report for the Direction Régionale de l'Environnement Martinique. 169 pp.
56. Failler, P., Touron-Gardic, G., Traore, M.-S. 2019. Is Aichi Target 11 Progress Correctly Measured for Developing Countries ? Trends in Ecology & Evolution. Elsevier Ltd. doi: 10.1016/j.tree.2019.07.007.
57. Fatoyinbo, T.E., Simard, M. 2013. Height and biomass of mangroves in Africa from ICESat/GLAS and SRTM. International Journal of Remote Sensing 34(2), 668-681.
58. Ferrario, F., Beck, M.W., Storlazzi, C.D., Micheli, F., Shepard, C.C., Airoldi, L. 2014. The effectiveness of coral reefs for coastal hazard risk reduction and adaptation. Nature communications, 5, 1-9.
59. Foley, N., Armstrong, C.W. 2010. The ecological and economic value of cold-water coral ecosystems. 39 p. Retrieved from https://munin.uit.no/

60. Folke, C., Carpenter, S., Walker, B., Scheffer, M., Elmqvist, T., Gunderson, L., Holling, C.S. 2004. Regime shifts, resilience, and biodiversity in ecosystem management. Annual Review of Ecology, Evolution and Systematics 35(1), 557-581.
61. Freiwald, A., Fossa, J.H., Grehan, A., Koslow, T., Roberts, J.M. 2004. Cold-water coral reefs: out of sight-no longer out of mind. UNEP-WCMC, Cambridge, UK, 86 p.
62. Furlan, E., Torresan, S., Critto, A., Lovato, T., Solidoro, C., Lazzari, P., Marcomini, A. 2019. Cumulative Impact Index for the Adriatic Sea: Accounting for interactions among climate and anthropogenic pressures. Science of The Total Environment 670, 379-397.
63. Greene, C., Kuehne, L., Rice, C., Fresh, K., Penttila, D. 2015. Forty years of change in forage fish and jellyfish abundance across greater Puget Sound, Washington (USA): anthropogenic and climate associations. Marine Ecology Progress Series 525, 153-170.
64. Griscom, B., Adams, J., Ellis, P., Houghton, R., Lomax, G., Miteva, D., Fargione, J. (2017). Natural climate solutions. Proceedings of the National Academy of Sciences, 114(44), 11645-11650.
65. Gund Institute (2007). MIMES Project: Dynamics, Modeling, and Valuation to Facilitate Conservation. Burlington, VT: University of Vermont. Retrieved from http://www.uvm.edu/giee/?Page=research/ecosystemservices/index.html
66. Haines-Young, R., & Potschin, M. (2018). Common International Classification of Ecosystem Services (CICES) V5.1 Guidance on the Application of the Revised Structure. Nottingham, NG11 0AE, UK: Fabis Consulting Ltd. Retrieved from https://cices.eu/content/uploads/sites/8/2018/01/Guidance-V51-01012018.pdf
67. Haines-Young, R., Potschin, M.B. 2018. Common International Classification of Ecosystem Services (CICES) V5.1 and Guidance on the Application of the Revised Structure.
68. Hamukuaya, H. 2011. An Overview of Management of Large Marine Ecosystems and Evidence of Impacts of Climate Change. Paper presented at the COP 17 Oceans Day on behalf of African LME Caucus. Durban, South.
69. Hebbeln, D., Bender, M., Gaide, S., Titschack, J., Vandorpe, T., Van Rooij, D., Wintersteller, P., Wienberg, C. 2019. Thousands of cold-water coral mounds along the Moroccan Atlantic continental margin: Distribution and morphometry. Marine Geology 411, 51-61.
70. Herr, D., Landis, E. 2016. Coastal blue carbon ecosystems. Opportunities for nationally determined contributions. Policy brief. Gland, Switzerland: IUCN. Washington, DC: TNC.
71. Herr, D., Pidgeon, E., & Laffoley, D. d. (2012). Blue carbon policy framework 2.0: based on the discussion of the International Blue Carbon Policy Working Group. IUCN.
