The Future of Marine Fisheries in the African Blue Economy

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Executive Summary

The marine capture fisheries production of Africa currently stands at 7 million tonnes. It has increased in recent years thanks to the strong resurgence of West African small pelagic catches and a return to normality in the Indian Ocean following the end of Somalian piracy. The marine fish supply is increasing but the current positive growth is at a rate that cannot match the increasing population's per capita consumption demands. With the African population expected to reach 1.7 billion in 2030 and 2.5 billion in 2050, feeding the population at today's level of per capita consumption (7.5 kg/capita/year form marine fisheries), will require 13 million tonnes of marine fish in 2030 and almost 19 million tonnes in 2050. These figures provide an idea of the scale of the production gap: about 6 million tonnes in 2030 and 12 million in 2050. They also make it clear that much change is required in both ecosystem capacity enhancement and capture and valorisation method improvement to reach such targets. Fisheries policies, institutional structures and the skills base of fisheries agencies in many African countries have been heavily influenced by a historical focus on production and revenue maximisation year-after-year, driven by the need to generate cash for the national treasury, with little or no reference to resource productivity and sustainability. The approach has led to overexploitation of most of the major fish resources.

Substantial pressures threaten Africa's marine fisheries. Climate change and the associated alterations in distribution patterns pose significant threats to catch potential, as well as the security of coastal communities. Healthy ecosystems are essential to ecosystem services, especially for fisheries. However, reductions in water quality through pollution, habitat destruction, and unsustainable and destructive fishing practices imperil the ability of ecosystems to support

fisheries. Furthermore, the lack of information about ecosystem status and health hinders their effective management at the national and regional level. Lastly, poor governance at all levels, with a historical focus on volume of production, mismanaged and overlapping jurisdictions, and lack of transparency only exacerbates the already complex issues of transboundary resources. This combination of issues has already caused the overexploitation of all major fish resources.

Despite the threats that exist, there is enormous potential to secure the future of African marine fisheries. Firstly, Africa has a large continental fish market, with high demand and an increasing purchasing power. This offers the potential to reverse the prevailing condition of Africa being a net importer of fish to prioritise Africa's needs first and export the excess, and potentially becoming a net exporting continent. Secondly, there is increasing attention and finance being invested in the health of ecosystems through efforts to mitigate biodiversity loss and the effects of climate change. This generates inputs into the restoration of coastal ecosystems, given their important role in carbon sequestration and coastal protection, which by proxy contributes to the protection and restoration of ecosystems essential to the provision on fishery resources. Lastly, with the increasing importance of developing the blue economy, fisheries are being integrated into a much wider management system and prioritised for their contributions to blue growth. This in turn generates further resources and regional attention that are channelled into fisheries as a gateway into the blue economy.

Harnessing these opportunities has the potential to significantly increase the production of Africa's marine fisheries. Making use of them offers a prosperous future transformation. Restoring ecosystems to a high ecological condition may increase fish production by 50-60%, adding 9 to 10.5 million tonnes to annual net supply by 2050. This can even be exceeded through more accurate valuation of ecosystems, increasing the role of marine protected areas (MPAs) in fisheries management, and addressing pollution and conflicts over different uses through improved marine spatial planning (MSP).

A further 2 to 3 million tonnes of fish net supply could be delivered by 2050 by improving the sustainability of fisheries operations and reducing the environmental footprint of fleets and processing industries. Enhancing the sustainability of the fisheries should focus on proper transboundary management, with a specific focus on finding a resolution for the control of foreign access agreements, as well as managing and monitoring migratory and illegal, unreported and unregulated fishing practices. Proper investment and focus should also be given to improving operations to limit the waste of bycatch and discard and employing sufficient monitoring, control and surveillance mechanisms. This will include balanced harvest tools, sustainability monitoring and regional control and surveillance mechanisms.

Improving harvest and post-harvest chains, including scaling up and integrating mariculture has the potential to increase production to deliver over 1.5 to 2 million tonnes net supply by 2030, with mariculture offering 2 to 4 million tonnes of added net supply. Mariculture offers increasingly sustainable alternatives to meet the demand for consumption and supply to international markets. Focusing on the value addition of all products, both capture fisheries and mariculture, is the key element to enable optimum profit or gains from fish products. Reducing post-harvest losses through improving or introducing proper standards and supporting investments into value-added products (for example fish smoking and drying technologies to increase shelf life) is an opportunity that would ensure that the prevailing loss of 35% of harvests are not wasted which could have major benefits for food security and livelihoods. Finally, Africa cannot cease trade with the outside world, but it can reduce its vulnerability to external shocks by boosting intra-regional trade and limiting exports to prioritise meeting the nutritional needs of African nations. Links at the African level need to be forged and investment channelled into regional collaborative mechanisms for trade. Regional trade mechanisms, within the African free Trade Agreement (AfCFTA) will also form an integral part of supporting an emerging blue economy.

For each of these four areas of intervention, specific solutions exist. Most of them have already been implemented with success and require promotion and bringing to scale. Within the current continental, regional and national blue economy schemes, pathways are available to integrate marine fisheries with other ocean resource concerns such as the restoration of coastal and marine ecosystems that provide simultaneous benefits for biodiversity, food security, and climate change mitigation (by blue carbon) and adaptation (by reducing coastal erosion) and the potential synergies are significant.

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Abbreviations

AfDB	African Development Bank
ASCLME	Agulhas and Somali Current Large Marine Ecosystem
AU	African Union
AUC	African Union Commission
AUDA	African Union Development Agency/New Partnership for African Development
AU-IBAR	African Union InterAfrican Bureau for Animal Resources
BCC	Benguela Current Convention
BCLME	Benguela Current Large Marine Ecosystem
CBD	Convention on Biological Diversity
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCLME	Canary Current Large Marine Ecosystem
CECAF	Fishery Committee for the Eastern Central Atlantic
Code	FAO Code of Conduct for Responsible Fisheries
COREP	Regional Fisheries Committee for the Gulf of Guinea
EAF	Ecosystem approach to fishery
EBM	Ecosystem-based management
ECOST	Ecological, economic and social cost (of fishing practices and fishery policies)
ECOWAS	Economic Community of West African States
EDF	European Development Fund
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organisation of the UN
FCWC	Fisheries Committee for the West Central Gulf of Guinea
FiTI	Fisheries Transparency Initiative
FOC	Flag of convenience
GCLME	Guinea Current Large Marine Ecosystem
ICCAT	International Commission for the Conservation of the Atlantic Tunas
IOCT	Indian Ocean Tuna Commission
ITQ	Transferable quota
IUCN	International Union for Conservation of Nature
IUU	Illegal, unreported, and unregulated (IUU) fishing
LME	Large Marine Ecosystem
MCS	Monitoring, control and surveillance
MedLME	Mediterranean Sea Large Marine Ecosystem
MPA	Marine Protected Area
MS	Member State
MSP	Marine spatial planning
MSY	Maximum sustainable yield
NAFO	Northwest Atlantic Fisheries Organisation
NAPA	National Adaptation Programmes of Action
NBS	Nature-based solutions
NEAFC	North-East Atlantic Fisheries Commission
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organisation
OECMs	Other effective area-based conservation measures
PFRS	Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa
PNBA	Banc d'Arguin National Park
PSMA	Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing
RAMPAO	West African Marine Protected Areas Network
RBFM	Rights-based Fishery Management
REC	Regional Economic Community
RFB	Regional Fisheries Bodies
RFMO	Regional Fisheries Management Organisation
SADC	Southern African Development Community
SDG	Sustainable Development Goal
SEAFO	South East Atlantic Fisheries Organisation
SNA	System of National Accounting
SRFC	Sub Regional Fisheries Commission
SWIOFC	Southwest Indian Ocean Fisheries Commission
TAC	Total allowable catch
TDA	Transparency Diagnostic Analysis
TROM	Target Resources Oriented Management
TURFs	Territorial Use Rights
UNCLOS	The Law of the Sea
UNECA	United Nations Economic Commission for Africa
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UNODC	United Nations Office on Drugs and Crime
WTO	World Trade Organisation

Introduction

Africa's 32 coastal states and six island states depend heavily on the resources and benefits that its oceans and coastal ecosystems provide. These ecosystems present abundant opportunities for African countries to participate in a sustainable ocean ('blue') economy which would fulfil the continent's potential to improve the productivity and sustainability of the ocean environment, increase employment, strengthen food and nutritional security and provide wealth creation opportunities. The blue economy can broadly be described as the sustainable use and conservation of ocean and coastal resources to generate equitably-distributed benefits. Africa could be a dynamic, sustainable blue economy[1], if existing structural systems are improved and innovative solutions are introduced to ensure the future ability of these dynamic resource-rich ecosystems to provide for the continent's social and economic needs (Failler et al. 2021).

In terms of fisheries, Africa is endowed with some of the richest productive fishing grounds in the world. The African large marine ecosystems are of strategic importance to the continent and its people as they provide opportunities for fisheries, shipping, coastal tourism, offshore oil and gas energy, marine minerals (e.g., diamonds) and wider blue economy-related activities. Marine capture fisheries production in Africa stands at almost 7 million liveweight tonnes, valued at $20 billion[2] (Failler et al., 2019). The total gross value-added of the fisheries was estimated, for the harvest and processing sectors, at $21 billion or 1.3% of the total GDP of all African countries. Marine artisanal fisheries contribute the most at $8.1 billion, followed by marine industrial fisheries and inland fisheries at $6.8 billion and $6.3 billion, respectively (AU-IBAR, 2019a). Despite the large volume of fish produced, the continent has invested limited attention in performance enhancement or competitiveness in the processing and value addition of its fishery resources for local consumption or exports (AfDB, 2016). In 2018, the sector employed about 13 million people, of whom 7 million were fishers and 6 million were processors (Failler et al., idem). African fisheries provide food and nutritional security to 200 million Africans as fish contributes at least 20% of the animal protein in Africa, with the average per capita per year fish consumption about 12 kg (inland, marine and aquaculture combined) and about 8 kg of marine fish products alone (FAO, 2021).

Women play a significant role in African fisheries, marketing 60% of all seafood and making up a sizeable portion of the workforce. Most of the employment by women in fisheries is related to post-harvest activities (i.e. processing and trading) which generates roughly half of the contribution by fisheries to Africa's GDP (Du Preez, 2018). This highlights the already important economic contribution women make in the sector and one with substantial space for growth. Furthermore, women are heavily involved in mariculture activities, an emerging sector with extensive economic potential for expansion providing better livelihoods, wealth generation, and food and nutrition security in the continent. In some instances, women have more pivotal roles whereby they provide loans to male fishers and invest in boats and equipment (GIZ, 2013). They contribute to a broad range of social services that underpin the functioning of fisheries systems making their value added and important roles in value and supply chains indispensable (Asiedu et al., 2015).

The challenges that continue to constrain the ability of African countries from realising the full potential from marine fisheries include weak governance and lack of policy coherence in fisheries management combined with policies that are poorly implemented, and rarely coordinated for shared stocks (AUC and NPCA, 2014). These challenges have resulted in, inter alia, increased intensity of fishing pressure, open access regimes, overfished stocks and illegal, unreported and unregulated (IUU) fishing (Sumaila et al., 2006; Agnew et al., 2009; Failler and El Ayoubi, 2015). The IUU fishing problem was conservatively estimated to have cost Africa $10 billion annually (AU-IBAR, 2019b). Sea piracy and trafficking have presented serious challenges in the blue economy sector as incidences of piracy pose a real threat not only to the safety of vessels and their crew but also

[1] *For that purpose, the African Union has adopted in 2020 a blue economy strategy. Its objective is to guide the development of an inclusive and sustainable blue economy that becomes a significant contributor to continental transformation and growth, through advancing knowledge on marine and aquatic biotechnology, environmental sustainability, the growth of an Africa-wide shipping industry, the development of sea, river and lake transport, the management of fishing activities on these aquatic spaces, and the exploitation and beneficiation of deep sea mineral and other resources (AU-IBAR, 2019a).*

[2] *All dollar signifiers ($) refer to USD unless stated otherwise.*

to the economies of affected countries, particularly in the Gulf of Guinea and the South-West Indian Ocean (Anyimadu, 2013; Sumaila, 2018). Many African coastal countries' laws and policies are outdated as they do not capture the emerging issues of climate change or offer sufficient environmental protection in preparation for a blue economy (Lam et al., 2012; AfDB, 2016). Africa's leaders adopted the Blue Economy Strategy in November 2019 that offers remarkable prospects for wealth creation and employment, including in areas that have not yet revealed their full potentials, such as biotechnology, renewable energy and carbon sequestration technologies. Thus, this study will ultimately contribute to the Blue Economy Flagship of the African Development Bank (AfDB).

This report focuses on marine fisheries across the entire African continent, provides an overview of challenges and opportunities and provides policy recommendations for their sustainable management within the framework of a blue economy development strategy. The report is structured as follows: Section 1 reviews the most significant trends in marine fisheries over the last decade, including the state of resources, pressures, governance and other factors, and provides a future outlook for fish supply demands in the future (2030 - 2050); Section 2 presents the opportunities for African marine fisheries; Section 3 details the challenges that marine fisheries face in meeting such opportunities and proposes strategic solutions to overcome them; and Section 4 offers overall conclusions and recommendations for the sustainable management of marine fisheries in the context of the African blue economy

01

Review of African marine fisheries

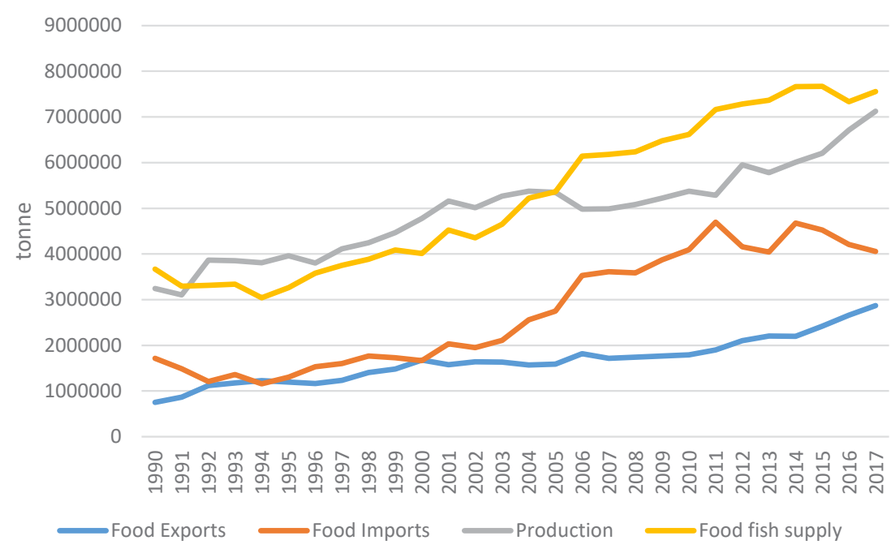
1.1 Global picture of marine and continental catches

The capture fisheries production of Africa currently stands at about 12 million tonnes, with the contribution of the inland fisheries fluctuating from 30% (2001) to 40% (2017) of the total. While in the last decade, freshwater and diadromous fish catches have contributed to the continuous increase of the total catches, in recent years, their contribution is decreasing, mainly due to the decline of precipitation on the main African watersheds (Niger, Senegal, Congo, Nile, Zambezi). Their decline is however compensated by the rise of the lake catches. On the marine side, the recent growth in catches is due to the steep increase of the West African small pelagic fisheries[3] and the return to normality in the Indian Ocean with the end of widespread Somalian piracy.

1.2 Overview of current and future marine net supply

Overall, the marine fish supply (calculated as production and imports less exports) is increasing at the African continent level (see figure 2). It reached a plateau of 7.5 million tonnes[4] (live weight equivalent [5]) in the recent period. Exports follow the same positive trend as production while imports have slowed in recent years due to: i) the limitation and ban of imported Chinese aquaculture products to protect national aquaculture and permit the development of domestic markets (Beyens et al. 2018); ii) the decrease in the small pelagic availability from the West African coasts (Isaksen et al., 2021) because the dramatic development of the fish meal industry in Mauritania, Senegal and Gambia consumes almost a million tonnes of small pelagics which were previously intended for human consumption in landlocked neighbouring countries and the coastal Gulf of Guinea countries (Failler et al., 2020a).

FIGURE 1: Marine Production, Imports and Exports[6]



When reporting the marine net supply to the population, it appears that from the beginning of the 1990s[7] to the late 2000s, that the increase of fish supply exceeds the increase of the African population as the annual per capita fish intake increases from 7 to 8.5 kg.

[3] Mauritania for instance has reached 1.5 million tonnes of catches in 2017, compared to less than 1 million in early 2010; the same phenomenon occurs with Morocco thanks to the exploitation of the waters in the Occidental Sahara region.

[4] The values of fish supply should be viewed with a degree of uncertainty given the frequent unreported catches by illegal, unregulated and reported fishing and artisanal fisheries which make up a large proportion of Africa's fisheries. This is highlighted by the 'Illuminating Hidden Harvests' project, a collaboration between the FAO, World Fish and Duke University.

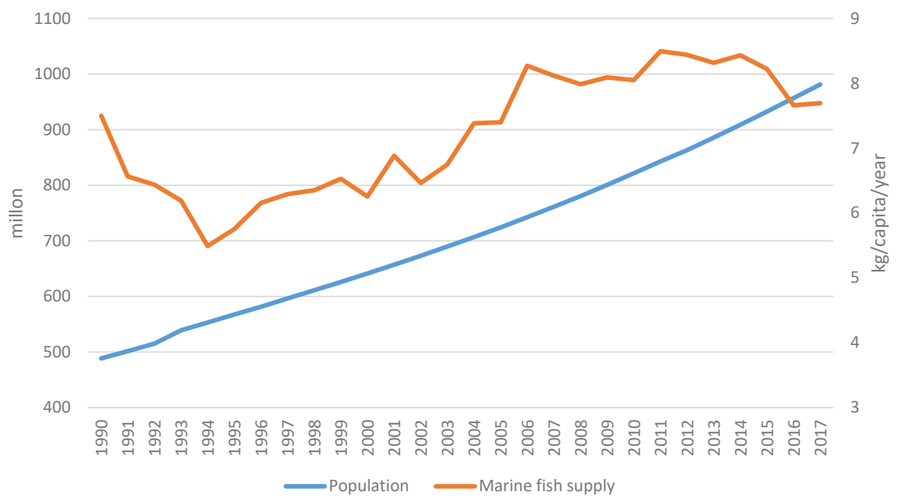
[5] Live weight equivalent corresponds to the weight of the fish when taken out of the water. Having all data in live weight equivalent allows the comparison of production, import and export and the calculation of the net supply (as commonly export and import are expressed in net weight (the weight of a can of tuna for instance) which fails to allow accurate comparison and calculation.

[6] Source: FAO data in live weight equivalent provided by the FAO Statistical Department (1961-2017).

[7] The steep decrease of the net supply in the beginning of the 1990s is due to the withdrawal of Russian and former satellite state fleets from Africa waters.

However, since the late 2010s, the consumption per capita is actually decreasing due to a decline in the imports (see figure 2 above).