72. Himes-Cornell, A., Grose, S.O., Pendleton, L. 2018a. Mangrove ecosystem service values and methodological approaches to valuation: Where do we stand? Frontiers in Marine Science 5, 376.
73. Himes-Cornell, A., Pendleton, L., Atiyah, P. 2018b. Valuing ecosystem services from blue forests: a systematic review of the valuation of salt marshes, sea grass beds and mangrove forests. Ecosystem Services, 30, 36-48.
74. Houghton, K. (2014). A sustainable development goal for the ocean: moving from goal framing towards targets and indicators for implementation. Potsdam, Germany, Working paper published by the Institute for Advanced Sustainability Studies.
75. ILO. (2020, December). World Social Protection Data Dashboards. Retrieved from Social protection platform: https://www.social-protection.org/gimi/WSPDB.action?id=32
76. Interwies, E. (2011). The Economic and Social Value of the Guinea Current Ecosystem – a First Approximation. Retrieved from: http://gclme. iwlearn.org/publications/our-publications/the-economic-and-the- social-value-of-gclme
77. Interwies, E., Görlitz, S. 2013. Economic and social valuation of the CCLME ecosystem services. In : Rapport au Groupe de travail socioéconomie et commerce du CCLME, vol. 50.
78. IOC-UNESCO, UNEP 2016. Large Marine Ecosystems: Status and Trends, Summary for Policy Makers. Nairobi, Kenya.
79. IPBES 2018. The regional assessment report on biodiversity and ecosystem services for Africa. Bonn, Germany. https://ipbes.net/assessment-reports/africa (accessed June 5, 2020).
80. IUCN. (2012). IUCN Habitats Classification Scheme. Retrieved November 2020, from Guidance Habitats Classification Scheme: https://nc.iucnredlist.org/redlist/content/attachment_files/dec_2012_guidance_habitats_classification_scheme.pdf
81. Jayathilake, D.R.M., Costello, M.J. 2018. A modelled global distribution of the seagrass biome. Biological Conservation 226, 120-126.
82. Jia, M. M. (2014). Remote Sensing Analysis of China's Mangrove Forests Dynamics During 1973 to 2013. Changchun, China: Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences.
83. Jiang, Z., Liu, S., Zhang, J., Zhao, C., Wu, Y., Yu, S., Kumar, M. (2017). Newly discovered seagrass beds and their potential for blue carbon in the coastal seas of Hainan Island, South China Sea. Marine pollution bulletin, 125(1-2), 513-521.
84. Jiao, N., & Azam, F. (2011). Microbial carbon pump and its significance for carbon sequestration in the ocean. Microbial Carbon Pump in the Ocean, 10, 43-45.
85. Jiao, N., & Zheng, Q. (2011). The Microbial Carbon Pump: from Genes to Ecosystems. Applied and Environmental Microbiology, 77(21), 7439-7444.
86. Jiao, N., Herndl, G. J., Hansell, D.A., Benner, R., Kattner, G., Wilhelm, S.W., Azam, F. (2010). Microbial production of recalcitrant dissolved organic matter: long-term carbon storage in the global ocean. Nature Reviews Microbiology, 8, 593–599.
87. Kaitala, V., & Lindroos, M. (1998). Sharing the benefits of cooperation in high seas fisheries: a characteristic function game approach. Natural Resource Modeling, 11(4), 275-299. doi:https://doi.org/10.1111/j.1939-7445.1998.tb00312.x
88. Knudsen, M. (2020). Testing of a Blue Economy Valuation Toolkit, Review of Rwanda' System of National Accounts. The United Nations Economic Commission for Africa (UNECA), unpublished report.
89. Krause-Jensen, D., Lavery, P., Serrano, O., Marbà, N., Masque, P., & Duarte, C. M. (2018). Sequestration of macroalgal carbon: the elephant in the Blue Carbon room. Biology Letters, 14(6). doi:https://doi.org/10.1098/rsbl.2018.0236

90. Laing, S. (2020). Testing of a Blue Economy Valuation Toolkit, Review of Seychelles' System of National Accounts. The United Nations Economic Commission for Africa (UNECA), unpublished report.