FIGURE 2: Marine Net Supply per capita[8]



The future of the per capita net supply is conditioned by the growth of the population which is projected to continue steadily in the coming decades (at 2.7% annually) reaching a total of 1.7 billion in 2030 and 2.5 billion in 2050[9]. To feed such a population at the present level (7.5 kg/capita/year), the marine net supply would need to increase to 13 million in 2030 and 19 million in 2050[10]. These figures provide an idea of the scale of the production gap, which will reach 6 million by 2030 and 12 million by 2050. The data also indicate the extent of change required in ecosystem capacity enhancement and capture the valorisation method improvement needed to reach such targets.

1.3 Fish stock status

Some progress has been made towards more holistic management of the African marine fisheries within the African large marine ecosystems (LME) (shown in Figure 3). Annex 1b provides further information on the African LMEs. Collaborating regionally, the large marine ecosystems have become the management unit of choice around Africa, embodying a paradigm shift from single species or single-sector management to ecosystem-based management, with the emphasis shifting from managing: (i) individual species to ecosystems; (ii) small spatial scale to multiple scales; (iii) short-term perspectives to long-term perspectives; (iv) humans seen as independent of ecosystems to humans understood as an integral part of ecosystems; (v) management divorced from research to adaptive management driven by best-available science; and (vi) extracting commodities to sustaining production potential for goods and services (Duda and Sherman, 2002). Through regional LME projects, commissions and entities, information on fisheries is now more readily available. A five-module indicator approach to assessing and managing LMEs has proven highly useful in introducing ecosystem-based approaches to management (Duda and Sherman, 2002; see Annex 1c: Management Frameworks). The modules have been adapted to specific LME conditions through the Transboundary Diagnostic Analysis (TDA) and Strategic Action Programme process in Canary Current LME, Gulf of Guinea LME, Benguela Current LME, Agulhas and Somali Current LME and Mediterranean LME. These processes are critical to integrating science-based analysis into management in a practical way, and to establish the appropriate governance to change human behaviour in specific sectors. The LME modular approach incorporates the ecosystem approach to fishery (EAF), which includes implementing management plans and building in ecosystem considerations, such as reducing discards and bycatches in fisheries management, but many challenges still remain before ecosystem health is fully attained to deliver contributions to the blue economy. The number of stocks being assessed is increased year-on -year and the quality of assessment has improved.

The assessment of fish stock indicates its level of exploitation (see figure 4 and Annex 1a for details of stock status per LME). The percentages of stocks status are confined to the major commercial stocks whose status could be estimated by regional working groups (such as the Fishery Committee for the Eastern Central Atlantic - CECAF, or the Southwest Indian Ocean Fisheries Commission - SWIOFC) and by the countries. The CCLME and Guinea Current Large Marin Ecosystem, (GCLME) use three status signifiers (Not Fully Exploited, Overexploited and Fully Exploited), whereas the rest of the LMEs adopted two statuses (Not overexploited, Overexploited). The Benguela Current Large Marine Ecosystem (BCLME) data needs to be treated with caution because the data include some stocks occurring on the east coast within the Agulhas Current, as the separation was not feasible in this review.

[8] Source: FAO data in live weight equivalent provided by the FAO Statistical Department (1961-2017).
[9] See: https://population.un.org/wpp/
[10] Calculation based on 1.7 billion x 7.5 kg = 12.75 million tonnes of fish; 2.5 billion x 7.5 kg = 18.75 million tonnes.

FIGURE 3: African Large Marine Ecosystems (LMEs)[11] ; see Annex 1b

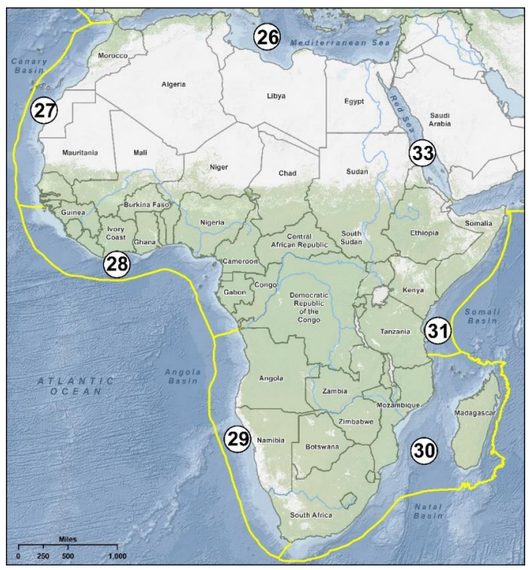
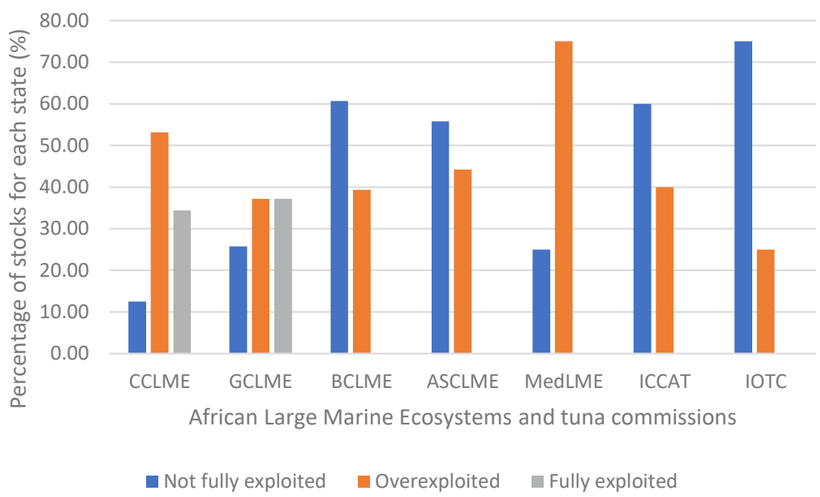


FIGURE 4: Status of the African marine fisheries (Source: FAO)



[11] *Adapted from Satia (2016) and the World Map of Large Marine Ecosystems: Benguela Current LME (29), Guinea Current LME (28), Canary Current LME (27), Mediterranean Sea LME (26), Red Sea LME (33), Somali Coastal Current LME (31), and Agulhas Current LME (30).*

Across all African LMEs, absent or unreliable biological data (fish length/age, recruitment indices, biomass) and fisheries data (catch, catch per unit of effort) pose severe challenges to understanding the long-term sustainability of the fisheries resources. Rapid increases in fleet capacity have been observed, particularly in Mauritania. More people have recently started working in the marine artisanal fisheries sector, for example, in the Gambia because agricultural production and available land is declining. Coastal communities have witnessed an influx of migrant fishers from inland regions (FAO/CECAF WG., 2019). The status of the fisheries in the MedLME, CCLME and GCLME are of concern, as most stocks are either overexploited or fully exploited. The overexploited stocks in the CCLME and GCLME include the sought-after stocks of sardinellas that are critically important for the food security and livelihoods to millions of coastal communities, however most of the tuna stocks appear thus far to be managed at safe biological levels.

Ultimately, fisheries are of critical importance to millions of African people, most of whom are overwhelmingly dependent on these resources for their livelihoods and food security. Based on the threats highlighted in the following section, 1.4, and noting other external factors, the future of the African fisheries looks uncertain without careful intervention.

1.4 Major threats to Africa's marine fisheries

Multiple risks threaten the security of marine fisheries around the continent. The four most imminent and severe threats are detailed below: climate change; degraded ecosystems; population growth; and poor governance. Further threats are outlined in Annex 1d.

1.4.1 Climate change and associated changes in distribution patterns

Climate change and climate variability are already impacting Africa's aquatic systems across the continent (Sumaila et al, 2020; Lam et al, 2020). In marine coastal ecosystems, sea-level rise, higher ocean temperatures, increasing acidification, and changes in the ocean current patterns will have tremendous impacts on the abundance, composition, distribution and availability of fish stocks in ways that are not yet fully understood (Ehler & Douvere, 2009). These changes could result in major ecosystem changes, collapse of key fish stocks, and threats to biodiversity (Allison et al, 2009). Projections of the catch potential of each country's exclusive economic zone (EEZ) by Barange et al (2018) indicate significant declines in catch potential under both current conditions and those of increased greenhouse gas emissions (Figures 5 and 6).

FIGURE 5: Projected changes in maximum catch potential (%) under current climate conditions by 2050(A) and 2095(B).

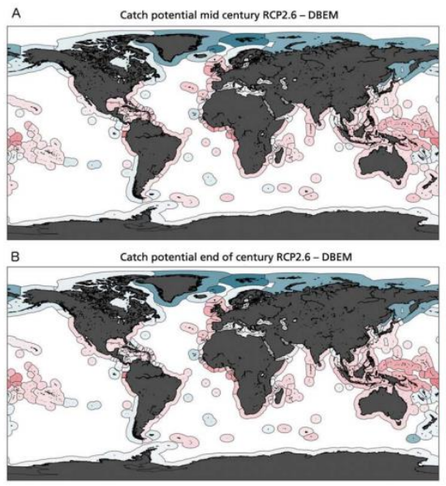
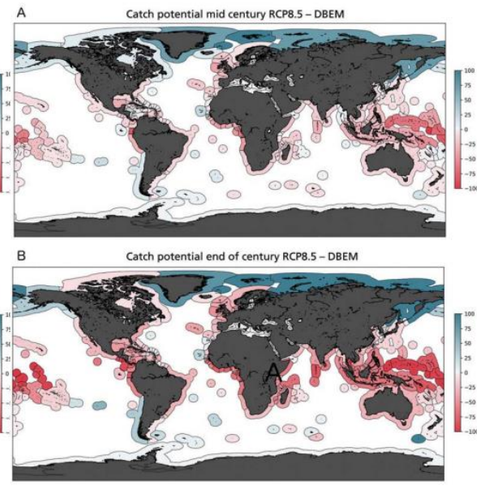


FIGURE 6: Projected changes in maximum catch potential (%) under increasing greenhouse gas emissions by 2050(A) and 2095(B).



Source: Barange et al, 2018

With the anticipated increase in demand (outlined in Section 1.1) which will be required to meet the needs of the burgeoning population, the projected declines in catch potential, particularly in the tropical to temperate regions within which all of Africa's fish supply originates, indicate a worrisome future (Cheung et al, 2010; Sumaila et al., 2019). This is particularly the case if productivity decreases, maximum sustainable yield (MSY) potentials will also decrease. This has already started to happen. If fleet sizes and fishing efforts are not rapidly reduced to adapt to the decrease in productivity, overfishing will rapidly increase, further exacerbating the problem of supply.

Box 1: Projected socio-economic impact of climate change on the fisheries in West Africa – the most densely populated coastal area along the African continent.

Warmer temperatures are expected to lead to a decline of 21% in the annual landed value of fish in West Africa and a decline of nearly 50% in fisheries-related employment by 2050 (Seggel and De Young, 2016). If overexploitation of fisheries in the region continues at their current rates, projections suggest marine-capture fisheries in Nigeria, Côte d'Ivoire, Ghana, Liberia, Sierra Leone, and Togo could halve by 2050 (World Bank, 2017).

The changes in potential catches associated with climate change and its associated shifts in distribution patterns include disproportionate impacts to small-scale fishing communities, which make up a large percentage of Africa's fisheries. It will mean increased migration of fishers in search of livelihood and food security opportunities elsewhere (see challenges associate with migratory fishing in Section 2.4.5). To mitigate these significant challenges changes are needed in policy and regulatory systems to manage the effects of climate change on fishing practices and traditional fishing patterns must adjust to the variations in species productivity and distribution. Further to the complex impacts of climate change on fish supply which affect regions with varying intensity and characteristics (Barange et al, 2018), climate change is expected to have multiple implications for coastal African countries, making them increasingly vulnerable because the essential contribution of fisheries and associated sectors to livelihoods, food and nutrition security, employment, and supply will be irreplaceable. This vulnerability will be exacerbated by migratory fishing from other fishing areas depleted by climate change and overfishing, as well as by agricultural farmers who turn to fishing as a replacement livelihood when drought diminishes earning and livelihood potential where they live, a practice which has already started. Furthermore, climate change is likely to bring drastically increased food prices caused by decreased supply, and the likelihood of increased costs for infrastructure, processing and distribution.

1.4.2 Degraded ecosystems

Healthy coastal and marine ecosystems are essential for ecosystem services and are critically important for fisheries. Additional threats that affect the ability of ecosystems to provide their services are pollution, habitat alteration and destruction, as well as unsustainable and destructive fishing techniques.

Declines in water quality through pollution is caused by several factors including oil pollution, wastes and sewage outfalls, heavy metals pollution from industrial processes and biological waste. Fertilisers, pesticides and agrochemicals lead to nutrient enrichment of coastal ecosystems posing a significant threat, where harmful algal blooms and microbial contamination has been shown to cause major changes in species composition, and the structure and function of marine communities (Islam and Tanaka, 2004). In recent decades, pollution from plastic has burgeoned. The most visible impacts of plastic debris are the ingestion, suffocation and entanglement of hundreds of marine species. Fish and other marine wildlife mistake plastic waste for prey and most then die of starvation as their stomachs become filled with plastic. Floating plastics also help transport invasive marine species, threatening marine biodiversity and the health of humans through the transmissions of toxins through the food chain. Marine pollution can have severe impacts on the ecosystem and

biodiversity and pose a threat to human health and the development of blue economies. On a systemic level, African countries face challenges that stem from inconsistent national legal and institutional frameworks that include overlapping jurisdictions, lack of communication across sectors, failure to domesticate the provisions of international conventions even when they have been ratified, weak implementation, inadequate financial, technical and human resources, uncoordinated surveillance activities, and lack of clarity over maritime borders which have not yet been agreed between some countries (ASCLME TDA, 2012). Globally, land-based activities (including agriculture) are considered to contribute between 80 – 90% of the chronic pollution load to the marine environment (ASCLME/SWIOFP 2012), a relationship rarely addressed holistically by governments.

Habitat destruction and alteration includes inter alia, the modification of seabed and coastal zones, the degradation of coast and coastline erosion. Furthermore, intense urbanisation of the coastal zones, unsustainable exploitation of wood, particularly from mangroves, coastal erosion and offshore oil exploration threaten the future structural and functional integrity of ecosystems. Decades of destructive fishing, such as smaller mesh sizes, bottom trawling, blast fishing and poison fishing, has resulted in the precipitous decline of key fish stocks as well as collateral impacts to other marine life. Bycatch is also highly unregulated and generally goes unreported in most areas, devastating protected and commercially viable stocks. Currently no ecosystem services compensation scheme is in place in Africa for those benefiting from ecosystem damage, particularly those who benefit the most from harmful practices.

There exists a large amount of uncertainty over the current ecosystem status. Information about ecosystem integrity, visible in changes in community composition, vulnerable species and biodiversity, the introduction of alien species and changing yields in a highly variable environment which now includes the unpredictable effects of global climate change, is sorely lacking. This inadequate state of knowledge of the ecosystem's status and the lack of regional coordination in studies of biodiversity, habitats, and ecotones (transition areas) hinders effective management nationally and regionally. The root cause of the lack of information derives from the absence of national or regional valuation of ecosystem services.

1.4.3 Population growth

Africa is projected to see the largest relative increase in the size of its population by 2030 to 1.71 billion people. Most African countries have high fertility rates, with large populations concentrated in coastal and riparian areas. This, coupled with a heavy reliance on fish for animal protein, has led to significant pressure on fisheries resources, and in many countries to overexploitation. Sustaining demand from an increasing population for fish protein, while at the same time allowing stressed stocks and ecosystems to recover, requires new approaches to management and supporting mechanisms and skills which differ from those of the past.

Habitat destruction and alteration includes inter alia, the modification of seabed and coastal zones, the degradation of coast and coastline erosion.

Statistics shows that in 2017, African countries imported fish and fish products estimated at $4.8 billion (3.7 % of global fish imports). The value of the exported fish and fish products during the same time was $11 billion, an estimated 8.5 % of global fish exports. At least 35 African countries are operating on a fish production deficit and are highly dependent on imports. The global and continent-wide demand for seafood will continue, driven by factors such as population growth, preference for fish as a diet of choice for health reasons, the growing affluent middle-class and increasing demand for aquaculture products. One of the greatest threats therefore is that the African coastal states are unable to produce sufficient fish to meet continental requirements and have excess products for export.

1.4.4 Poor governance

Across the continent, there is inadequate governance at the national level to manage transboundary stocks. This has led to insufficient transparency and accountability, incoherent policies, limited structured participation of resource users and non-state actors in the formulating policies and managing the resources (AUC-NEPAD, 2014). At regional levels, there are often too many regional fisheries bodies in one area, such as in the Gulf of Guinea, with overlapping jurisdictions. Most of the bodies have the ability to adopt conservation and management measures but have only advisory responsibilities, with no regulatory powers. Despite overlapping in competencies, there is limited regional coordination for governance and collaboration among them and ineffective enforcement, including monitoring, control and surveillance (MCS) or implementation of the management measures they advise. For these bodies to deliver on their mandates, including implementing FAO's Code on Responsible Fisheries (FAO, 1995), among other best practice instruments, effective coordination mechanisms at the regional level are urgently required.
In many Member States, the legal, policy, and institutional frameworks are not crafted to suit fisheries' unique and complex features, resulting in mismatches of fisheries policies with national development goals (AUC-NEPAD 2014). This gives rise to insufficient mandates and effective compartmentalisation. Furthermore, insufficient human capacity to cover key areas in fisheries

administration, management and research, and weak information-collection and analysis hampers sound decision-making processes. To illustrate, five key institutions in Ghana are involved in trade or export and health and safety requirements to export fish to the EU market. These institutions are challenged to adapt to more stringent EU regulations and develop new sets of domestic rules. Sadly, there is an inadequate inter-institutional collaboration as well as overlaps or absence of mandates to allow an efficient end-to-end food safety system. These experiences are not confined to Ghana but are typical in other African countries that are currently exporting fish to Europe or who wish to do so (Beyens et al. 2018).

In Africa, despite the extensive possibilities for effective management systems, two types of fisheries management are most commonly employed: indirect or technical management measures, and rights-based management.

Lastly, fisheries policies, institutional structures and the skills base of fisheries agencies in many African countries have been heavily influenced by a historical focus on production and revenue maximisation year-after-year, driven by the need to generate cash for the national treasury, with little or no reference to resource productivity and sustainability. The approach has led to overexploitation of most of the major fish resources.

1.5 Governance schemes and management frameworks

1.5.1 Fisheries policies and management

Many African countries face challenges that include: i) the absence of up-to-date policies, laws and regulatory standards at the national level; the lack of harmonisation of policies, laws, regulatory standards at the regional level; low compliance, inadequate enforcement and limited effective involvement of stakeholders in the fisheries management process. Where the legislation and policies are in place, the implementation plans are either absent or the compliance mechanisms are not working (AU-IBAR, 2020). At the continental level, the African Union has established a clear vision to unlock the full potential of marine fisheries as enshrined in the Agenda 2063 The Africa We Want, African Integrated Maritime Strategy (AIMS 2050), the Lomé Charter on Maritime Security and Safety and Development and the African Blue Economy Strategy (AU 2019a), to mention but a few key framework strategies. Fundamentally, the future of marine fisheries depends on the advances which must now be made to holistically reform the fisheries as conceived in the Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa (PFRS) (AUC and NPCA 2014). Annex 1c provides a review of various management frameworks that have been suggested or applied in the African context.

In Africa, despite the extensive possibilities for effective management systems (Annex 1c), two types of fisheries management are most commonly employed: indirect or technical management measures, and rights-based management.

- **Technical management measures:** Designed to reduce wasteful discarding of fish and unintended fishing mortality, technical measures are a broad set of rules that include gear modifications (e.g. mesh size) as well as spatial or temporal restrictions (e.g. distance from shore). Ultimately, rules about where, when and how certain fishing gear may be used helps to regulate activity that may impact the long-term sustainability of fishery resources. In terms of size selectivity, mesh size restrictions can be a useful measure to avoid capturing individuals of target species in the immature stages, but they have limitations in multi-species fisheries. When organisms of different shapes and sizes occur on the same fishing ground, immature individuals of a larger species might still be captured. Fishing mortality can be modified by restricting fishing activity to certain times or seasons, or by restricting fishing in particular areas. Such measures can be used to reduce the mortality rate of individuals of either target or non-target species in vulnerable life stages. The selective reduction of fishing mortality rate on both target and non-target species generally reduces both the direct and indirect effects of fishing on the ecosystem. Closures may protect critical habitats where fishing activity would otherwise cause damage to the physical structures supporting the ecosystem. They may also help to reduce mechanical disturbance to the benthos and help more stable and structured communities become established. Selectivity can be improved through a variety of methods other than mesh size, including the use of square mesh, sorting grids and other devices which enable the unwanted portion of the catch to escape.

- **Right-based fisheries management (RBFM):** limits entry to the fisheries sector to keep catches at biologically sustainable levels (see case study below for the Namibian example). It focuses on the right (together with the responsibilities) held by individuals, communities, companies and government relating to fishing. There are four different types of use rights (FAO, 2002), namely, 'territorial use rights' (TURFs), 'limited entry, effort rights' (quantitative input rights) and 'harvest quotas' (quantitative output rights). The TURFs assign rights to be able to fish to individuals or groups in certain localities with limited-entry systems that allow only a certain number of individuals or vessels to take part in a fishery, with entry being granted by a licence or other form of permit (FAO, 2002; Andrew and

Evans, 2009). Such a system of management is generally applied for local demersal resources, but has limitations for halieutic resources which undertake long North-South migrations along the African coast. TURFs are implemented in Sierra Leone (Baio and Seik, 2018) and in lagoon fisheries in Côte d'Ivoire and beach seine net fisheries along the West African coast.

Under limited entry, the authority issues a limited number of licences to fish. It prevents the entry of new fishing boats or fishers, controls potential fishing effort (limiting fleet capacity), and helps conserve the resource and eventually generates higher incomes for those holding the use right.

The effort rights (quantitative input rights) approach is intended to regulate the catching power not to exceed the target fish stock's reproductive capacity ensuring that fishing levels are commensurate with the sustainable use of fishery resources (FAO, 1995, paragraph 7.1.8 of the Code). This is often implemented through a 'limited entry' scheme to control the number of vessels fishing, which can be combined with limiting the amount of fishing by each fisher (or vessel). The possible inputs that could be controlled include time fished, vessel size, amount of gear, and gear attributes.

Harvest quotas (quantitative outputs) are set by the authority in the form of a total allowable catch (TAC), which is not a use-right per se but rather a conservation control. However, when a TAC is subdivided into quotas allocated to fishery sectors, individual fishers, or communities, these shares represent quantitative output rights. Individual quotas remain rare in Africa due to their considerable financial requirements but are practiced in some industrial fisheries, as with an individual transferable quota (ITQ) system in Namibia and South Africa. The advantage of individual harvest rights include the ability to plan fishing activity as desired, which can (a) potentially provide a better match to available markets, and (b) avoid the 'race for the fish', so that individual harvests can be taken at a lower cost, with less incentive for the over-capitalisation that can occur with limited entry and input allocation programmes. User rights, when allocated to the community rather than the individual, are particularly beneficial to small-scale fishing communities that need to have secure tenure rights to fishery resources to sustain their livelihoods and are in line with the FAO Voluntary Guidelines for Securing Small-Scale Sustainable Fisheries in the context of food security and poverty eradication[12].

[12] *See: www.fao.org/voluntary-guidelines-small-scale-fisheries/en/*

Case study: Namibian rights-based fisheries management system

By law, Namibia has no open access to fisheries resources and instead, adopted a right-based management system to limit unrestrained entry to the fisheries sector and keep catches at sustainable levels. Fishing rights are granted for periods of 7, 10, 15 or 20 years, depending on various factors such as level of employment, level of Namibian ownership and status of investment by the operator in social and economic development. Right holders receive fishing quotas annually, based on TACs and scientific advice about stock health. Fishing rights are not transferable to ensure that they remain in the hands of the initial recipients to promote Namibian dominance in the sector. Foreign newcomers have to form joint ventures with Namibians as a precondition for long-term fishing rights. Namibia is one of the few countries in the world that has succeeded in capturing economic rent (resources rent) from its fisheries, where several fees are charged, including quota fees, research levy, by-catch fees and licence fees. The industry is not subsidised[13] because subsidies cause over-capitalisation, leading to overfishing and unfair trade distortion (AU-IBAR. 2012).

1.5.2 Institutions and actors

The primary responsibility to reform fisheries lies with the individual nations of Africa as they oversee their respective sectors and can regulate, promote, support, guide, and coordinate the implementation of reforms through broad consultative processes with other stakeholders (AUC and NPCA, 2014). The eight African regional economic communities (RECs)[14], can support the reform by a number of actions including financing the priorities of the regional fishery bodies (RFBs) (AUC and NPCA, 2014). However, most RECs do not prioritise fisheries and have no dedicated department or unit that is responsible for the sector, nor regular annual budgetary allocation to support it. The ten RFBs are mandated (by their members) to manage the fisheries resources sustainably, thereby advancing the strategic objectives of the African Union. Notable achievements in establishing formal linkages between RECs and RFBs include the signing of memoranda of understanding between the Economic Community of Central African States (ECCAS) and the Regional Fisheries Commission of the Gulf of Guinea (COREP), and between the African Union Inter-African Bureau for Animal Resources (AU-IBAR) and the Ministerial Conference on Fisheries Cooperation Among African States Bordering the Atlantic Ocean (ATLAFCO). The ATLAFCO has further signed agreements with COREP and

[13] *The Namibian fishing industry is taxed and levied to generate revenues for the government. Thus, for every tonne allocated, the fisher pays a) quota levies b) marine resources fund levies and c) by-catch levies. The combined total of these levies and fees cost about 5.1% of the landed value per kg of the marine resources. The payment for quota levies is made regardless of whether the catch is made or not.*

[14] *RECs: https://au.int/en/organs/recs*

the Fisheries Committee for the Centre West of the Gulf of Guinea (FCWC), while SRFC and FCWC have done the same.

The AU-IBAR analysis "Rationalization of RFBs for Effective Performance" (AU-IBAR, 2018) revealed that RFBs have largely been ineffective in meeting their objectives with the main challenges including their inability to effectively combat illegal, unregulated and unreported (IUU) fishing activities, incoherent policies, permitting excess fishing capacity, poor management, weak coordination, and lack of cooperation in the sector (at institutional and inter-state levels) and inadequate domestic governance. In some regions (e.g., the GCLME), the area of geographical competence and the roles and mandates of existing RFBs tend to overlap leading to duplication of effort, waste of resources and unnecessary competition between bodies, and membership fee fatigue – all of which adversely affects the finances of some RFBs and their ability to carry out their mandates satisfactorily. Most RFBs have no comprehensive system of observation, inspection, compliance and enforcement, and there is a paucity of reliable assessment data for important stocks. Furthermore, there is limited networking, complementarity, linkages and cooperation between the RFBs and RECs in their areas of competence.

The regional seas programmes and conventions initially focused on pollution-related issues, and have now expanded their mandates to embrace a broader ecosystem approach to protect the environment and manage marine resources. To illustrate, the Barcelona Convention covers biodiversity, ecosystems and climate change adaptation while the Regional Organization for the Conservation of the Environment of the Red Sea and the Gulf of Aden (PERSGA) programmes under the Jeddah Convention include the sustainable use of the fisheries and marine protected areas. Furthermore, the Nairobi Convention incorporates ecosystem-based ocean governance, while the Abidjan Convention has developed six new protocols including sustainable mangrove management and regional integrated ocean management policy.

Public participation is critical for good governance with many advantages emerging from involving stakeholders in the decision-making process (Pita et al., 2010). The policy reform (AUC and NPCA, 2014) recommends the active participation of non-state actors, including non-governmental organisations (NGOs) and civil society organisations (CSOs), in decision-making throughout the fisheries reform process. Development partners, such as the African Development Bank have a critical role to play both in facilitating reforms and in creating the institutional conditions to ensure the benefits of appropriate policies and reforms highlighted in the PFRS are sustained (AUC and NPCA, 2014).

1.5.3 Foreign fishing agreements

Since the adoption of the Exclusive Economic Zone (EEZ) by African countries (through the United Nations)[15], three marine governance schemes can be found in Africa: the first relies on the exploitation of the fish stocks by the domestic fleet[16] and more particularly by the artisanal fleet; the second depends on the establishment of joint ventures and the third relies on the fishing agreement to exploit certain stocks of fishes. For many countries, the three types of governance are operating together. For instance, in Senegal and Mozambique, the artisanal fleet continues to expand alongside joint ventures (Korean Republic in Senegal and China in Mozambique) and bilateral fishing agreements with the EU

[15] The United Nations Convention on the Law of the Sea (UNCLOS) of 1982 officially gave all coastal states the right to establish a 200-mile EEZ limit from their shorelines. Article 62 of the Convention states that "The coastal State shall determine its capacity to harvest the living resources of the exclusive economic zone. Where the coastal State does not have the capacity to harvest the entire allowable catch, it shall, through agreements or other arrangements and pursuant to the terms, conditions, laws and regulations referred to in paragraph 4, give other States access to the surplus of the allowable catch (…)". The article confers a legal basis to fisheries agreements.

[16] Or in certain circumstances of the renting of foreign vessels such as in Mauritania for the catch of small pelagic fishes.

(with about 15 countries; see Annex 1e) and China (with Mauritania, Gambia, Mozambique, etc.). Other countries have also developed a private agreement system in parallel with their bilateral agreements[17].

The total reported catch by African and distant water fleet nations operating in African waters is about 7 million tonnes annually[18]. Catches by African fleets rapidly increased from 2.5 to approximately 6 million tonnes between 1990 and 2017. In contrast, those of European fleets, including all countries (EU and Russia), steadily declined from 3 to 0.5 million tonnes over the same period (FAO, 2021). The collapse of the Soviet Bloc's fleets partially explains this phenomenon since they accounted for about 50% of the total European catch between 1970 and 1988. The other explanation is the gradual withdrawal of fleets of the three key European countries, namely Spain, France and Italy, whose catch decreased by over 70% between the late 1980s and 2017. The transfer of vessels from some EU Member States to Flags of Convenience (FOCs) also contributed to this situation. For this reason, Caribbean countries, often acting as flag of convenience states, in late 2000 and the beginning of the next decade, have a catch volume of about 500,000 tonnes. Asian countries occupy a lower position in terms of the total catch because of the gradual withdrawal of Japan from the 1970s (the Japanese catch dropped from 250,000 to 20,000 tonnes during this period). The progressive entry of Chinese fleets (and those of the Chinese province of Taiwan in particular) and Korean ones, to a lesser extent, contributes to higher volumes of catches, although the figure remained relatively low at 150,000 tonnes per year. Whistleblowing by international NGOs on illegal fishing practices, such as lack of catch reports from Asian fleets, leads us to the assumption that these data represent the minimum volume of catches. Given the steep increase in the prevalence of artisanal fleets and their production, the importance of fishing agreements is decreasing each year (Failler P., 2014a, 2016 and 2020). The fishing agreements contribute significantly to IUU fishing in host countries due to corruption and a lack of resources (capacity and financial) to enforce standards and ensure compliance. This exacerbates the already existing problem of IUU fishing that is so engrained in artisanal fishing by its nature.

[17] See Failler (2015) for a full review of the fishing agreements in place in African costal countries.
[18] The main species fished by all fleets are small pelagics (approximately 4.5 million tonnes on average over the period 1970-2017, accounting for over 65% of the total catch). Demersal and unidentified marine fish and others (comprising all groups of species whose percentage was negligible) weighed 27% of the total catch, representing about 2 million tonnes per year, while tuna and tuna-like species represented an estimated 500,000 tonnes per year (8% of total catch).

02

Opportunities for securing the future of African marine fisheries

To meet the projected 13 million and almost 19 million tonnes net supply in 2030 and 2050, dramatic and transformative change is needed. In recent years, the continent has discovered better practices and fostered regional cooperation in unprecedented ways. This has brought new hope to coastal communities, coastal cities and ultimately, the fisheries sector. Fulfilling the food security, livelihood and economic demands of Africa over the coming years is possible providing radical change is put at the forefront of decision-making.

2.1 Key areas for improved production

This paper did not plan a detailed technical analysis but it is clear four key opportunities related to the sustainable development of the fisheries sector should be urgently considered to harness the fishery and aquaculture development. Investments in these areas will provide returns at a very high rate and pave the way to prosperous results long into the future. These steps should be harnessed in an integrated and holistic way to overcome the major challenges faced in these areas. In total, they would be responsible for adding in the region of 15 - 19.5 million tonnes of marine fish to the current potential.

TABLE 1: Potential net supply added to fisheries productivity through opportunities of investment and development.

Opportunity for increased fish supply	Potential increase in capacity	Potential tonnage added to net supply by 2050
Ecosystem health	50-60%	9 - 10.5 million tonnes (Tregarot *et al.,* 2020)
Sustainable operations	30-40%	2 - 3 million tonnes (FAO, 2021)
Improving harvest and post-harvest chains	20-25%	1.5 - 2 million tonnes (FAO, 2021)
Mariculture	25-35%	2.5 - 4 million tonnes (Ragasa, 2022)
Total potential		15 - 19.5 million tonnes

Source: Author's own conception

Harnessing these opportunities has the potential to significantly increase the production of Africa's marine fisheries. Making use of these opportunities, together with managing some key challenges, will present prosperous future outcomes. By focusing on restoring ecosystems to a high ecological condition, there is the potential to further increase fish production service by 50-60%, adding 9 to 10.5 million tonnes to the annual net supply by 2050. This can be overcome through better valuation of ecosystems, increasing the role of marine protected areas (MPAs) in fisheries management, addressing pollution and other conflicts through improved marine spatial planning (MSP).

A further 2 to 3 million tonnes of fish net supply could be delivered by 2050 by improving the sustainability of fisheries operations and minimising the environmental footprint of fishery fleets and processing industries. Enhancing the sustainability of the fisheries should focus on proper transboundary management, with a specific focus on finding resolutions among fishery committees for the control of foreign access agreements, as well as managing and monitoring migratory and IUU fishing practices. Serious investment and attention should also be given to improving operations to limit bycatch and discard and employing sufficient monitoring, control and surveillance (MCS) mechanisms. This includes balanced harvest tools, sustainability monitoring and regional control and surveillance mechanisms.

Improving harvest and post-harvest chains, including scaling up and integrating mariculture has the potential to increase production to deliver over 1.5 to 2 million tonnes of net supply by 2030, with mariculture offering a further 2 to 4 million tonnes of added net supply. Mariculture offers increasingly sustainable alternatives to meet the demand for both home consumption and supply to

international markets. Focusing on value addition of all products, both capture fisheries and integrating with mariculture, is the key element to enable optimum profit or gains from the fish products (Failler, 2014b). Reducing post-harvest losses through improving or introducing proper standards and supporting investments in value-added products (for example fish smoking and drying technologies to increase shelf life) is an opportunity that would ensure that the prevailing loss of 35% of harvests are not wasted but potentially become the fastest way to create value. Lastly in the fishery chain, Africa can reduce its vulnerability to external shocks by boosting intra-regional trade and limiting exports to ensure each nation's nutritional needs are met first. Links at the African level need to be developed and investment channelled into regional collaborative mechanisms for trade. Regional trade mechanisms will form an integral part of the emerging blue economy and should be prioritised early.

2.2 Highly valued ecosystems

Given the severe pressures associated with biodiversity loss and climate change, there is an extensive amount of work taking place across the continent to protect and restore natural habitats, often through nature-based solutions (NBS). This is driven by the extensive funding being invested in climate change mitigations and adaptations. As an example, the European Development Fund(EDF) has announced major investments of up to 50% of their fund in climate change. This means for the first time serious investment and restoration efforts will be channelled into coastal habitats, which are fundamental to Africa's fisheries.

There is increasing evidence of the importance of coastal ecosystems for climate change mitigation, carbon sequestration, and coastal protection linked to the services that coastal ecosystems provide. So much so, that Nationally Determined Contributions (NDCs) have started including a drive for the restoration of coastal ecosystems through NBS, according the first revision cycle of NDCs associated with COP26. This is an incredibly important opportunity for Africa's fisheries sector, given the connection between biodiversity, ecosystem health and fisheries. Specifically, the abundance of fish is directly related to the health of the ecosystems and concerted efforts in this direction could be significant.

2.3 Large continental fish market

The demand for fish across the continent is guaranteed, and with increasing blue economy developments, there is a corresponding increase in purchasing power as the GDP per capita is increasing on average, particularly in cities.

More of the population will be able to afford to buy fish on the local market, as the price of fish will be similar or the same as export fish prices. This brings a wealth of benefits, as it is easier and cheaper to supply the local market than the international one. There is significantly less risk, less exposure to external shocks and fewer difficulties associated with product origins and certifications. With the African Continental Free Trade Area (AfCFTA) signed in 2018, a critical opportunity is available for member states to fast-track trade documents, tariff timings, rules of origin and a system for addressing non-tariff barriers, all in an attempt to support seamless movement of goods between member countries. It is to be hoped that these efforts will encourage improved coordination of trade policies in the eight RECs, encouraging further economic growth and food security for the continent. Thus, the local market is becoming increasingly important. Ultimately this will allow for the reversal of the current net importation to supporting Africa's needs first and only exporting any excess to eventually become a net exporting continent.

2.4 Blue economy development

Fisheries in Africa are recognised for their importance in delivering national and regional priorities. Africa has a range of possible options for the governance of its biodiversity to benefit its people. The existing policies, strategies, plans

and programmes at the national, regional and local levels are progressively addressing threats to fishery-related environments and making contributions to the fishery sector, and have led to some modest degree of recovery of threatened biodiversity areas. These mechanisms are increasingly encouraging the transition to a blue economy in the context of sustainable development. Governance options that harness synergies and deliver multiple benefits, supported by an enabling environment can help balance the access and allocation of ecosystem services to benefit the fisheries. Mechanisms for the blue economy are designed to do exactly that, offering wide opportunities for increased provision of natural resources, and supporting the economy.

The development of the Africa Blue Economy Strategy by the African Union and the IGAD Regional Blue Economy Strategy and Implementation Plan for 5 years (2021-2025) prioritises fisheries and aquaculture, positioning these industries as part of a much bigger system that requires particular attention, rather than independent sectors operating in isolation. Several national blue economy strategies have been subsequently established or are currently under development. Some examples are the Seychelles Blue Economy Action Plan (Failler and El Ayoubi, 2020), the incorporation of the blue economy into a ministry by Mauritius, Kenya's Presidential Blue Economy Taskforce, and the Policy Charter for the Blue Economy in Cabo Verde. Through such strategies, money is therefore being channelled to the blue Economy on a large scale, usually aided further by development assistance, such as through the African Development Bank. In this regard, sustainable finance for the fisheries is being generated by its strong integration into the blue economy and associated mechanisms for its development.