91. Lavery, P.S., Mateo, M.Á., Serrano, O., Rozaimi, M. 2013. Variability in the carbon storage of seagrass habitats and its implications for global estimates of blue carbon ecosystem service. PloS one, 8(9), p.e73748.
92. Ledoux, L., Turner, R.K. 2002. Valuing ocean and coastal resources: a review of practical examples and issues for further action. Ocean and Coastal Management, 45, 583-616.
93. Ling, M. A., King, S., Mapendembe, A., & Brown, C. (2018). A review of ecosystem service valuation progress and approaches by the member states of the European Union. Cambridge, UK: UNEP-WCMC. Retrieved from https://ec.europa.eu/environment/nature/capital_accounting/pdf/eu_es_valuation_review.pdf
94. LUC 2015. Calculating the economic values of the ecosystem services by Natura 2000 features and sites in Wales. Prepared by LUC for Natural Resources Wales as part of the LIFE Natura 2000 Programme in Wales, Action A9: LIFE N2K Wales: LIFE 11 NAT/UK/385, 21 p.
95. Luck, G.W. 2007. A review of the relationships between human population density and biodiversity. Biological Reviews 82, 607-645.
96. Luisetti, T., Turner, R. K., Andrews, J. E., Jickells, T. D., Kröger, S., Diesing, M., Weston, K. (2019). Quantifying and valuing carbon flows and stores in coastal and shelf ecosystems in the UK. Ecosystem Services, 35, 67-76.
97. MA 2005. Millennium Ecosystem Assessment: Ecosystems and Human Well-being – Synthesis. Island Press, Washington, DC, pp. 155.
98. Mangos, A., Bassino J-P., Sauzade, D. (2010). Valeur économique des bénéfices soutenables provenant des écosystèmes marins méditerranéens. Plan Blue research report. Sophia Antipolis, France: Centre d'activités régionales.
99. Martinez, M.L., Intralawan, A., Vazquez, G., Perez-Maqueo, O., Sutton, O. and Landgrave, R. (2007). The coasts of our world: ecological, economic and social importance. Ecological economics, 63, 254-272.
100. McKenzie, L., Nordlund, L.M., Jones, B.L., Cullen-Unsworth, L.C., Roelfsema, C.M., Unsworth, R., Mcleod, E., Chmura, G. L., Bouillon, S., Salm, R., Björk, M., Duarte, C. M., Silliman, B. R. (2011, December). A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO2. Frontiers in Ecology and the Environment, 9(10), 552-560.
101. Mcleod, E., Chmura, G. L., Bouillon, S., Salm, R., Björk, M., Duarte, C. M., Silliman, B. R. (2011). A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO2. Frontiers in Ecology and the Environment, 9(10), 552-560. doi:https://doi.org/10.1890/110004
102. Mcleod, E., Chmura, G.L., Bouillon, S., Salm, R., Björk, M., Duarte, C.M., Lovelock, C.E., Schlesinger, W.H., Silliman, B.R. 2011. A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO2. Frontiers in Ecology and the Environment 9(10), 552-560
103. Meng, W., Feagin, R.A., Hua, B., He, M., & Li, H. (2019). The spatial distribution of blue carbon in the coastal wetlands of China. Estuarine, Coastal and Shelf Science, 222, 13-20.
104. Meng, W., Feagin, R.A., Hua, B., He, M., & Li, H. (2019). The spatial distribution of blue carbon in the coastal wetlands of China. Estuarine, Coastal and Shelf Science, 222, 13-20. doi:https://doi.org/10.1016/j.ecss.2019.03.010
105. Meng, W., He, M., Hu, B., Mo, X., Li, H., Liu, B., & Wang, Z. (2017). Status of wetlands in China: A review of extent, degradation, issues and recommendations for improvement. Ocean & Coastal Management, 146, 50-59.
106. Millennium Ecosystem Assessment (2005). Ecosystems and Human Well-being: Synthesis. Washington, DC: Island Press.
107. Moe, S. J., De Schamphelaere, K., Clements, W. H., Sorensen, M. T., Van den Brink, P. J., Liess, M. 2013. Combined and interactive effects of global climate change and toxicants on populations and communities. Environmental Toxicology and Chemistry 32(1), 49-61.