03

Challenges and innovative solutions

To truly benefit from the existing opportunities for fisheries in Africa's blue economy, there needs to be significant consideration of several challenges. This will require innovative solutions that suspend traditional ways of thinking and shift the focus onto ensuring Africa's demands are met first.

3.1 Restore ecosystems to high ecological condition

Without healthy ecosystems, fishery resources diminish. Overall, the coastal and marine ecosystems around Africa are already significantly degraded, with the effects on fisheries severe. Table 2 identifies the habitat functionality index[19] of the coastal habitats of Africa's LMEs, indicating that for habitats (such as mangroves, coral reefs, seagrass beds, kelp forests) essential to the productivity of fisheries, none are functioning at their optimal level to provide services. This is a concerning prospect for the future of Africa's marine fisheries.

[19] *Habitat functionality refers to the capability of habitat features to sustain species, populations, and diversity of wildlife over time.*

TABLE 2 Large Marine Ecosystems and their spatial coverage

Large Marine Ecosystems (LME) and the additional region	Coral reefs [km²]	Mangroves [km²]	Seagrass beds [km²]	Combined [km²]	Kelp forests [km²]
African Islands of the Indian Ocean	2,285	8	134	2,427	0
Agulhas Current LME	6,442	5,792	9,714	21,948	0
Arabian Sea LME	408	11	0	419	0
Benguela Current LME	0	617	601	1,217	1,000
Canary Current LME	0	3,212	6,195	9,407	0
Guinea Current LME	0	16,195	43,582	59,777	0
Mediterranean Sea LME	0	0	5,065	5,065	0
Red Sea LME	5,481	76	6,963	12,521	0
Somali Coastal Current LME	2,844	1,555	160	4,559	0
Total	17,460	27,465	72,415	117,339	1,000

Source: Tregarot et al. (2020)

However, there is remarkable ongoing work that focuses on the linkages between healthy ecosystems and the abundance of fisheries resources[20]. For example, RAMPAO, the West African Marine Protected Areas Network, through the 'Sustainable Exploitation of small pelagics in MPAs and other protected areas in West Africa' (PPAMP) project, seeks to guarantee the protection of natural habitats conducive to the life cycle of small pelagic fish. More generally RAMPAO, which is active within the West African marine ecoregion that encompasses Cabo Verde, the Gambia, Guinea-Bissau, Guinea, Mauritania, Senegal, Sierra Leone and Benin, works to maintain a coherent set of habitats necessary for the ecological processes which regenerate natural resources and conserve biodiversity for the benefit of society (Deme and Failler, 2022). Through their extensive work on the development of protected area networks, the project has enhanced the linkages between ecologically important areas and the abundance of fish which are of high economic importance in the region.

Following the lead of projects such as these, nations and development aid should prioritise enhancing the synergies between ecosystems and the resources they provide. If the major challenge of improving ecosystem health is overcome, we will increase the abundance and availability of fish by 2030 and 2050 and be able to meet the needs of Africa's marine fisheries. Subjugating this challenge

[20] *Similarly, there is a large project under development by the IUCN and funded by the GEF, 'Using Marine Spatial Planning in the Gulf of Guinea for the implementation of Payment for Ecosystem Services and Coastal Nature-based Solutions'. This project focuses on the synergies between fisheries and ecosystems in the Gulf of Guinea. It is the first of its kind to offer regional-level integrated systems to develop marine spatial plans, to guide areas of intervention for the set-up of payments for ecosystem services (PES) and fisheries-related carbon compensation schemes. The money generated from the PES schemes is to be directed into restoration and protection efforts through nature-based solutions.*

is essential to fisheries and is necessary for all elements of in the development of the continent's blue economy. Outlined below are some key areas for intervention. While not exhaustive, here we highlight integrated approaches that would bring prosperity not only to the marine fisheries sector, but to the blue economy as a whole.

3.1 1 Better valuing of ecosystem services and increased restoration

There is an enormous gap in the knowledge around the state of ecosystems. Without a better understanding in this area, it becomes increasingly difficult to measure baselines and progress and therefore African nations and regional committees must better quantify and qualify the economic value of the ecosystem services provided by coastal environments. Assigning value to biodiversity undeniably contributes to any efforts towards marine resources conservation and sustainable exploitation[21]. 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: a means to represent the costs of marine ecosystems' degradation and destruction, and to define the environmental status of relevant ecosystems to determine areas for urgent attention.

There is a wide range of applicable tools for environmental accounting. The Natural Capital Project's InVEST[22] (Integrated Valuation of Ecosystem Services and Trade-offs) tools offer a range of open-access software tools for valuing natural capital. At the African level, recent work by Tregarot and al. (2020) assesses the value of the services provided by Large Marine Ecosystems (see figure 8).

[21] 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.

[22] InVEST: https://naturalcapitalproject.stanford.edu/software/invest

FIGURE 7: 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)

The work uses a habitat vulnerability and functionality index to describe the ability of ecosystems to provide their monetary services. The analysis clarifies 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 3 below).

Such evaluation attempts should be a starting point for regions currently without ecosystem services valuations. Certainly, 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, taking into account the Gross Domestic Product and the socio-economic and environmental contexts.

TABLE 3: 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.

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	3,459	1,876	-	445	5,780
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	5,813	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
% functionality	44 %	45 %	67 %	75 %	59 %

Source: Tregarot et al. 2020

Also in the African context, a novel systems-level blue economy approach to ecosystem services valuation that can be applied is the Blue Economy Valuation Toolkit (BEVTK)[23] developed by the United Nations Economic Commission for Africa (UNECA). The valuation toolkit is designed to capture the various dimensions of human interactions with the "blue environment" (ocean, lakes, rivers, etc.) and account for the various types of benefits (environmental, ecological, utilitarian, hedonistic and monetary) that can be procured through the blue economy (Lallemand and Failler, 2020). It covers three main components of the blue economy: economic activities, social interactions, and importantly in this case, natural habitats, and the ecosystem services they provide. The unique feature of this accounting tool in terms of ecosystem valuations, is its consideration of the health of the ecosystems rather than just the area coverage, as most other tools provide. The three components are articulated around a series of recent classification systems widely accepted among international experts and compatible with System of National Accounting (SNA), and the UN System of Environmental-Economic Accounting (SEEA)[24].

[23] *See the operation manual for the BEVTK here: https://www.uneca.org/sites/default/files/SROs/BEVTK%20Operational%20Manual_0.pdf*

[24] *The BEVTK is ready for use and training courses on the use of the toolkit are offered by the African Institute for Economic Development and Planning (IDEP).*

Case Study: Seychelles Blue Economy Accounting

The Seychelles began to adopt the UN SNA in 2007[25], just prior to defaulting on interest payments on a $230m Eurobond due to its foreign exchange reserves having been exhausted. 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 has captured accounts from most sectors of the economy, coding them with the International Standard of Industry Classification (ISIC Revision 4)[26].

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[27].

The accounting for blue economy activities is in its infancy in the Seychelles. Like other countries, Seychelles' current SNA does not account for stocks and flows of natural capital, nor activities that are solely applicable to the blue economy. This should be addressed urgently as the country's entire economy, particularly its two primary industries of tourism and fisheries, is heavily dependent on the health and quality of its marine natural capital[28] as well as the global health pandemic situation that constraints tourism activity. Traditionally, the management of coastal and marine ecosystems have been compromised by "insufficient financing, capacity, and legal and institutional frameworks"[29].

Yet, Seychelles is conducting several projects in to better understand the economic importance of its industries; some of the projects are in line with its progress toward blue economy accounting. A fisheries satellite account[30] has been piloted and currently a tourism satellite account is being developed[31]. The United Nations Development Programme's Biodiversity Finance Initiative (BIOFIN) conducted a series of investigations in Seychelles to assist with implementing biodiversity financing, however Seychelles' graduation to high income status saw them lose the development assistance of this programme, as well as many others.

[25] *https://www.nbs.gov.sc/statistics/national-accounts*

[26] *https://www.nbs.gov.sc/statistics/national-accounts*

[27] *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*

[28] *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*

[29] *Ibid.*

[30] *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*

[31] *https://www.unwto.org/africa/news/2019-07-10/mission-develop-tourism-satellite-account-kicks-start-seychelles*

Case Study: Seychelles Blue Economy Accounting (continued)

Nonetheless, BIOFIN identified a series of possibilities for financing biodiversity protection and management[32]. The Seychelles Fishing Authority has strategic management initiatives underway to enhance 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[33], as well as the 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 with project outcomes presented in the figure below (Laing, 2021).

The BEVTK has provided for the first time a meaningful overview of the blue economy in the country from the three angles. UNECA intends to develop a more sophisticated blue economy satellite account, allowing for accurate reporting of this portion of the economy on an annual basis.

Despite the absence of a current blue economy 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 demonstrate and monitor economic and environmental achievements. For instance, investment in its 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 blue economy innovation, disbursed by the Seychelles Conservation and Climate Adaptation Trust (SeyCCAT)[34]. Seychelles developed the innovative Blue Bond[35] 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[36].

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

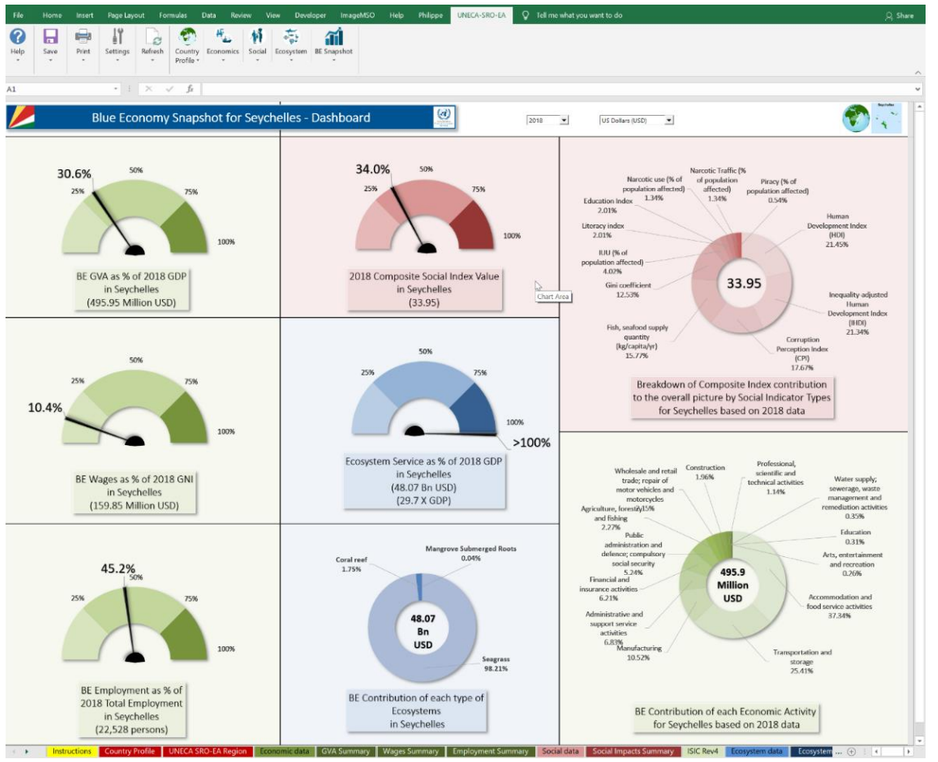
[33] Lallemand, P. 2015. Supporting the improvement of marine fisheries governance and management in Seychelles: Economic study on major trends in the tuna industry and its impact on the Seychelles economy over the 5-year period, 2009-2013. Smart Fish: Indian Ocean Commission. http://www.fao.org/3/a-bl764e.pdf

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

[35] With the establishment of 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.

[36] 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

FIGURE 8: UNECA BEVTK outcomes for Seychelles: example of dashboard



The 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 Contributions[37] and exploring the likelihood of trading BC credits in the future, while there have also been discussions surrounding investment into marine biotechnology as a future prospect. Despite the positive progress the Seychelles has made, many of these projects are yet to be realised. Additionally, aside from the blue economy valuation toolkit and formal economic accounts, many gaps still exist in capturing the real 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.

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

3.1.2 Increasing the role of MPAs as a tool for fisheries management

The utility of the incentive fisheries management tools such as marine protected areas and harvest control have been tested over time. Marine protected areas have been shown to increase the abundance and diversity of fish, and some of these fish swim out of areas, causing spill over effects that benefit adjacent fisheries. Not all MPAs have such diffusion effects as they depend on the location of the MPAs and their purpose e.g. as nurseries or refuge. Within the MPA the halting of fishing and preservation of habitat health led to a reduction in natural and fishing mortality and improved growth and reproduction, leading to a significant increase in biomass (Lester et al., 2009)[38].

Pollution is destroying nursery habitats and feeding grounds important to regional and local fish stocks and having a major effect on fisheries.

However, ensuring the effectiveness of MPAs requires a comprehensive understanding of species distribution and the habitat relationships therein, which is often lacking in protected areas worldwide. The lack of spatially explicit information on species distributions and habitat preferences can compromise their effective protection, even when they occur within designated MPAs (Hunt et al., 2020). It is crucial that management plans are developed and implemented for each MPA. To successfully contribute to the sustainable management of fisheries and to economic prosperity, an MPS's location and size, its habitats, and connectivity to other MPAs, as well as the quality of local stakeholders' participation in its management are key determining factors (Garcia et al., 2013).

MPAs have the potential to benefit fisheries significantly through the services they provide if the ecological condition is maintained or restored to a high level. Therefore the improved management of current MPAs and the networking of MPAs should be a more refined focus for fisheries management, rather than using MPAs solely for conservation purposes. MPAs should be designed and managed based on sound evidence of the areas that contribution significantly to fishery resources. In this regard, to have any meaningful impact on fish stocks, the export of biomass and 'no-take' zones that prohibit all fishing activity are necessary. Furthermore, without rules in place to control and inhibit fishing around the perimeter of the MPAs, the efforts of the MPA remain redundant. MPA management for fisheries needs to take place alongside additional measures, and not independently as a socio-economic conservation measure. In this way, the benefits of the MPA would then spread to provide services to the whole EEZ.

As an example, in Mauritania, the Banc d'Arguin National Park (PNBA) acts as an essential supplier of fishery resources to the nation's fishery sector. Fish stocks in the once highly productive EEZ of the country are overfished with little sign of recovery (Failler et al., 2005; Tregarot et al., 2020), making the fishery extremely dependent on the good functioning of the PNBA for their resilience. Currently, the PNBA makes up 15% of fishery contributions to the country, generating up to $90 million per year (Tregarot et al., 2020), a very high return from a single MPA. The PNBA is a focus point for a number of restoration and carbon sequestration activities associated with biodiversity conservation and climate change mitigation. These activities include those through the action of projects such as RAMPAO, mentioned earlier in Section 3.1. The findings of Tregarot et al. (2020) confirm that fish stocks in the EEZ of Mauritania benefit from the PNBA, as the largest MPA of West Africa. This highlights the learning that increasing attention to the restoration of coastal and associated marine ecosystems through endeavours to increase biodiversity and mitigate climate change provides positive opportunities for Africa's fisheries, given the critical dependency of fish abundance and biomass on healthy functioning ecosystems[39].

3.1.3 Addressing pollution through improved marine spatial planning

Pollution is destroying nursery habitats and feeding grounds important to regional and local fish stocks and having a major effect on fisheries. Given the challenges associated with pollution (described in 1.4.2.), the effective management of marine pollution requires a strong legal regime covering national, regional and international levels.

Marine spatial planning (MSP) offers an opportunity to address these issues, given it can allow the implementation of the ecosystem approach in ways that protect marine and coastal biodiversity, proactively avoid conflicts between

[38] Increased biomass within the MPA leads to greater competition between the individuals present and causes part of the population to leave the MPA, impacting the areas around it. At the scale of the ecosystem, there are also a number of effects including that the movement of eggs, larvae, the emergence of juvenile or adult stages depending on the species can have beneficial effects on areas located far from the MPA (Claudet et al., 2006), as well as the time required for an MPA to reach maturity. The role of MPAs in providing fisheries benefits can still be debated because the results are often context-dependent (Hilborn et al., 2004; Hugues et al., 2016). After all, the spill-over effects can be very localised or limited by migration, and fish stocks may only benefit from protected areas of sufficient size (Coll´eter et al., 2014; Mesnildrey et al., 2013).

[39] Similar results have been identified in the Saloum Estuary, Senegal, where in the Bamboung MPA, after a decade of fishing closure, a two-fold increase in predator biomass and a 1.5-fold decrease in prey biomass was recorded. Fishing closure favours the development of large and high-trophic level species, including sharks, barracuda and dolphins (Thiaw et al., 2021). The Bamboung MPA is dynamic, with biomass outside the MPA showing high variability, especially in terms of small pelagic fishes (Deme et al., 2021a). Overall, an increase of total fish biomass and of maximum fish length has been registered after the fishing ban.

sectors, enhance synergies between marine uses, and establish framework conditions for better ocean governance and wealth distribution. As such, MSP provides the spatial foundation for managing pollution and pollution events in an integrated and stakeholder inclusive way. A description of MSP and its wider benefits, such as managing conflicting industries or competing for marine space, is outlined in Annex 2a.

In the context of the marine ecosystems important to Africa's fisheries, land-based sources of pollution can be better controlled by managing the key leakage points of plastic, wastewater outflows and agricultural run-off. Given the integrated and holistic nature of MSP, enhanced management systems and policies for the land-sea interface, including upstream sources of pollution would naturally develop as a by-product of a planning process. While pollution from land is a dominant impact on marine ecosystems, marine pollution is also derived from maritime activities (e.g., lost fishing gear and oil spills). Some suggest that to tackle lost fishing gear, MSP could be used to restrict specified gear types (such as bottom trawls) to certain zones, and that spatial planning could coordinate the risk and vulnerability analyses related to oil spills due to the shared spatial dimension of the two processes and a similar demand for data (Kirkfeldt and Santos, 2013). Currently, there is no framework to record pollution which can be integrated into ecosystem health. MSP would be a valuable tool to close this gap as an entire layer of the MSP could be used to indicate pollution, including major isolated pollution events as well as consistent leakage points that need attention. This would generate improved monitoring and contribute significantly to the valuing of ecosystems based on their true condition (as highlighted in Section 3.1.1). Furthermore, countries which are not effectively covered by any proactive regional intergovernmental organisation with a strong marine environmental protection agenda, such as the governing bodies of the regional seas conventions will find MSP may fill this void as a tool to undertake regional, national, or local initiatives unilaterally, or in cooperation with neighbouring partners.

3.2 Improve the sustainability of fisheries operations

To ensure their long-term viability, fisheries need to minimise their environmental footprint and improve their social and environmental sustainability.

3.2.1 Proper transboundary management (for IUU, migratory fishing and foreign access)

An increasing number of states have already developed their own national fisheries policies and strategies. However, what is lacking is the alignment and harmonisation of these instruments when countries share the same fish stocks. The necessary step will be to encourage the states concerned to work bilaterally or through regional fishery bodies (RFBs), regional fisheries management organisations or RECs to adopt aligned conservation and management measures, informed by the best available scientific evidence and applying the precautionary approach. As part of coordinating mechanisms for its blue economy governance framework, the African Union should establish a coordination unit as a matter of urgency, that will support and encourage African countries to work collaboratively to advance the blue economy across the continent, with essential attention given to the fisheries. The RFBs established under the FAO constitution provide only advisory services and do not adopt binding conservation and management measures, while the tuna commissions do. There is no scarcity of RFBs around Africa; what is required is a political will, cooperation and coordination. Existing regional coordination mechanisms (RMCs) are outlined in Annex 2b.

Illegal, unreported and unregulated (IUU) fishing is a severe challenge in the marine waters of Africa. It was conservatively estimated to have cost Africa $10 billion annually (AU-IBAR, 2016). The practice threatens resource conservation, the sustainability of fisheries and the livelihoods of fishers and other stakeholders in the sector and exacerbates unemployment, malnutrition, poverty and food insecurity (AU-IBAR, 2019b; AU-IBAR 2016; AUC-NEPAD, 2014). Target 14.7 of the relevant SDG calls the ending of IUU fishing by 2020. One of the factors that make Africa particularly vulnerable to IUU is the lack of transparency and data sharing around foreign fishing arrangements (AU-IBAR; 2016).

In terms of foreign access agreements (as outlined in Section 1.5.3) there is an urgent need for agreeing the benefits provided to African fisheries ahead of foreign fleets. A resolution by fisheries committees to have shared access to fish across neighbouring countries should provide regional benefits, giving priority to African industrial and artisanal fleets. As highlighted in previous work by Failler et al (2018), West African artisanal fisheries make up a significant proportion of regional fishery contributions. Prioritising their development, as well as improving their monitoring and control could see marked returns on investment, and a notable increase in net supply while still maintaining social structures and cultural histories. Migrant fishing should also be considered in the formulation of national and regional policies in such a way as to ensure the effectiveness of the regulations governing access, control and surveillance.

3.2.2 Improving operations to limit bycatch and discards

The incidental catch of non-target species by fishing gear has become a severe conservation challenge for marine fauna (Lewison et al. 2014. See Annex 1d for more details on the threat of bycatch on Africa's fisheries). However, there has been a wide range of technical developments to better manage bycatch and incidental losses. Technologies developed in recent years demonstrate that the impact of fishing gear on non-target species and habitats can be significantly reduced without a major negative effect on the profitability of the fishing operation. Clearly, economic rewards should also be offered for the creation of new types of gear and modifications that reduce by-catch and minimise impact on habitats. The ecological, economic and social impacts of new measures and modifications must be addressed comprehensively. Innovative management and regulatory measures that offer positive incentives for the effective use of reduced-impact fishing techniques should be implemented. All participants must accept that the inefficient, destructive and wasteful use of potentially valuable resources will in the long run, have severe economic costs. If more environmentally-friendly fishing techniques are adopted, tougher fishing rules will place additional burdens on existing fisheries, no-fishing zones may need to be established or expanded, or certain gear types and fisheries may be banned altogether. In the long term, the fishing industry can benefit economically from the use of fishing methods with reduced impact on habitats and minimal bycatch. In such circumstances, it is a sound strategy for the industry to cooperate in developing better and more practical solutions. There is an inherent need to apply specific tailor-made tools for management of bycatch and discards, with as much co-management as possible. In this regard, general approaches, such as the ecosystems approach to fisheries, are often failing to make meaningful progress in combatting complex issues.

Shrimp trawling is considered one of the most unselective and damaging fishing methods in the world as bycatch of commercial and non-commercial species may significantly outweigh the catches of target species (Banks and Macfadyen, 2011; Hall, 1996). The ratio of shrimp to other species in landed catch weight ranges from 1:8 in West Africa (Banks and Macfadyen, 2011) to 1:1 in some fisheries with effective selectivity devices such as Madagascar (Banks and Macfadyen, 2011). Mozambique and Madagascar employed output controls in shrimp fisheries, including TAC, to restrict bycatch in shrimp fisheries. In the case of Mozambique specialized vessels recovered the by-catch of shrimp boats. In the past in Madagascar, skippers and crew are awarded premium wages for catching larger-sized shrimps. Other countries have applied more technical measures such as minimum mesh sizes, headrope length and bycatch reduction devices (Banks and Macfadyen, 2011).

3.2.3 Improved monitoring, control and surveillance (including tools for balanced harvest, sustainability monitoring and regional control and surveillance)

The continued decline of African fisheries towards unsustainability and the persistent poverty existing in poor fisheries communities indicates that fisheries management is a complex interaction involving competing for social, economic and ecological objectives. To address this complexity, decision-makers may constrain the short-term economic drive of fishers to manage ecological objectives with measures such as effort control, but this approach tends to cause economic inefficiencies in fisheries (Kompas et al., 2004). Thus, an integrated assessment method to evaluate and monitor fishing activities and policies should contribute to better oversight of the aquatic resources which affect sustainable development in coastal zones around the world.

The ECOST (Ecological, Economic and Social Cost of fishing practices and fishery policies evaluation) model and tool is structured with three modules

addressing social, economic and ecological systems, respectively[40] (Failler et al., 2022). This tool enables us to evaluate fisheries management and policies from a raft of social, economic and ecological dimensions[41]. The ECOST tool can be expanded to consider climate change. For instance, CO2 emissions from fishing fleets can be recorded and integrated into the model to assess the full cost of fishing activities and contribute to the implementation of the National Determined Contribution of African countries.

Several global initiatives are at play in respect of improving transparency in fisheries management and governance.

Another strategic solution to sustainable fisheries management is balanced harvesting (Nilsen et al. 2020). It is defined as moderate fishing pressure spread across the widest possible range of species, stocks, and sizes of an ecosystem, in proportion to their natural productivity so that the relative size and species composition is maintained (Garcia et al. 2012). However, it has received several criticisms on ethical and theoretical grounds (see references in Nilsen et al. 2020) and in terms of its practicality (Howell et al., 2016). The idea has attracted broad interest worldwide and has been supported by both empirical studies in African lake ecosystems with small-scale fisheries (Kolding and van Zwieten, 2014; Kolding et al., 2015) and by modelling studies of marine systems (Garcia et al., 2012; Law et al., 2013). These studies suggest that a balanced harvest may increase the total sustainable yield while maintaining ecosystem structure better than today's selective harvesting (Nilsen et al. 2020). Although not widely employed in African fisheries, balanced harvesting has the potential to significantly contribute to sustainable management.

Several global initiatives are at play in respect of improving transparency in fisheries management and governance. The transparency standards developed by the Fisheries Transparency Initiative (FiTI)[42] represent an intention by the implementing country to improve government transparency and promote the sustainable and responsible use of fisheries resources (Solene 2021; Drakeford et al., 2020). In Africa, Mauritania and the Seychelles have submitted their first FiTI report in 2021, covering 2018 for Mauritania and 2019 for the Seychelles and leading the global movement towards transparency in fisheries management. EJF is an NGO that has proposed ten transparency measures for states to provide information on vessel identities, activities and ownership, and actions against IUU fishing (EJF, 2018). The Global Fishing Watch is an alternative initiative[43] that provides real-time online information on commercial fishing vessels activities using satellite technology. The Building Transparency in West Africa project involving the Fisheries Committee for the West Central Gulf of Guinea (FCWC) in collaboration with Trygg Mat Tracking, Stop Illegal Fishing, Global Fishing Watch and Ocean 5, through the West Africa Task Force attempt to strengthen the Regional Fisheries Body's capacity to share and make publicly available national and regional legal frameworks, vessel registers and other relevant material, through its website and other communication platforms[44]. Another attempt to promote transparency, the 'Fisheries Intelligence and Monitoring, Control and Surveillance (MCS) Support in West Africa' funded by Norway establishes the West Africa Task Force, operationalising key FCWC conventions on information-sharing and MCS cooperation and strengthening regional information and cooperation to spur enforcement actions aimed at reducing illegal fishing in West African coastal waters. Similarly, the Southern African Development Community (SADC) has set up a regional coordination centre for MCS operations. While its entry into force has been slow to materialise, it provides a relevant example that regional coordination could play an important role in ensuring transparency through improved monitoring and control.

[40] To analyse systems with numerous interacting elements such as species interactions in an ecosystem or those between industries and consumers in a socio-economic system, economists and ecologists have applied regional fisheries linear economics models, ecosystem-based management models and multi-models (Fulton, et al., 2014; Fulton, et al., 2015) as well as probabilistic models (Ruiz, et al., 2017). Linear models such as the Input-Output (IO) model and Social Accounting Matrix (SAM) are used to analyse the regional economic impacts of fisheries and multispecies and approaches such as multispecies production models (MSP) and Ecopath with Ecosim (EwE) have shown remarkable potential for ecosystem modelling (Latour, et al., 2003). More recently, Fay (Fey, et al., 2019) linked the Atlantis ecosystem model to an Input-Output regional economic model and assessed the economic impact of change in the fishing effort via different scenarios in the Northeast US. Rybicki et al. (2020) use a bioeconomic model to understand the response of northeastern Atlantic pelagic fishery fleets to different scenarios related to quota allocation, disruption in fish and fuel price and changes in recruitment. In another study by (D'Andrea, et al., 2020) a bioeconomic model captured the dynamics between resources and fishing activities and evaluated the performance of fisheries in terms of catch and profit is developed.

[41] At the heart of the model stands a fisheries economic module describing the fisheries economy; within the model the economic module is extended to the areas of fisheries sociology and biology or ecology where social and ecological aspects of fisheries are modelled following appropriate theory and methodology, respectively; under the model the three modules are interconnected through established links (the so-called hardlinks) so that any changes in a system will automatically affect other systems and also take other systems' reaction into account. In particular, the linkage between social and economic systems is made through income distribution, the linkage between economic and ecological systems is made through changes in fish stock and marine environment, and the linkage between social and ecological systems is made through social response to environmental problems, concerns and states (Failler, et al., 2014).

[42] See:https://www.fiti.global/fiti-standard#:~:text=The%20FiTI%20Standard%20provides%20governments,of%20fishers%20and%20fishing%20companies.

[43] See: https://globalfishingwatch.org/

[44] See: https://fcwc-fish.org/

3.3 Improve harvest and post-harvest chains

A key area for ensuring supply demands for the future are met, lies in improving the supply chain. This calls for the better use of fish products, minimising post-harvest losses and truly tapping in to Africa's aquaculture potential.

3.3.1 Reduce post-harvest losses by improving or introducing proper standards

Value addition is the key element that enables optimum profit or gains from fish products. It creates employment and foreign currency earnings. In developed countries, consumers often prefer ready-to-cook or ready-cooked meals, presenting an opportunity for African countries to prepare and create more value at a higher price instead of exporting unprocessed fish to European markets or elsewhere. Embracing the concept of value addition enhances wider benefits from the fishing industry –creating more value from less catch. There is a need to invest in technology and provide African countries with the resources to meet the processing, packaging and marketing requirements for target markets. Value addition should be prioritised within the seafood value chain in government planning in a number of ways including:

i. private investors could be encouraged and where feasible assisted, to invest in seafood value addition, for instance, zero-rating imported value addition machinery;
ii. seafood producers should be equipped with the skills and knowledge to function across the value chain and may require access to training;
iii. there is a need to continuously study and if necessary, refine the supply chain to remove bottlenecks and operational challenges;
iv. supporting market development and diversification; and,
v. information centres should be established to support operators with the necessary information for planning investment decision-making.

The African countries must support investments in value-added products, for example, fish smoking and drying technologies, to increase the shelf life of fish especially the species that can be exported within the continent (taking advantage of regional trade agreements) and to people in the diaspora.

3.3.2 Scaling up mariculture

The fish supply deficit in most African countries presents significant prospects for mariculture development. AU-NEPAD and AU-IBAR have identified mariculture as another key priority for investment. Currently the contribution of Africa to global mariculture is limited, making up less than 1% of the global share in 2016 in comparison to 20% by Asia (FAO, 2018), highlighting the significant lag of mariculture development behind the rest of the world.

Inland aquaculture in African is increasing significantly at a rate of around 10% per year between 2006 and 2016 (FAO, 2018)[45]. This highlights the prospects for continent-wide mariculture development if same level of investments were to be made along the coast or on offshore sites. The abalone[46] farm development in South Africa, prawn farms in Mozambique and ecological certified shrimp farms in Madagascar, as well as oysters and mussels in South Africa and Morocco are paving the way for a new age of African mariculture. With dwindling catches from capture fisheries, mariculture offers increasingly sustainable alternatives to meeting the demand for supply to domestic and international markets. These examples indicate that mariculture could deliver between 2.5 to 4 million tonnes in 2050[47]. Thus, international investors are increasingly considering African as a destination for possible investment in mariculture development (Chan et al., 2019). It also expands the potential of further economic opportunities up and

[45] *Nigeria has become the largest producer of catfish in the world, producing 291,323 tonnes in 2018 (FAO, 2019), and making significant contributions to its economy. Egypt is the world's second largest producer of tilapia (after China) and has the largest aquaculture industry in Africa, producing 1.5 million tonnes in 2018, and generating $2.2 billion in 2015 (FAO, 2019). Egyptian aquaculture currently provides almost 79% of the country's fish needs, with almost all the output coming from small and medium-sized privately-owned farms.*

[46] *According to statistics from the 2016 Aquaculture Yearbook compiled by the Department of Agriculture, Forestry and Fisheries of South Africa, marine aquaculture production in South Africa has increased by 240% from 2000 to 2015.*

[47] *On a total farm production of 18 million tonnes per year by 2050 for the continent under particularly high production scenarios (Chan et al., 2021).*

downstream of the mariculture and aquaculture ventures themselves, creating additional livelihoods.

What is essential for the development of mariculture is harnessing skilled capabilities. Making links with Asia, where practitioners are experienced in successful mariculture activities, would provide a valuable resource of having skilled practitioners in place for the development of mariculture. Generating these connections and providing the pathway to develop mariculture could provide a notable investment opportunity for international development agencies such as the African Development Bank. This could take place through key pilot projects run by expert practitioners to carry out training and capacity building and use this to then spread to other countries and regions throughout the African continent[48]. In this regard, strategies should be employed to develop mariculture in a way that prioritises national development and capacity building. To ensure the sustainability of mariculture and safeguard the economic interests of farmers, there needs to exist sufficient environmental practices, supported by strong legislative frameworks.

3.3.3 Improving intra-regional trade

Currently, intra-African fish trade accounts for a mere 10%, or $430 million of the region's total fish exports, which are estimated at $4 billion (NEPAD). However, the reported value of intra-Africa trade in fish and fishery products in Africa could be an underestimation, because much of the informal transactions are not captured in official statistics. Africa needs to trade with the outside world, but it can also reduce its vulnerability to external shocks by boosting intra-regional trade and limiting its exports to the excess once it ensure each nation's nutritional needs are met. Such a promotion of intra-regional trade constitutes an imperative response to the challenges facing Africa and could also contribute to enhancing the countries' capacity and preparing them to compete more effectively on international markets. The African Union-New Partnership for Africa's Development (AU-NEPAD) and African Union-InterAfrican Bureau for Animal Resources (AU-IBAR) have identified intra-African trade as a key priority for investment.

Currently, intra-African fish trade accounts for a mere 10%, or $430 million of the region's total fish exports, which are estimated at $4 billion (NEPAD).

To promote intra-regional trade, it should be made easier for fish products to cross borders. Countries should ensure that compliance with import and export approval processes is not burdensome for traders, especially women. The processes should be simplified by centralizing the import and export declarations and phytosanitary inspections ideally within the same government agency. In West Africa, for example, governments in the region should incorporate fish into the ECOWAS Trade Liberalisation Scheme, which sets preferential tariffs for intra-regional trade at zero percent, and fish should not face any further restrictions. Governments should also integrate fish in the One Stop Border Posts, as is highlighted in the Africa Continental Free Trade Area agreement. These combine two border stops into one and consolidate functions in a shared workspace for exiting one country and entering another, thus reducing travel time for passenger and freight vehicles. In addition, governments should put in place common conformity assessment procedures to be used by all countries to test, inspect and certify fish products for imports and exports. This will ensure that the products being placed on the market comply with all common legislative and food safety requirements.

Importantly, as woman make up most of fish traders in Africa, their voices should be promoted. Often, gender inequalities prevent them from participating in crucial decisions pertaining to fisheries management, fish processing and cross-border trade. Prevalence of harmful fish smoking practices and harassment of cross-border women traders are clear signs that insufficient attention has been paid to ensuring a safe work environment and enabling profitable livelihoods for women. NGOs should help identify "women's champions" who raise the debate about women's role in cross-border fish trade and promote them as success stories. Ultimately, improving the African regional trade mechanism should be a key focus since it forms a significant part of the development of the blue economy.

[48] *See in that regards the collaborative continental research and capacity building project: https://en.ird.fr/project-afrimaqua-sustainable-marine-aquaculture-africa*

04

Conclusion

This study of marine fisheries across the African continent provides an overview of opportunities and challenges for marine fisheries to meet the demand for fish supply by 2030 and 2050 and proposes solutions for their sustainable management within the context of the growing blue economy. The study makes clear that solutions are clearly available to enable the sustainable development of fisheries and resolve the major challenges threatening Africa's fishing and coastal communities and the fisheries on which they depend.

Climate change, degraded ecosystems, a burgeoning population, and inadequate governance mechanisms are distinct and major threats. However, several significant opportunities are already present that provide promising prospects for the future. Harnessing this potential will allow the continent and its nations to bridge the existing and future production gap, that will prevail into the future if no transformative measures are taken. Putting nature at the forefront of decision-making, optimising the operations of the fisheries sector and increasing the outputs of the value chain should be prioritised in any national or regional blue economy initiatives. Collaborative, regional coordination and transparency are essential to all these elements.

Africa should prioritise integrated management measures to ensure that the benefits of a continent with such a wealth of resources - particularly within fisheries and the context of the blue economy – should be primarily delivered to Africa's population. This means prioritising African agendas and ensuring that the core demands of people's food security and livelihoods in all countries in the continent are met first, before export is considered. Increasing the ability of fisheries to contribute a significant portion towards national economies in a sustainable way will not only meet these demands, but also accelerate the growth of blue economies and the delivery of national, regional, and international agendas and targets such as the Sustainable Development Goals.

In the context of the blue economy's development at country, regional and continental levels, fishery support should be considered as a priority. It will continue to be the main animal protein provider to the population as well as the main job provider in coastal areas in most coastal countries. The fishery sector can also be a key contributor to wealth creation if the value addition is centred in coastal countries and not exported. As the main indicator of changes at sea, fishery plays a pivotal role in both the preservation of key habitats and the rehabilitation of degraded ones. This is possible within a blue economy approach that articulates a definition of marine biodiversity which embraces solutions that benefit the climate change mitigation and adaptation perspectives. As such fisheries has a bright future in the forefront of the African blue economy.

Annex Ia:
Fish stock status of the African Large Marine Ecosystems

Canary Current Large Marine Ecosystem (CCLME)

TABLE 4. Status of fishery resources in the Canary Current LME

Number of stocks	Not Overexploited	Fully Exploited	Over Exploited
4	X		
17		X	
11			X

Small pelagics fishery resources:

The assessments of the small pelagics by the FAO/CECAF Working Group (FAO/CECAF WG., 2019) in the Canary LME (Morocco, Mauritania, Senegal, the Gambia and Canary) provide the following results: sardine *(S. pilchardus)* is Not Fully Exploited, chub mackerel *(Scomber colias),* horse mackerel *(T. trachurus and T. trecae),* and anchovy stocks *(Engraulis encrasicolus)* are Fully Exploited, while sardinellas *(S. aurita, S. maderensis and Sardinella spp.)* and bonga *(Ethmalosa fimbriata)* are considered Overexploited. The fishmeal industry in some countries in the sub-region pose a severe threat to food security, particularly where overexploited fish stocks are concerned.