108. Mohanty, S. K., Dash, P., & Gupta, A. (2017). Blue Economy Enhancing Growth and Sustainability. Research and Information System for Developing Countries.
109. Monteiro, J., Almeida, C., Freitas, R., Delgado, A., Porteiro, F., Santos, R. 2008. Coral assemblages of Cabo Verde: preliminary assessment and description. In Proceedings of the 11th International Coral Reef Symposium, Fort Lauderdale, Florida 7, 1416-1419.
110. Moore, J.C. 2018. Predicting tipping points in complex environmental systems. Proceedings of the National Academy of Sciences 115, 635-636.
111. Mulazzani, L., & Malorgio, G. (2017). Blue growth and ecosystem services. Marine Policy, 85, 17-24. doi:https://doi.org/10.1016/j.marpol.2017.08.006
112. Munro, G. 1979. The optimal management of transboundary renewable resources. Canadian Journal of Economics 12(8), 355–376.
113. Murray, B. C., Pendleton, L., Jenkins, W. A., & Sifleet, S. (2011). Green payments for blue carbon: economic incentives for protecting threatened coastal habitats. Durham: Nicholas Institute for Environmental Policy Solutions, Duke University.
114. National Development and Reform Commission; National Maritime Administration. (2017). The 13th Five-Year Plan for National Marine Economic Development. National Development and Reform Commission, National Maritime Administration.
115. Ndour, A., Laïbi, R.A., Sadio, M., Degbe, C.G., Diaw, A.T., Oyédé, L.M., Anthony, E.J., Dussouillez, P., Sambou, H. 2018. Management strategies for coastal erosion problems in west Africa: Analysis, issues, and constraints drawn from the examples of Senegal and Benin. Ocean & Coastal Management 156, 92-106.
116. Nellemann, C., & Corcoran, E. (2009). Blue carbon: the role of healthy oceans in binding carbon — a rapid response assessment. UNEP/Earthprint. Retrieved from https://books.google.co.uk/books?hl=zh-CN&lr=&id=onCVCHQl4RoC&oi=fnd&pg=PA17&dq=Blue+Carbon.+A+Rapid+Response+Assessment.+United+Nations+Environment+Programme&ots=ZS

tcgXDeuY&sig=Vb_PCCfw3BfXM5O3D8cRidqDAVo#v=onepage&q=Blue%20Carbon.%20A%20Rapid%20Response
117. Nixon, S., Trent, Z., Marcuello, C., Lallana, C. 2003. Europe's water: an indicator-based assessment. European Environment Agency, Copenhagen, 97 p.
118. Nordlund, L.M., Jackson, E.L., Nakaoka, M., Samper-Villarreal, J., Beca-Carretero, P., Creed, J.C. 2018. Seagrass ecosystem services–What's next? Marine pollution bulletin 134, 145-151.
119. OECD. (2016). The Ocean Economy in 2030. Paris: OECD Publishing. doi:https://dx.doi.org/10.1787/9789264251724-en
120. Oreska, M.P., McGlathery, K.J., Porter, J.H. 2017. Seagrass blue carbon spatial patterns at the meadow-scale. PloS one, 12(4), e0176630.
121. Palmer, M., Filoso, S. 2009. Restoration of ecosystem services for environmental markets. Science 352, 575–576.
122. Pascal, N., Allenbach, M., Brathwaite, A., Burke, L., Le Port, G., Clua, E. 2016. Economic valuation of coral reef ecosystem service of coastal protection: A pragmatic approach. Ecosystem Services, 21, 72-80.
123. Pascal, N., Brathwaite, A., Brander, L., Seidl, A., Philip, M., Clua, E. 2018. Evidence of economic benefits for public investment in MPAs. Ecosystem Services 30, 3-13.
124. Patil, P., Virdin, J., Colgan, C., Hussain, M., Failler, P., & Vegh, T. (2018). Toward a Blue Economy: A Pathway for Sustainable Growth in Bangladesh. Washington, DC: The World Bank Group.