Demersal fishery resources:

In 2019, a total of 27 demersal stocks were assessed (FAO/CECAF WG., 2019) in the CCLME (Morocco, Mauritania, Senegal, the Gambia and Canary). The assessments show that thirteen species are Overexploited, six Fully Exploited, and three Not Fully Exploited. The Overexploited species are the grouper *(Epinephelus aeneus)* in Mauritania-Senegal-Gambia, the blue-spotted seabream *(Pagrus caeruleostictus)* in Mauritania-Senegal, the axillary seabream *(Pagellus acarne)* in Morocco, the rubber-lip grunt *(Plechtorynchus mediterraneus)* in Morocco-Mauritania, deepwater pink shrimp *(Parapenaeus longirostris)* in Senegal-Gambia and in Morocco, octopus *(Octopus vulgaris)* in Dakhla and Cap Blanc, cuttlefish *(Sepia officinalis)* in Dakhla and Senegal-Gambia, white hake *(Merluccius merluccius)* in Morocco and black hake in Morocco-Mauritania-Senegal-Gambia. Six fully exploited stocks are the red pandora *(Pagellus bellottii)* in Mauritania-Senegal-Gambia, the southern pink shrimp *(Penaeus notialis)* in Mauritania, the southern pink shrimp *(Penaeus notialis)* in Senegal-Gambia, the deepwater pink shrimp *(Parapenaeus longirostris)* in Mauritania, striped red shrimp *(Aristeus veridens)* from Mauritania, and octopus *(Octopus vulgaris)* in Senegal-Gambia. Three stocks are Not Fully Exploited, including the squid *(Loligo vulgaris)* from Mauritania, cuttlefish *(Sepia officinalis)* at Cap Blanc, and the large-eyed dentex *(Dentex macrophthalmus)* in Morocco-Mauritania-Senegal. To halt overfishing and commence with the rebuilding plans, catches of overexploited stocks should be reduced. A paucity of reliable biological and fisheries data diminishes the power of stock assessments, and threatens the resources' sustainability (FAO/CECAF. WG., 2019).

Guinea Current Large Marine Ecosystem (GCLME)

TABLE 5. Study of fishery resources in the GCLME

Number of stocks	Not Overexploited	Fully Exploited	Over Exploited
9	X		
13		X	
13			X

Small pelagic fish resources:

For stock assessments, the FAO/CECAF Working Group (2019) on small pelagic has conveniently divided the Guinea LME into four sub-areas, namely, North (Guinea, Guinea-Bissau, Sierra Leone, Liberia), West (Côte d'Ivoire, Ghana, Togo, Benin), Central (Nigeria, Cameroon) and South (Republic of the Congo, the Democratic Republic of the Congo, Gabon and Angola). The main small pelagic fish species assessed are: the round sardinella *(Sardinella aurita),* the flat sardinella *(Sardinella maderensis)*, bonga *(Ethmalosa fimbriata)*, anchovy *(Engraulis encrasicolus)* and horse mackerel and other carangidae. In total, sixteen stocks were assessed (seven species/species groups) and the results show that four stocks are Overexploited – *S. aurita*, western stock; *S. maderensis,* western stock; and *Trachurus trecae* for the northern and southern stocks. Two stocks are Fully Exploited - *Sardinella spp.*, southern; and *Decapterus spp.* northern stock; (c) four stocks are Not Fully Exploited – *sardinella spp.* northern and southern stocks; bonga, southern stock; and anchovy for the western and southern stocks. Six stocks were not assessed or had inconclusive results – *S. aurita,* central stock; *S. maderensis* central stock; bonga, northern, central, and western stocks; and *Trachurus trecae,* western stock. Some countries did not provide the required data, while in other cases, the integrity of the data supplied is questionable, compromising the model output and management advice. Reduction of catches are recommended for Overexploited stocks (FAO/CECAF. WG., 2019). To arrest overfishing, catches of overexploited stocks should reduce (FAO/CECAF WG., 2019).

Demersal fish resources:

A total of 53 stocks were analysed by the FEA/CECAF Working Group (2019) on demersal fish stocks. Nine stocks were found to be Overexploited: the grey grunt *(Pomadasys spp.)* in Guinea-Bissau; lesser African threadfin *(Galeoides decadactylus)* in Guinea-Bissau, the stock in Côte d'Ivoire, Ghana, Togo, and Benin, and the stock in Gabon, Congo, and Angola; the bigeye grunt *(Brachydeuterus auritus)* in Côte d'Ivoire, Ghana, Togo, and Benin; deepwater rose shrimps *(Parapenaeus longirostris)* in Congo and the stock in Angola; southern pink shrimp *(Penaeus notialis)* in Congo; and pink lobster *(Palinurus charlestoni)* in Cabo Verde. Eleven stocks are Fully Exploited: moreias *(Muraenidae)* in Cabo Verde; croakers *(Pseudotolithus spp.)* in Côte d'Ivoire, Ghana, Togo, and Benin, and the stock in Nigeria and Cameroon; lesser African threadfin *(Galeoides decadactylus)* in Nigeria, Cameroon, and Equatorial Guinea; Sole *(Cynoglossus spp.)* in Nigeria, Cameroon, and Equatorial Guinea, and the stock in Gabon, Congo, and Angola; bigeye grunt *(Brachydeuterus auritus)* in Nigeria, Cameroon, and Equatorial Guinea; marine catfish *(Arius spp.)* in Nigeria, Cameroon, and Equatorial Guinea; southern pink shrimp *(Penaeus notialis)* in Guinea-Bissau; coastal shrimps in Cameroon; and cuttlefish *(Sepia spp.)* in Guinea-Bissau. Five stocks are Not Fully Exploited: red pandora *(Pagellus bellottii)* in Côte d'Ivoire, Ghana, Togo, and Benin); marine catfish *(Arius spp.)* in Gabon and Congo; deepwater rose shrimp *(Parapenaeus longirostris)* in Guinea-Bissau; southern pink shrimp *(Penaeus notialis)* in Gabon; and cuttlefish *(Sepia spp.)* in Ghana. For twenty-eight stocks, the results of the assessments were not satisfactory because of uncertainties in the data available. The Working Group recommended that fishing effort be reduced for the overexploited stocks or not increased for the other stocks to avoid further depletion.

Benguela Current Large Marine Ecosystem (BCLME)

TABLE 6: Status of fishery resources in the BCLME

Number of stocks	Not Overexploited	Over Exploited
37	X	
24		X

Stock assessments of commercially important fish stocks in the BCLME region are conducted. The Angolan stocks are covered under the GCLME. Based on the Namibian assessments of the small pelagic fishes, horse mackerel *(Trachurus capensis)* status is Not Overexploited, whereas sardines *(Sardinops sagax)* is overexploited. Five demersal Namibian stocks are assessed, and their status as follow: deepwater hake *(Merluccius paradoxus),* cape hake *(M. capensis),* cape monkfish *(Lophius vomerinus)* and deep-sea red crab *(Chaceon maritae)* are Not Overexploited while orange roughy *(Hoplostethus atlanticus)* and West Coast rock lobster *(Jasus lalandii)* are Overexploited (Anonymous 2021).

In South Africa, a total of 61 stocks were assessed (DEFF, 2020) of which 37 (or 61%) are considered Not to be of Concern (blue and green categories in the Kobe Plot), while 24 (or 39%) are of Concern (orange and red categories). The results indicate significant improvement over the past eight years (2012), when 46% of stocks were considered not to be of concern and 54% were considered of concern. The assessment of small pelagic show that sardine stocks are depleted/Overexploited, while anchovy, West Coast round herring *(Etrumeus whiteheadi)*, anchovy *(Engraulis encrasicolus)* and Cape horse mackerel are considered abundant/Not Overexploited. Demersal stocks assessed include deepwater hake and shallow-water hake, both of which are not overexploited. The West Coast rock lobster resource remains heavily depleted/Overexploited, while kingklip *(Genypterus capensis)* decreases in abundance on the South Coast, while increasing on the West Coast. The assessment for the monkfish indicates that while the resource has shown marginal increases on the West Coast, the increase is not as apparent as in previous years. The South Coast component of the resource appears to remain stable. Seven stocks of linefish, hottentot seabream *(Pachymetopon blochii),* snoek *(Thyrsites atun),* carpenter *(Argyrozona argyrozona),* santer *(Cheimerius nufar),* slinger *(Chrysoblephus puniceus),* Roman *(Chrysoblephus laticeps)* and yellowtail *(Seriola lalandi))* are considered Not Overexploited, while silver kob *(Argyrosomus inodorus),* geelbeck *(Atractoscion aequidens)* and white stumpnose are considered depleted/Overexploited.

Agulhas and Somali Current Large Marine Ecosystem (ASCMLE)

TABLE 7: Status of fishery resources in the ASCLME

Number of stocks	Not Overexploited	Over Exploited
48	X	
38		X

Based on the report of the 9th session of the SWIOFC Scientific Committee (SWIOFC SC, 2019), 86 groups were assessed, of which 48 were Not Overexploited, while 38 were Overexploited and 21 unknown. It must be noted that the percentages of Overexploited or Not Overexploited stocks refer to the stocks whose status could be estimated by the countries, not to the total number of stocks that exist in each country. Fifty-six percent of the assessed stocks can be considered sustainably exploited, while 44 were unsustainably harvested.

Most of the stocks reported as assessed by Comoros were considered as Overexploited. France reported 31 stocks in total, which included 14 that were Not Overexploited. More than half of the stocks reported by Kenya show the status Unknown, with the others classified both as Not Overexploited and Overexploited. Half of the stocks with information reported by the Maldives were Not Overexploited. Mauritius presented an equal number of Overexploited and Not Overexploited stocks. Mozambique reported eight stocks, of which four classified as Not Overexploited and the other four as Overexploited. Seychelles reported 15 stocks, of which more than 50% are assessed as Overexploited. South Africa provided information on eight stocks with 56% Not Overexploited. The proportion of Not Overexploited stocks from the United Republic of Tanzania was 73% out of a total 15 (SWIOFC SC, 2019). EAF management framework has been considered in the preparation, elaboration or implementation or revision of their fisheries management plans (number of plans shown in brackets) by Comoros (2), France (3), Kenya (5), Madagascar (5), Maldives (4), Mauritius (1), Mozambique (4), Seychelles (5) and in the United Republic of Tanzania (4) (SWIOFC SC, 2019).

The future prospects for sustainability of these resources depend on the choice of management frameworks by ASCLME/SWIOFC member states. The key transboundary stocks are yet to be scientifically identified, and management plans of priority species in several countries have to be harmonised to improve the effectiveness of management measures. Data collection procedures and protocols have to be standardised and capacity in data analysis, mainly acoustic survey data need to be enhanced (SWIOFC SC, 2019).

Mediterranean Sea LME

TABLE 8. Status of the fishery resources in the MedLME

% of stocks	Not Overexploited	Over Exploited
25	X	
75		X

Seventy-five of the validated assessments stocks are fished outside biologically sustainable limits, in other words, are overexploited, although there is an improvement since 2014, when the percentage of overexploitation was 88%. The assessment indicates that fishing mortality for all species and management units combined is around 2.5 times higher than the reference point. The European hake *(Merluccius merluccius),* blue and red shrimp *(Aristeus antennatus)* and Norway lobster *(Nephrops norvegicus),* have the highest maximum values of exploitation ratios. Stocks fished within biologically sustainable limits include anchovy *(Engraulis encrasicolus)*, common cuttlefish *(Sepia officinalis),* Norway lobster and red mullet *(Mullus barbatus),* as well as deep-water rose shrimp *(Parapenaeus longirostris)* (FAO, 2020b).

International Commission for the Conservation of the Atlantic Tunas (ICCAT)

TABLE 9. Status of tuna stocks under ICCAT.

Number of stocks	Not Overexploited	Over Exploited
6	X	
4		X

Twenty-one out of fifty-two contracting parties of ICCAT are African coastal states. In this review, only tuna and tuna-like species that are of interest to Africa (in terms of participation in the fisheries) are considered. The review excludes any species with annual yield of less than 5,000 tonnes. Ten species meet the inclusion criteria, and their assessments status (ICCAT, SCRS 2019) is as follows: four stocks are Overexploited, and these are swordfish (south Atlantic), swordfish (Mediterranean), bigeye and southern bluefin tuna. Six stocks are Not Overexploited, namely Atlantic yellowfin, swordfish (north Atlantic), skipjack (east Atlantic), albacore (north Atlantic) and albacore (south Atlantic).

The bigeye fisheries are socio-economically important, particularly for Ghana, Senegal and the Canary, but the current catches are not expected to end overfishing by 2028 unless the juvenile mortality is significantly reduced. The catches for swordfish in the Mediterranean and those of South Atlantic swordfish would need to be reduced to rebuild the population to a biomass level that can produce maximum sustainable yield (MSY) by the end of the projected period in 2028. The outlook for skipjack which is particularly important for Ghana, Côte d'Ivoire, Cabo Verde, Morocco and Senegal fishing industries is good as the current catches could even be above MSY by 2028. The bluefin tuna in the eastern Atlantic and the Mediterranean Sea which is commercially important, especially to Morocco, Tunisia, Algeria and Libya has no scope to increase the current catches without jeopardising the health of the species. The catches of up to 30,000 tonnes of South Atlantic albacore are expected to maintain stock levels above MSY until 2033. This fishery is important for Namibia and South Africa. In 2018, the CCSBT agreed on a new management procedure for rebuilding for southern bluefin tuna by achieving 30% of initial spawning biomass by 2035 (CCSBT ESC, 2021).

Indian Ocean Tuna Commission (IOTC)

TABLE 10. Status of tuna stocks under IOTC

Number of stocks	Not Overexploited	Over Exploited
3	X	
1		X

Eleven out of thirty contracting parties of IOTC are African coastal states. The major fisheries are yellowfin, skipjack, bigeye and albacore. The latest assessments (IOTC SC, 2020) indicate that the yellowfin stock is currently Overfished, and precautionary measures are recommended to reduce overfishing by not exceeding the annual catch of 403,000 tonnes. Catches of skipjack consistently exceeded the TAC in recent years (2018-2019). Nonetheless, the assessments indicated that the stock is currently Not Overfished. Due to piracy, the fishing pressure on bigeye fishery has declined but the stock is Not Overfished although it is subjected to overfishing, however, there is a low risk of exceeding MSY-based reference points by 2025 if catches are maintained at a level of 90,000 tonnes (2017 catches). As for albacore, the assessment indicates that the stock is Not Overfished although subjected to Overfishing. Based on projections under the current catch, the biomass of albacore will continue to decline due to low recruitment, despite reduced efforts (IOTC SC, 2020).

Annex 1b:

Key characteristics of the African LMEs (Section 1.2)

TABLE 11: Key characteristics of African LMEs

	CCLME	GCLME	BCLME	ASCLME	Red SEA LME	Med-LME
Countries	7 Countries: Morocco, Mauritania, Senegal, The Gambia, Cabo Verde, Guinea-Bissau and Guinea	16 Countries: Guinea-Bissau, Guinea, Sierra Leone, Liberia, Côte d'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroon, Equatorial Guinea, Gabon, Congo, Angola, The Democratic Republic of Congo, São Tomé and Príncipe	3 Countries: Angola, Namibia, and South Africa	10 Countries: Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia, South Africa and Tanzania La Réunion (France)	8 Countries in total: Djibouti, Egypt, Eritrea, Israel, Jordan, Saudi Arabia, Sudan and Yemen	22 Countries in total: Including 5 African countries - Algeria, Egypt, Libya, Morocco, Tunisia
Length (km)	5,400[49]	7,600[50]	6,800[51]		2,000[52]	4,000
Area within EEZs (km^2)	> 2,000,000	1,958,802[53]	1,485,000	22 million[54]	458,620[55]	2,522,000[56]
Average annual primary productivity, (mgm^3)[57]	0.374	0.308	0.550	ACLME = 0.51 SCLME = 0.193	0.252	0.144

[49] *https://www.fao.org/documents/card/en/c/I6e5a7ad-47ef-4a16-a4e5-826da8f9b33c/. The number of fishers excluding Morocco.*
[50] *Guinea Current Large Marine Ecosystem Project. Transboundary Diagnostic Analysis. 2003. https://www.ais.unwater.org/ais/aiscm/getprojectdoc.php?docid=393*
[51] *Gunnar Finke, Environmental Development, https://doi.org/10.1016/j.envdev.2020.100569*
[52] *https://www.emecs.or.jp/en/wp-content/uploads/2019/10/2015_guidebook-16_redsea.pdf*
[53] *Adewumi I.J. et al. See the Reference*
[54] *ASCLME/SWIOFP 2012. Transboundary Diagnostic Analysis for the western Indian Ocean. Volume 1: Baseline*
[55] *http://www.du.edu.eg/upFilesCenter/sci/1585010435.pdf*
[56] *https://www.worldatlas.com/seas/mediterranean-sea.html*
[57] *O'Reilly, J.2017. See the Reference*

Annex Ib (continued):

Key characteristics of the African LMEs (Section 1.2) (continued)

TABLE 11: Key characteristics of African LMEs

	CCLME	GCLME	BCLME	ASCLME	Red SEA LME	Med-LME
Population (2022, million)[58]	78	471	95	251	234	-
Total catch (2018, tonnes)	3.2 million[59]	3.1 million	1.6 million	1.8 million	624,00	800,000[60]
# of fishers	1 million	9 million	134,800[61]	2.7 million		227,000
# of fish species	1,344	1,000	410 in Angola; 421 in Namibia and ~2,000 in South Africa[62]	2,200	1,200	650
# of fishing boats	20,000 pirogues and 1,000 industrial vessels[63].	-	-	-	-	75,000
Research, governance & Management	FAO CECAF, SRFC, ATLAFCO and ICCAT	FAO CECAF, FCWC, COREP, ATLAFCO and ICCAT	BCC and ICCAT	SWIOFC and IOTC	PERSGA	Barcelona Convention, FAO GFCM and ICCAT

[58] *https://www.worldometers.info/world-population/population-by-country/*
[59] *https://data.worldbank.org/indicator/ER.FSH.CAPT.MT. Accessed on 18 January 2022*
[60] *Piroddi et al. 2020. See Reference. 75,000 boats small-scale (gillnet, trammel net) accounting for 78%.*
[61] *Kainge, P. et al. 2020. See the Reference*
[62] *Benguela Current Large Marine Ecosystem Transboundary Diagnostic Analysis, 2021. BCC Secretariat. Swakopmund, Namibia.*
[63] *Canary Current Large Marine Ecosystem Project Document. GEF/6030-04-10.*

Annex Ic:

Management frameworks of marine fisheries

The management framework employed in any aquatic ecosystem determines the expected outcome of the status of the resources. Several management frameworks have been used in different fisheries globally. Six frameworks and their application where they have been applied widely in African marine fisheries are briefly presented below.

- **Target Resources Oriented Management (TROM):** TROM is referred to as a conventional fisheries management concept used in all African countries and rooted in the view that the productivity of a stock is a function of its size and its reproductive potential (FAO, 2006), and thus the underlying fisheries management objective is to exploit this stock at a level where its reproductive ability is close to its natural mortality (FAO, 2006). Its management planning process focuses on assessing and managing target stocks with no or very limited consideration of the sustainable use of the broader ecosystem. It does not sufficiently recognise the potential direct and indirect effects of fishing on the dynamics of the ecosystem, the conditions under which its productivity can be maintained and the existence of other societal values and uses. TROM is often based on a management unit (e.g. species, gear and jurisdiction) that takes little account of the ecosystem structure or boundaries in which it is operating (FAO Technical Guidelines for Responsible Fisheries. No. 4, Suppl. 2. Rome, FAO. 2003. 112 p.). Technical measures such as input controls (e.g., licences) and output controls (TACs, size limits of landed fish) are essential to regulate the fisheries. Beverton and Holt's yield-per-recruit model has been used extensively in Africa under TROM. In the last two decades, theory and policy have come to appreciate the weakness of TROM's approach as it paid little attention to the wider interactions between fisheries and the ecosystems in which they operated (Cochrane and Garcia, 2005; FAO, 2006), and hence the emergence of concepts such as EAF and EBM.

- **Ecosystem Approach to Fisheries (EAF):** The EAF is not a replacement for TROM but an incremental extension of it, as it "strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries (FAO 2003)." It is consistent with sustainable development (Holden et al., 2014; FAO, 1995; WCED, 1987;) and respects the following principles: fisheries should be

managed to limit their impact on the ecosystem to the extent possible; ecological relationships between harvested, dependent and associated species should be maintained; management measures should be compatible across the entire distribution of the resource (across jurisdictions and management plans); the precautionary approach should be applied because the knowledge of ecosystems is incomplete; and governance should ensure both human and ecosystem well-being and equity. All aspects of responsible fisheries can be addressed through EAF (FAO, 2003). Many African coastal countries have adopted a set of objectives, policies and principles consistent with EAF over the past years, and the FAO EAF Nansen Programme has been instrumental in this regard.

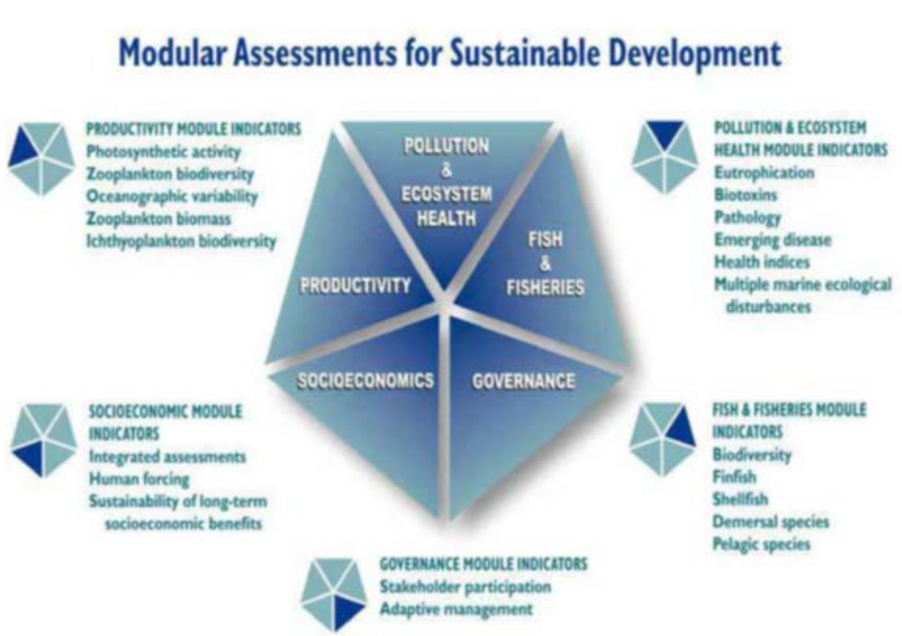
- **Precautionary approach:** The status of any fish stock is clouded with uncertainties and risks, and it is now clear that fish populations are less resilient than once imagined, and that the recovery of populations, once depleted, can be much slower than expected (Hilborn, Pikitch and Francis, 1993). Thus, the FAO Code of Conduct for Responsible Fisheries (FAO, 1995) enshrines the concept that: (section 7.5.1) states should apply the precautionary approach widely to the conservation, management, and exploitation of living aquatic resources to protect them and preserve the aquatic environment. The absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation and management measures and (section 7.5.2), in implementing the precautionary approach, states should take into account, inter alia, uncertainties relating to the size and productivity of the stocks, reference points, stock condition in relation to such reference points, levels and distribution of fishing mortality and the impact of fishing activities, including discards, on non-target and associated or dependent species, as well as environmental and socio-economic conditions. Fisheries scientists at a country level and within regional fisheries bodies (e.g. CECAF) are aware of these uncertainties and risks in all aspects of the fisheries (including production, management process, research, management and decision-making, monitoring, control and surveillance (FAO, 1996) and often recommend precautionary catch limits.

Box 2: Examples of recommended precautionary catch limits.

The CECAF Working Group on Demersal Fish made the following precautionary management recommendations (FAO, 2020a): i) not to exceed the level of fishing mortality for Arius spp. in Senegalese/Gambian waters as available data does not allow for closer assessment; ii) not to exceed the 2016 fishing mortality level of Sparus aurata and Pagrus auriga in Morocco as available data does not allow for assessment to be made; iii) not to exceed the current fishing mortality of Pagellus belottii in Mauritania-Senegal-Gambia. Similarly, the CECAF Working Group on Small Pelagics (FAO, 2019) made the following precautionary approach recommendations: i) not to exceed the catch level recommended from 2014 for Sardinella aurita and not to exceed the average of the last three years for S. maderensis in Nigerian waters as no effort data was available; ii) not to exceed the fishing level for 2017 for sardinella spp. for Guinea-Bissau, Guinea, Sierra Leone, and Liberia and not to exceed the catch level of the average of the last five years for Gabon, Congo, DR Congo and Angola.

- **LME Modular Approach:** Large Marine Ecosystems (LMEs) are relatively large ocean spaces of approximately 200,000 km² or more, adjacent to the continents in coastal waters, with unique bathymetry, hydrography, productivity, and trophic relationships. The boundaries of the LMEs are based on ecological criteria, including bathymetry, hydrography, productivity, and trophic linkages. It is within the spatial domains of LMEs that five modules of indicators of changing ecological states of LMEs are applied to support ecosystem-based management (EBM) of LMEs: (i) productivity, (ii) fish and fisheries, (iii) pollution and ecosystem health, (iv) socio-economics, and (v) governance. The first three modules listed are based on natural science metrics, and the last two address social science issues relative to the human dimensions of LMEs (Sherman and Hamukuaya, 2016). The Large Marine Ecosystem (LME) Modular Approach is an example of a multi-sectoral approach to develop an integrated plan for the region or ecosystem and set of common conservation and development objectives (see figure 6). The shift to ecosystem-based management requires integration and coordination among all marine sectors. The LME Modular Approach is based on five modules: a) the productivity (focus on carrying capacity for supporting fishery resources, b) fish and fisheries (focus on the changes of biodiversity of fish communities, c) pollution and ecosystem health (dealing with marine pollution, which is a major cause of the degradation and deterioration of the environment and resources in LMEs), d) socioeconomics, and e) governance (formulated mainly based on the information obtained from the above four modules as well as international rules and systems embraced in relevant global and regional agreements applicable to the areas concerned). Each module has a set of indicators that provide a framework for assessing and monitoring, then evaluating the changing status of the LMEs (Carlisle, 2014; Sherman and Duda, 1999; Duda and Sherman, 2002).

FIGURE 9: Ecosystem-based five-module approach



Box 3: LME modular approach in the implementation of EBM in the BCLME region.

The signing of the Benguela Current Convention in March 2013 ushered in a new era of South–South collaboration between the three southern African countries of Angola, Namibia and South Africa towards the ecosystem-based multi-sectorial ocean governance of the Benguela Current Large Marine Ecosystem (BCLME). The collaboration started in the early 1990s with the development of a common vision for improved understanding and management of the priority transboundary environmental problems that threaten the resilience and robustness of the BCLME. What started with modest scientific collaboration developed organically into a holistic approach to EBM using the five modular LME approach to ocean governance (figure 8). The result is the signing in 2013 and ratification by 2015 of the Benguela Current Convention – the first legal framework in the world to be based on the LME approach to ocean governance. Requisite organisational structures are in place and functional and the Marine Spatial Planning (MSP) has been adopted as one of the processes to facilitate the implementation of EBM. Strong political patronage, real commitment to provide requisite resources and the central role of science have proven to be among the key success factors (www.benguelacc.org).

- **Open access:** This is a framework practiced in many developing countries, including Africa. It does not restrict entry into the fishery as the right to harvest fish is available to all. It is widespread amongst artisanal and small-scale fishing communities in GCLME, CCLME and ASCLME, and is important for nutritional and food security while it has led to overcapacity and over-fishing (Ostrom, 1990, World Bank Sunken Billion 2017), changes in the fish species community composition and structure of fished ecosystems, and fishing down the trophic levels of food webs and increases in the incidences of IUU fishing (AUC-NEPAD, 2014). Economic theory predicts that in mature fisheries that are operated under such open access regimes, equilibrium profits tend to remain very small, at a level just sufficient to keep the fishers in the industry, but generating little or no economic benefits (World Bank Sunken Billion 2017). Access control in well-regulated fisheries (e.g. registration, licencing systems) is yielding varying types of benefits to several AU Member States, including social benefits and revenue (AUC-NEPAD, 2014). While this open access policy is widely recognised as a main driver of overfishing, many, including the FAO, also acknowledge that there is still an ongoing debate about the most effective and equitable way of authorising access and allocating resources which until resolved makes open access practical (World Bank Sunken Billion 2017).

Annex Id:
Further threats to Africa's marine fisheries

Challenges in meeting international management targets

After a decade of efforts to halt biodiversity loss through the 20 Aichi Targets of the Convention of Biological Diversity (CBD), the situation remains very mixed with overall progress towards its achievement in Africa being very low, and notably so for Aichi Target 11 for reaching 10% coverage of MPAs and OECMs by 2020 (see Section 2.2.2 on progress towards SDG 14 Target 5 – progress towards reaching 10% coverage). Such targets have received criticism (Phang et al, 2020) over the fact that MPA targets (as set by the CBD and the SDGs) are more concerned about the total area of MPAs rather than their quality, often resulting in little more than paper parks. Furthermore, criticism lies in the appropriateness of this single target for all countries, given the size of the EEZ relevant to the population, where 10% of an EEZ of a country with a small population will impact far fewer coastal communities and industries than 10% of a country with a large population. The target called for protected areas to be "conserved through effectively and equitably managed, ecologically representative and well-connected systems" of MPAs and OECMs. However, there is often a lack of capacity and resources, as well as financial burdens that inhibit a nation's ability to enforce and manage the areas in a way that meaningfully contributes to the progress towards these targets (Deme et al., 2022).

The introduction of new targets by the Convention on Biological Diversity (CBD) to increase MPA coverage to 30% by 2030 poses a significant threat to the future of Africa's marine fisheries, unless Other effective conservation measures (OECMs) are employed that have the sustainability of fisheries as their focus. Lessons should have been learned from the fact that most countries in the global South (including African nations) have not been able to achieve the 10% target thus far (Failler et al, 2019), and rather than increase the quantity and size of MPAs, the new targets should ensure the existence of implementations processes needed in order to enact and execute conservations measures in existing protected and conserved areas (Phang et al, 2020). Furthermore, much research has shown that MPAs are most effective (within their boundaries) when extractive practices such as fishing and mining are banned (Brehmer et al., 2017). Considering the projections of the increased amount of fish required to maintain the food security of the continent, outlined in Section 1.1, increasing the extent of no-take MPAs in African nations will inhibit the potential productivity of coastal nations, and will ultimately result in less space for fisheries (depending on what percentage is allocated to no-take MPAs). This concern is compounded by the fact that 30% less space for fishing activities will not result in an equivalent decrease in fishing effort. Research shows that fishing effort around MPAs tends to be high (Failler, 2002), thus while extending the area of no-take MPA networks is likely to improve biodiversity and biomass within these areas, mass depletion is likely to take place around them as the fishing efforts will be displaced from inside the MPAs to outside them.

Currently, there a major gap in knowledge exists regarding the main coastal marine habitats around Africa (Tregarot et al, 2020), which raises concerns about the fact that although MPAs are usually declared based on knowledge of important ecosystems, those which are unmapped are effectively unprotected and will be subject to increased fishing effort. This could in fact exacerbate ecological decline and the ability of ecosystems to provide fisheries services (such as fish nurseries or breeding sites). Setting out to increase MPA and OECMs' coverage to 30% without first gaining a sound understanding of all ecosystems in the area and the services they provide is likely to prove futile and only have unintended knock on effects in the long-term.[64]

All these conditions will have significant deleterious effects on the capacity of ecosystems to deliver the resources needed to sustain fishing. Such ecosystems are, and will increasingly become under more pressure from the effects of climate change on productivity. Thus, it is essential to ensure that any MPA measures are accompanied by climate change adaptation and mitigation measures such as nature-based solutions. Moreover, increased pressure on fisheries is not only likely to displace fishing effort and render countries unable to keep up with burgeoning food demands but may in fact, displace entire small-scale fishing communities too. Ultimately, for a continent that is unable to manage even 10% of its coastal and marine areas, aiming to achieve 30% will put immense pressure on national capacity and resources, and on ecosystems where fishers will try to find alternative means and areas to fish. Moving from the current 5% of MPA coverage (Failler et al, 2019) to 30% is simply unrealistic and will take major consideration for the future development of fisheries across the continent.

Challenges in achieving SDG 14: Life Below Water

Given that SDG 14: Life Below Water directly relates to the management of fisheries and conservation measures that ensure sustainable fisheries, it is important to acknowledge the state of achievement of fisheries and ecosystem

[64] *Tregarot et al. (2020).*

management targets. These are: SDG 14.2[65], SDG 14.4[66], SDG 14.5[67] and SDG 14.6[68]. Using the UN's established indicators under each target and the existing databases that contain data by country regarding these targets, an analysis of achievement by country has been conducted (Andriamahefazafy et al. 2021). For each indicator, the current suggested methods of measuring achievement were used and adapted to available data. Assessing these four targets presents the opportunity to reflect on the effectiveness of SDG 14 to achieve sustainably managed fisheries and the marine environments which support them. Understanding the current state of progress of African countries highlights areas that may be limiting their sustainable development.

The analysis shows that achieving these four targets in African coastal states (of which there are 38) has been meagre with most countries not achieving any of the four targets, and no country achieving more than one. Furthermore, when analysed globally, Africa has the highest number of non-achieving countries of all continents for reaching targets of SDG 14 (see figure).

To improve the sustainable management of ecosystems through ecosystem-based approaches to management, just under 29% of African coastal states have made no progress towards meeting target 14.2, yielding no single country which has achieved it. Most countries (66%) have made low progress, one country made average progress (Seychelles), and one made good progress (Algeria).

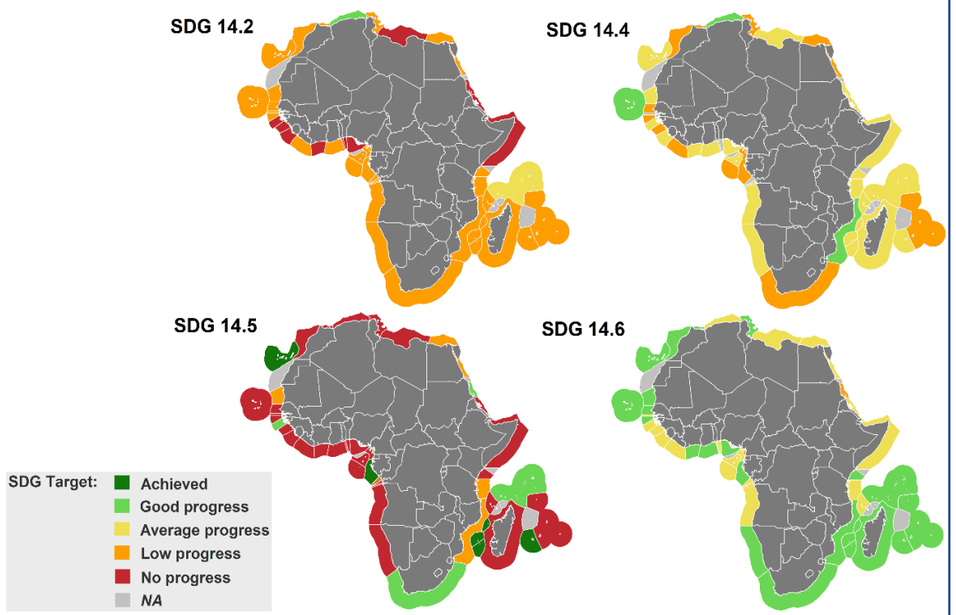
[65] *SDG 14.2: By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans.*

[66] *SDG 14.4: By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics.*

[67] *SDG 14.5: By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information.*

[68] *SDG 14.6: By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, and eliminate subsidies that contribute to IUU fishing, and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the WTO fisheries subsidies negotiation.*

FIGURE 10: Maps of achievement by each coastal state achievement of the four SDG 14 targets (14.2, 14.4, 14.5 and 14.6)



Source: Andriamahefazafy et al. 2022 (accepted for publishing)

TABLE 12:. Achievement status of SDG 14.2 (EBA) by number and percentage of African coastal states

Status of achievement	No progress	Low progress	Average progress	Good progress	Achieved
Number of coastal states (out of 38)	11	25	1	1	0
Percentage of coastal states	28.9%	65.8%	2.6%	2.6%	0%

Andriamahefazafy et al. 2021

In terms of making progress towards sustainably managed fish stocks (target 14.4) Africa has no countries which have failed to make any progress at all, but none which has achieved this target either. Three countries (Algeria, Cabo Verde, Mozambique) have made good progress, with the majority of countries having made only average progress (47.4%). For this target, there was a large portion of countries with insufficient data to accurately assess this target's

achievement, highlighting that improved monitoring and reporting is hindering progress.

TABLE 13: Achievement status of SDG 14.4 (Sustainable Stocks) by number and percentage of African coastal states

Status of achievement	No progress	Low progress	Average progress	Good progress	Achieved	NA
Number of coastal states (out of 38)	0	10	18	3	0	7
Percentage of coastal states	0%	26.3%	47.4%	7.9%	0%	18.4%

Andriamahefazafy et al. 2021

Africa is the world's region with the second highest percentage (71%) of nations failing to make any progress towards the 10% MPA coverage target (after the Middle East with 80% failing countries), and with only 5% of countries (Cameroon and Gabon) having achieved the target. As indicated in Section 2.2.1 several challenges exist associated with expanding the coverage of MPAs which threaten nations' ability to keep up with fisheries demands.