125. Potgieter, T. (2018). Oceans economy, blue economy, and security: notes on the South African potential and developments. Journal of the Indian Ocean Region, 14(1), 49-70. doi:10.1080/19480881.2018.1410962
126. Prober, S.M., Doerr, V.A.J., Broadhurst, L.M., Williams, K.J., Dickson, F. 2019. Shifting the conservation paradigm: a synthesis of options for renovating nature under climate change. Ecological Monographs 89(1), 1-23.
127. QGIS Development Team 2020. QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org
128. Ram, J., Ramrattan, D., & Frederick, R. (2019). Measuring the Blue Economy: The System of National Accounts and use of Blue Economy Satellite Accounts. Caribbean Development Bank.
129. Ramos, A., Sanz, J.L., Ramil, F., Agudo, L.M., Presas-Navarro, C. 2017. The giant cold-water coral mounds barrier off Mauritania. In Deep-Sea Ecosystems Off Mauritania. (Springer), pp. 481-525.
130. Rozan, A. and Stenger, A. (2000) Intérêts et limites de la méthode du transfert de bénéfices. Economie et Statistique, 336, 69-78.
131. Rwanda Water Portal. (2020). Rwanda Natural Capital Accounting Water Accounts: Overview and Key Results. Retrieved from Rwanda Water Portal: https://waterportal.rwb.rw/sites/default/files/2019-04/Rwanda%20NCA%20Water%20Accounts.pdf
132. Satia, B. 2016. An overview of the large marine ecosystem programs at work in Africa today. Environmental Development 17, 11-19.
133. Schröter, D., Cramer, W., Leemans, R., Prentice, I.C., Araújo, M.B., Arnell, N.W., Bondeau, A., Bugmann, H., Carter, T.R., Gracia, C.A. 2005. Ecosystem service supply and vulnerability to global change in Europe. Science 310(5752), 1333-1337.
134. Sherman, K. 2019. Large marine ecosystems in Kirk Cochran, J., Bokuniewicz, H., Yager, P. Encyclopedia of Ocean Science 3rd Edition. Academic Press, 709-723.
135. Sherman, K., Alexander, L. 1986. Variability and Management of Large Marine Ecosystems. American Association for the Advancement of Science Selected Symposium 99. Westview Press, Boulder, Colorado, USA.
136. Sifleet, S., Pendleton, L., & Murray, B. C. (2011). State of the Science on Coastal Blue Carbon (Doctoral dissertation, School of the Environment, Duke University). Nicholas Institute for Environmental Policy Solutions .
137. Smith-Hall, C. 2009. Forests sustain livelihoods. In: Lambrechts, C., Wilkie, M.L., Rucevska, I., Sen, M. (Eds) Vital Forest Graphics. Stopping the Downswing? pp. 16-17.
138. Sondak, C., Ang, P., & Beardall, J. e. (2017). Carbon dioxide mitigation potential of seaweed aquaculture beds (SABs). Journal of Applied Phycology, 29(5), 2363–2373. doi:https://doi.org/10.1007/s10811-016-1022-1
139. Song, W. L., He, G. S., & McIlgorm, A. (2013). From behind the Great Wall: The development of statistics on the marine economy in China. Marine Policy, 39, 120-127. doi:https://doi.org/10.1016/j.marpol.2012.09.006
140. Steven, A. D., Vanderklift, M. A., & Bohler-Muller, N. (2019). A new narrative for the Blue Economy and Blue Carbon. Journal of the Indian Ocean Region, 15(2), 123-128. doi:https://doi.org/10.1080/19480881.2019.1625215
141. Sumaila, U.R. 2016. Socio-economic benefits of Large Marine Ecosystem valuation: The case of the Benguela Current Large Marine Ecosystem', Environmental Development 17, 244–248.
142. Sutton-Grier, A.E., Moore, A. 2016. Leveraging carbon services of coastal ecosystems for habitat protection and restoration. Coastal Management 44(3), 259-277.
143. Tam, J.C., Link, J.S., Large, S. I., Andrews, K., Friedland, K.D., Gove, J., Hazen, E., Holsman, K., Karnauskas, M., Samhouri, J.F., Shuford, R., Tomilieri, N., Zador, S. 2017. Comparing Apples to Oranges: Common Trends and Thresholds in Anthropogenic and Environmental Pressures across Multiple Marine Ecosystems. Frontiers in Marine Science 4(282).
144. Tang, J., Ye, S., Chen, X., Yang, H., Sun, X., Wang, F., . . . Chen, S. (2018). Coastal blue carbon: Concept, study method, and the application to ecological restoration. Science China Earth Sciences, 61, 637–646. doi:https://doi.org/10.1007/s11430-017-9181-x
145. Tang, Q., & Liu, H. (2016). Strategy for carbon sink and its amplification in marine fisheries. Strategic Study of Chinese Academy of Engineering, 18(3), 68-73. doi:10.15302/J-SSCAE-2016.03.011
146. Tang, W., Zheng, M., Zhao, X., Shi, J., Yang, J., Trettin, C.C. 2018. Big geospatial data analytics for global mangrove biomass and carbon estimation. Sustainability 10, 472.

147. TEEB 2010. The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A Synthesis of the Approach, Conclusions and Recommendations of TEEB. Earthscan, London-Washington, 39 p.
148. The Republic of Seychelles. (2018). Seychelles Blue Economy: Strategic Policy Framework and Roadmap Charting the future (2018-2030). Victoria, Mahé: The Republic of Seychelles and the Commonwealth Secretariat.
149. The World Bank 2020. World Development Indicators. Retrieved from: https://databank.worldbank.org/data/
150. Tittensor, D.P., Walpole, M., Hill, S.L., Boyce, D.G., Britten, G.L., Burgess, N.D., Butchart, S.H., Leadley, P.W., Regan, E.C., Alkemade, R. 2014. A mid-term analysis of progress toward international biodiversity targets. Science 346, 241-244.
151. Trégarot, E., Catry, T., Pottier, A., Cornet, C., Maréchal, J.-P., Fayad, V., … Failler, P. (2018). Évaluation des services écosystémiques du Banc d'Arguin, Mauritanie. Report for the National Park of Banc d'Arguin, 398 p.
152. Trégarot, E., Failler, P., & Maréchal, P. (2017). Evaluation of coastal and marine ecosystem services of Mayotte: Indirect use values of coral reefs and associated ecosystems,. International Journal of Biodiversity Science, Ecosystem Services & Management, 13(3), 19-34. doi:10.1080/21513732.2017.1407361
153. Trégarot, E., Failler, P., Maréchal, J.-P. 2017. Evaluation of coastal and marine ecosystem services of Mayotte: Indirect use values of coral reefs and associated ecosystems. International Journal of Biodiversity Science, Ecosystem Services and Management 13(3), 19-34.
154. Trégarot, E., Touron-Gardic, G., Cornet, C. C., & Failler, P. (2020). Valuation of coastal ecosystem services in the Large Marine Ecosystems of Africa. Environmental Development, in press. doi:https://doi.org/10.1016/j.envdev.2020.100584
155. Turner, K., Badura, T., & Ferrini, S. (2019). Valuation, Natural Capital Accounting and Decision Support Systems: Process, Tools and Methods. Norwich: CSERGE, University of East Anglia.
156. Ullman, R., Bilbao-Bastida, V., & Grimsditch, G. (2013). Including blue carbon in climate market mechanisms. Ocean & Coastal Management, 83, 15-18. doi:https://doi.org/10.1016/j.ocecoaman.2012.02.009
157. UN. (2008). International Standard Industrial Classification of All Economic Activities (ISIC), Rev. 4, ST/ESA/STAT/SER.M/4/Rev.4. Department of Economic and Social Affairs, Statistics Division. New York: United Nations Statistical papers.
158. UN. (2009). Classification internationale type, par industrie, de toutes les branches d'activité économique (CITI), ST/ESA/STAT/SER.M/4/Rev.4. Département des affaires économiques et sociales - Division de statistique. New York: Nations Unis, Études statistiques.
159. UN. (2019). HUMAN DEVELOPMENT INDICES AND INDICATORS: 2018 STATISTICAL UPDATE. New York: United Nations. Retrieved from http://hdr.undp.org/sites/default/files/2018_statistical_annex.pdf
160. UNDP 2017. Large Marine Ecosystems and Sustainable Development: A review of Strategic Management Process. United Nations Development Programme, 108 p.
161. UNECA 2016. Africa's Blue Economy: A policy handbook. Retrieved from: https://www.uneca.org/publications/africas-blue-economy-policy-handbook.
162. UNECA. (2015). The Blue Economy. United Nations Economic Commission for Africa, Sub-Regional Office for Eastern Africa (UNECA SRO-EA).
163. UNECA. (2016). Africa's Blue Economy: A Policy Handbook. Addis Ababa: The United Nation, Economic Commission for Africa.
164. UNEP, GRID-Arendal 2016. The Socio-Economics of the West, Central and Southern African Coastal Communities: A Synthesis of Studies Regarding Large Marine Ecosystems. Nairobi, Abidjan and Arendal. Retrieved from: https://gridarendal-website-live.s3.amazonaws.com/production/documents/:s_document/323/original/AfricanLME_screen.pdf?1491297440.
165. UNEP-WCMC 2016a. The State of Biodiversity in Africa: A mid-term review of progress towards the Aichi Biodiversity Targets. Edited by UNEP-WCMC. Cambridge, UK.
166. UNEP-WCMC 2016b. Impacts du changement climatique sur la biodiversité et les aires protégées en Afrique de l'Ouest, Résumé des résultats du projet PARCC, Aires protégées résilientes au changement climatique en Afrique de l'Ouest. Cambridge, UK. Retrieved from: http://parcc.protectedplanet.net/system/comfy/cms/files/files/000/000/164/original/PARCC_FR_WEB.pdf.
167. UNEP-WCMC, Short, F. 2017. Global Distribution of Seagrasses (version 6.0). Sixth update to the data layer used in Green and Short (2003), UN Environment World Conservation Monitoring Centre.
168. UNEP-WCMC, WorldFish Centre, WRI, TNC 2018. Global distribution of warm-water coral reefs, compiled from multiple sources including the Millennium Coral Reef Mapping Project. Version 4.0. Includes contributions from IMaRS-USF and IRD (2005), IMaRS-USF (2005) and Spalding et al. (2001). Cambridge (UK): UN Environment World Conservation Monitoring Centre. Retrieved from: http://data.unep-wcmc.org/datasets.
169. United Nations 2015. Transforming our world: The 2030 Agenda for Sustainable Development. Edited by United Nations: New-York, NY, USA.
170. United Nations 2019. World Population Prospects 2019. United Nations, Department of Economic and Social Affairs, Population Division, Online Edition. Rev. 1. Retrieved from: https://population.un.org/wpp/.
171. United Nations Economic Commission for Africa [UNECA]. (2016). Africa's Blue Economy: A policy handbook. Addis Ababa, Ethiopia: United Nations Economic Commission for Africa. Retrieved from https://www.uneca.org/sites/default/files/PublicationFiles/blue-eco-policy-handbook_eng_1nov.pdf
172. United Nations Economic Commission for Africa. (2014). Unlocking the full potential of the blue economy: Are African Small Island Developing States ready to embrace the opportunities? Addis Ababa, Ethiopia: United Nations Economic Commission for Africa.
173. United Nations. (2014). System of EnvironmentalEconomic Accounting 2012 - Central Framework. New York: United Nations.

174. Veen, J., Dallmeijer, H., Veen, T. 2018. Selecting piscivorous bird species for monitoring environmental change in the Banc d'Arguin, Mauritania. Ardea 106, 5-19.
175. Vegh, T., Potouroglou, M. 2018. High Level Assessment of Seagrass Ecosystem Services in Western Africa. ResilienSEA, MAVA Fondation pour la Nature, 36 p. Retrieved from: https://resiliensea.org
176. Ventura, A.d.O.B., da Cunha Lana, P. 2014. A new empirical index for assessing the vulnerability of peri-urban mangroves. Journal of environmental management 145, 289-298.
177. Wang, L.-l., & Xiao, W.-w. (2016). Industry Linkage of Marine Industry and Marine-Land Industry Linkage Development—Based on Input-Output Model. Economic Geography, 36(1). doi:10.15957/j.cnki.jjdl.2016.01.016
178. Wang, X. (2016). The Ocean Economic Statistical System of China and Understanding of the Blue Economy. Journal of Ocean and Coastal Economics, 2(2), Article 10. doi:https://doi.org/10.15351/2373-8456.1055
179. Wangai, P.W., Burkhard, B., Müller, F. 2016. A review of studies on ecosystem services in Africa. International Journal of Sustainable Built Environment 5(2), 225-245.
180. Ward-Paige, C.A., Mora, C., Lotze, H. K., Pattengill-Semmens, C., McClenachan, L., Arias-Castro, E., Myers, R.A. 2010. Large-Scale Absence of Sharks on Reefs in the Greater-Caribbean: A Footprint of Human Pressures. PloS one 5, e11968.
181. Wenhai, L., C., C., M., B., W., T., C., M., K., P., . . . Y., Y. (2019). Successful Blue Economy Examples With an Emphasis on International Perspectives. Frontiers in Marine Science, 6(261). doi:https://doi.org/10.3389/fmars.2019.00261
182. Wernberg, T., Krumhansl, K., Filbee-Dexter, K., Pedersen, M.F. 2019. Status and trends for the world's kelp forests. In: World seas: an environmental evaluation (pp. 57-78). Academic Press.
183. Whisnant, R., & Reyes, A. (2015). Blue Economy for Business in East Asia: Towards an Integrated Understanding of Blue Economy. Philippines: PEMSEA.
184. Whitney, C.K., Bennett, N.J., Ban, N.C., Allison, E.H., Armitage, D., Blythe, J.L., Burt, J.M., Cheung, W., Finkbeiner, E.M., Kaplan-Hallam, M., Perry, I., 2017. Adaptive capacity: from assessment to action in coastal social-ecological systems. Ecology and Society, 22(2), 22.
185. Willcock, S., Hooftman, D., Sitas, N., O'Farrell, P., Hudson, M.D., Reyers, B., Eigenbrod, F., Bullock, J.M. 2016. Do ecosystem service maps and models meet stakeholders' needs? A preliminary survey across sub-Saharan Africa. Ecosystem Services 18, 110-117.
186. World Bank, & UN Department of Economic and Social Affairs. (2017). The Potential of the Blue Economy: Increasing Long-term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries. Washington DC: World Bank.
187. Yesson, C., Taylor, M.L., Tittensor, D.P., Davies, A.J., Guinotte, J., Baco, A., Black, J., Hall-Spencer, J.M., Rogers, A.D. 2012. Global habitat suitability of cold-water Octocorals. Journal of Biogeography 39: 1278-1292.
188. Zhang, H., Luo, Y., Liu, X., & Fu, C. (2015). Coastal Blue Carbon Research and its Prospects. Chinese Science: Earth Science, 45(11), 1641-1648. Retrieved from http://html.rhhz.net/sciD/15zd1641.htm
189. Zhao, C., Fang, C., Gong, Y., & Lu, Z. (2020). The economic feasibility of Blue Carbon cooperation in the South China Sea region. Marine Policy(113), 103788. doi:https://doi.org/10.1016/j.marpol.2019.103788
190. Zhao, R. (2013). The role of the ocean industry in the Chinese national economy: an input-output analysis. Center for the Blue Economy.
191. Zhao, R., Hynes, S., & He, G. S. (2014). Defining and quantifying China's ocean economy. Marine Policy, 43, 164-173.

African Union
Inter-African Bureau for Animal Resources (AU-IBAR)
Kenindia Business Park
Museum Hill, Westlands Road
P.O. Box 30786
00100, Nairobi, KENYA
Telephone: +254 (20) 3674 000 / 201
Fax: +254 (20) 3674 341 / 342
Website: www.au.ibar.org
Email address: ibar.office@au-ibar.org