TABLE 14: Achievement status of SDG 14.5 (MPAs) by number and percentage of African coastal states

Status of achievement	Far from achievement	Low progress	Nearing completion	Achieved
Number of coastal states (out of 38)	27	5	4	2
Percentage of coastal states	71%	13%	11%	5%

Andriamahefazafy et al. 2021

When examining the progress of SDG 14.6 on removing harmful subsidies by placing controls on IUU fishing, there has been positive action in that no country has failed to make any progress, and only three countries (Cameroon, The Democratic Republic of Congo, The Sudan) have made low progress. Half of the coastal states have made average progress, and 42% have made good progress. At this stage, no country has achieved this target. When evaluating the achievement of a target for an issue as complex as combatting IUU fishing, it is unrealistic to be certain that a country has fully achieved its target. When, by its nature, IUU finishing involves unreported and criminal activity, the true value of IUU fishing cannot be determined. Rather, the highest degree of achievement is having developed a comprehensive response to combatting IUU fishing. By developing, financing and implementing national plans of action to combat IUU fishing, and signing up to response-related instruments, such as the FAO Compliance Agreement or the Port State Measures Agreement, nations are gradually improving their ability to establish better systems to combat IUU fishing. Although it is impossible to ever eliminate all fishing-related crime, having sound mechanisms in place to minimise it can be achieved. However, signing up to binding instruments serves little purpose when effective implementation and enforcement do not follow, which is a particular problem in African states where limited resources and financial burden hinder the ability enforce these instruments.

TABLE 15: Achievement status of SDG 14.6 (IUU) by number and percentage of African coastal states.

Status of achievement	No progress	Low progress	Average progress	Good progress	Achieved
Number of coastal states (out of 38)	0	3	19	16	0
Percentage of coastal states	0%	7.9%	50%	42.1%	0%

Andriamahefazafy et al. 2021

Of Africa's 38 coastal states, 9 were unable to achieve more than one target (Benin, Côte d'Ivoire, Guinea, Nigeria, Sierra Leone, Somalia, Togo, Eritrea). The lack of achievement in Africa is likely to be linked to a lack of reporting or limited data in these countries (Failler et al., 2020b). The World Database on Protected Areas, for example, relies on countries to submit their own data relating to the coverage of MPAs (SGD 14.5). However, low-income countries often lack the technical, human and financial capacities to accurately digitise the spatial data relating to this target, and therefore to provide reliable information on their level of achievement. Therefore, lack of achievement may be seen as a result of poor reporting rather than ultimate failure to achieve these goals, and this should be kept in mind when regarding country-by-country analyses referenced here. However, taking an approach such as this does allow for wider review of continental, regional or global progress.

Based on this analysis, it is clear that the achievement of the four assessed 2020 targets of SDG 14 in Africa has been underwhelming. This result presents both a reality-check and a wake-up call showing that too little has been attempted, and that the global achievement of the SDG 14 targets by 2020 is to be rated an overall failure when considering the ability of developing nations, such as those in Africa, to meet these targets. Moving towards the eventual achievement of SDG 14, and thus improved fisheries, will require substantive additional efforts in both implementation and monitoring.

Further pollution concerns

In the CCLME, wastewater from domestic, urban and industrial sources and ports are the main source of pollution and are largely caused by inadequate or lack of adequate sanitation (CCLME TDA, 2015). Persistent organic pollutants with harmful effects on the environment and human health mainly used in agriculture have been reported in Morocco, Senegal, the Gambia and Guinea and have accumulated in living organisms and natural habitats. Hydrocarbon pollution is generally a problem around ports owing to port traffic, boat maintenance, discharges, the emptying of ballast tanks of ships, and oil spills during oil exploration and exploitation offshore and are extremely harmful to marine and coastal wildlife. Land and marine-based activities have contributed significantly to the deterioration of water quality in the GCLME. The main sources are domestic and industrial pollutants associated with the large cosmopolitan areas of Abidjan, Accra, Port Harcourt, Lagos, Douala and Luanda. Untreated effluents discharged directly into sewers, canals, streams, rivers end up in the ocean, causing widespread deterioration of the water quality (GCLME TDA 2006). In the BCLME region, hotspots are found around the major coastal cities (including Cape Town, Walvis Bay, and Luanda), in ports, and in areas with mining and petroleum activities and other industries. The main pollution sources in the BCLME region include both sea and land-based activities, the latter due to run-off from non-point sources (e.g. agricultural areas) and to point sources (e.g. rivers, effluent outfalls) as well as atmospheric deposition (BCLME TDA, 2021). In ASCLME, the deteriorating quality of the coastal waters poses a significant threat to public health as well as to the health of its living marine resources and ecosystems – and therefore also to blue economies. The sources of pollution in this region include both land-based and maritime-related activities that include dumping, shipping, ports, and oil and gas activities (ASCLME/SWIOFP 2012).

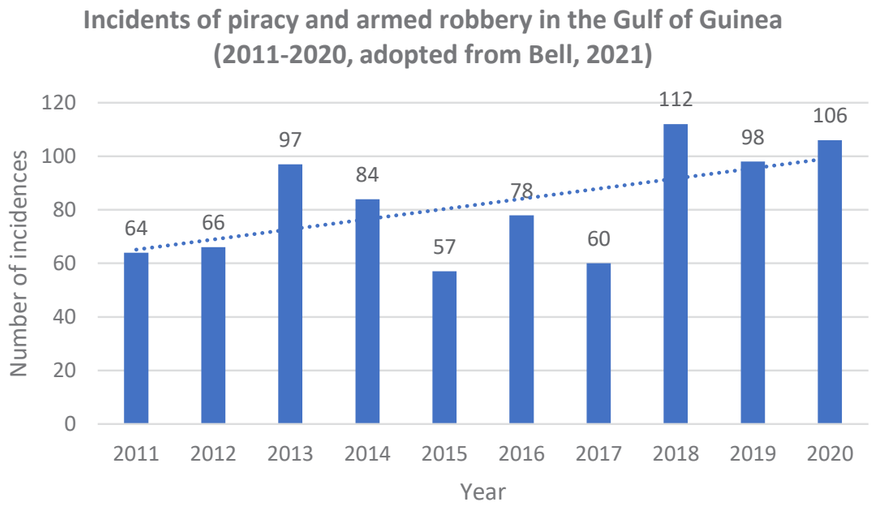
Most of the African coastal countries are party to relevant international pollution instruments and those in the West of the continent, are all members of the Abidjan Convention while those in the East are party to the Nairobi Convention. There is a need to introduce or enhance the management of all marine sources of pollution through the setting standards as appropriate, implementing monitoring and assessment programme, developing and implementing environmental management plans, and developing industry-specific Codes of Practice (e.g. for marine mining) (ASCLME/SWIOFP 2012). Marine plastic pollution continues to present serious challenges to the integrity of coastal livelihoods and marine biodiversity globally as demonstrated by the recent International Union for the Conservation of Nature (IUCN) analysis of Eastern and Southern Africa (Pucino et al., 2020). Countries in Africa are increasingly adopting policies to reduce single-use plastic pollution, with limited success as stakeholders are not always consulted in the development and formulation of the legislation (Adam et al., 2020). However failures of policy or implementation have the same effect of marine pollution and fish resources cannot thrive in an unhealthy ecosystem.

Safety and security

A comprehensive overview of several African maritime boundary disputes is provided by Okonkwo (2017) who cited the alarming fact that only about 30% of African borders are demarcated, pointing out that natural resources are at the heart of maritime border disputes. As Okonkwo documents, there exist several unresolved maritime boundaries in Africa. Walker (2015) cautioned that African maritime boundary disputes, unless resolved in a concerted and timely manner, will imperil both the short and long-term implementation of maritime policies or even impede efforts to construct regional maritime security communities, such as combined economic zones and joint anti-crime operations. Innovative means of overcoming disputes exist and include Joint Development Zones such as the one between São Tomé and Príncipe and Nigeria. States should seek peaceful resolutions through bilateral and regional resolution mechanisms where possible, and if they seek recourse through, for example, the International Court of Justice, they must be prepared to accept the decisions of the arbitrators or adjudicators (Walker 2015).

The security of African countries' EEZs is of paramount importance to develop and guarantee the sustainability of their blue economy, which affect multiple maritime sectors, including fisheries, tourism, transport, trade and offshore exploitation. Through the existing instruments of governance, the Africa Integrated Maritime Strategy (AU 2050 AIM Strategy) will establish a Combined Exclusive Maritime Zone of Africa (CEMZA) which will grant Africa enormous cross-cutting geo-strategic, economic, political, social and security benefits, as it will combine collective efforts and reduce the risks of transnational threats, environmental mismanagement, smuggling and arms trafficking. It will also boost intra-African trade, maritime safety and security, protection of the marine environment, fisheries control, among other benefits. Currently, the piracy industry sector is a serious problem as it poses a real threat not only to the safety of vessels and their crew but also to the economies of affected countries. According to the 2018 annual report of the International Maritime Bureau, the Gulf of Guinea is particularly dangerous for seafarers with reports of attacks in the waters between the Côte d'Ivoire and the Congo more than doubled in 2018, and these incidents accounted for the most serious acts of piracy worldwide. The Gulf of Guinea accounted for all six hijackings, 13 of the 18 ships fired upon, 130 of the 141 hostages held, and 78 of 83 seafarers kidnapped for ransom worldwide. Based on Bell's report (2020), incidences during 2019 and 2020 are highest compared to a period between 2011 and 2017 (Figure 9).

FIGURE 11: Incidents of piracy and armed robbery in the Gulf of Guinea (2011-2020, adopted from Bell, C. 2021).



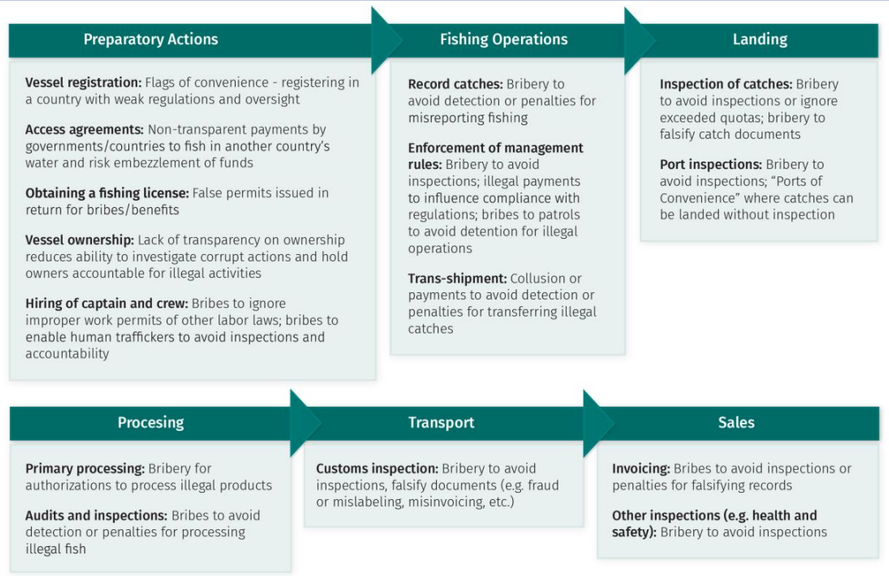
Since 2013, the number of piracies along the Somali coast has declined significantly (just two recorded in 2018) due to extensive military and naval support provided by the international community in response. African countries need to collaborate by coordinating their monitoring, control and surveillance operations and share timely information to ensure freedom of navigation at sea, curb illegal unreported unregulated (IUU) fishing, illicit trafficking, piracy and maritime criminality. A regional approach mounted through joint operations through the RECs and LME commissions could be the most effective way of addressing this challenge and ECOWAS (in the Gulf of Guinea) and SADC are advanced in this regard.

Lack of transparency

Lack of transparency is recognised as an issue in African fisheries marine management (AUC and NPCA (2014), and improving it may lead to substantial gains, such as reducing corruption, improving the effectiveness of aid, and combating illegal fishing (Standing, 2011). It must be noted however, that most of the RFBs already publicly list vessels engaged in IUU fishing activities. According to the UN Office on Drugs and Crime (UNODC, 2019), corruption is increasingly recognised as a major challenge for the sustainable management of fisheries. It can occur at all points along the supply chain, from the issuance of unauthorised vessel registrations and illegitimate licences, to the intentional under-reporting of fish at landing, to the sale of intentionally mislabelled fish (WWF, 2021; See figure below). The Al Jazeera exposé of corrupt practices in Namibian fishing "anatomy of a bribe: a deep dive into an underworld of corruption" involved the Namibian Minister of Fisheries and Marine Resources, his Angolan counterpart and an Icelandic fishing company providing a typical example of corruption in African fisheries[69]. Lifting the veil of secrecy is an opportunity to eliminate widespread corruption and weak governance in countries that allow illegal fishing to persist (EJF, 2018). Limited transparency in the marine fishery sector is detrimental to the future prospect of resources sustainability. Drakeford et al., (2020) highlighted the importance of transparency in fisheries which is echoed in various instruments: in UNCLOS; the United Nations Fish Stocks Agreement; FAO's Code of Conduct for Responsible Fisheries (FAO, 1995); by UNGA (Davis and Hanich, 2020; Solene, 2021); and the RFMOs (Davis and Hanich 2020). These texts all aim to increase transparency and make data publicly accessible (Drakeford et al., 2020). Only a few African countries (including Mauritius and Madagascar) publish complete lists of foreign fishing vessels that are provided fishing licences. In countries where licences are granted to foreign firms on condition they form joint ventures with local companies (e.g. in Senegal, Namibia, Mozambique, Angola and Mauritania), information on the beneficial owners is more difficult to obtain. All other foreign governments or fishing associations with similar agreements (i.e. from China, Japan, Korea, Taiwan, Russia) fail to publish details on their value and what levels of fishing are allowed. The EU has faced increasing criticism for the levels of transparency surrounding its fisheries agreements.

[69] *https://www.aljazeera.com/features/2019/12/11/anatomy-of-a-bribe-a-deep-dive-into-an-underworld-of-corruption*

Box 4: Corruption risks along the seafood supply chain (WWF, 2021).



Outdated perspectives of fishery management

Fisheries policies, institutional structures and the skill bases of fisheries agencies in many African countries have been heavily influenced by a historical focus on physical production and revenue maximisation year-after-year, driven by the need to generate cash for their national treasury, with little or no reference to longer-term resource sustainability. The approach has led to overexploitation of most of the major fish resources (refer to section on fish stock status above). Strategies for the sector should now be anchored in wealth-based fisheries approaches, and that the generation of social benefits, institutional structures and skill sets are linked to, and capable of, supporting management objectives (AUC-NEPAD, 2014) that maintain the catches that can meet demand. Typically, in RFMOs such as ICCAT, African countries are allocated small quotas, as the allocation criteria are primarily based on historical catches starting in years when most African nations had not attained independence, to the current date when they lack capacity to catch the resources. In addition, financial and budgetary constraints, limited human resources, with modest institutional and technical capacity, the absence of harmonised positions on common issues, compounded by poor coordination among African Member States of RFMOs limit them to contribute effectively to the work of these bodies and permit their countries to derive more economic benefits because of their memberships.

Fishery subsidies are often included in existing management systems for fisheries, and prove harmful as they disrupt and distort international trade (WTO, 2021). They fuel overcapacity in fishing vessels, resulting in overfishing in already declining fish stocks, affecting the core sustainability of the resources (Sumaila et al., 2021). Subsidies come in the form of benefits to the operators of tax-free fuel, tax exemptions, assistance to modernise equipment or low-interest loans. In the processing and the marketing segments, they are often provided as import and export tax exemptions. Such subsidies encourage continued exploitation of fish stocks. Shifting away from this historical focus on production and outdated fisheries management systems will involve assessing and incorporating the true environmental and social costs of fishing practices and policies. This includes accounting for CO2 emissions associated with fishing fleets, processing and distribution. Under the SDG Goal 14 (Target 14.6), all countries must by 2020, "prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing, and refrain from introducing new such subsidies." Ending the lack of taxation on harmful processes and products would generate substantial amounts of government funds that could otherwise be available to support sustainable fisheries in the African countries (see Section 2.2.2 on challenges in achieving SDG 14).

Epidemics

Significant connections exist between human and environmental health, with environmental health critical for the millions across Africa who cope with recurrent illness and rely on natural resources for sustenance. Numerous studies have identified the role of environmental degradation in exacerbating infection disease (Myers et al, 2013; IPCC, 2014). Epidemics and pandemics associated with ongoing changes in climate and the environment threaten the future of marine fisheries in a number of ways, as recently demonstrated by the COVID-19 pandemic of 2019. First, lockdown or confinement measures inhibit the mobility of workers and consumers, reducing employment and incomes. This has led to lower demand for aquatic foods and lower derived demand for aquatic food production inputs such as feed and fish seed. Secondly, this economic impact threatens biodiversity and fish stocks since many coastal fishers are driven to illegal fishing or piracy to support their incomes and livelihoods (Sumaila and Bawumia, 2000). It has been determined that when ill, or physically restricted, fishers are also more likely to use methods that are illegal, destructive and concentrated in inshore areas due to the lower requirement of travel and energy expenditure (Fiorella et al, 2017). The goal of protecting vulnerable fishing populations from illness must also consider the disruption of livelihoods for fishing communities, socio-economic insecurity and both existing and emerging health risks.

Poverty amongst fishers and women involved along the fish chain and their weak political voice

About 5.7 million people were employed in fisheries and aquaculture in Africa, many of whom struggle to maintain reasonable dignified livelihoods (AU, 2012). It has been assumed that many more people are involved along the supply chain. FAO gender-disaggregated data of 2016 shows that 11% of the total fishers in Africa were women (AU, 2012). The challenge is to grow the sector to its full potential so that it can serve as a source of equitable, profitable and sustained employment for a broad range of people, including the youth and women. Post-harvest processing can create additional jobs in the sector (FAO, 2016).

Women already play a significant role in African fisheries, making up a large portion of the workforce, marketing 60% of all seafood. Most of the employment by women in fisheries is related to post-harvest activities (i.e. processing and trading) which makes up roughly half of the contribution by fisheries to Africa's GDP (Du Preez, 2018). This highlights the significant economic contributions by women in the sector. Furthermore, women are heavily involved in mariculture activities, an emerging sector with extensive economic potential for livelihoods, wealth generation, and food and nutrition security in the continent. In some

instances, women have more important roles where they provide loans to male fishers and take part in investment activities in boats and equipment (GIZ, 2013). They furthermore contribute to a broad range of social services that underpin the functioning of fisheries systems. The value-added and important roles that women play in value and supply chains is indispensable.

Despite the important role that women play in generating wealth and ensuring supply chain functioning (outlined in Section 2.3), their contributions often go unseen or are considered to be domestic work (Du Preez, 2018). Particularly where harvesting is considered domestic work, the resources are not accounted for or addressed in management practices, generating deleterious impacts on the environment and livelihoods (De la Torre-Castro et al., 2017). This, alongside the paucity of data on the needs and roles of women in fisheries and associated communities, results in their exclusion in any consultation around the management of fisheries. Rendering the role of women invisible generates inaccurate perspectives on wealth generation, livelihoods, and food and nutritional security, complicating the understanding of economic balances (Harper et al., 2017). Moreover, the systemic lack of data limits the markets to informality, lacking regulation or taxation, resulting in further environmental and economic impacts (Frocklin et al., 2013). Without an increased focus on gender dynamics with regard to wages, equal treatment, wealth generation and nutrition, approaches to improve livelihoods and human rights within Africa's fisheries will ultimately fail.

Diminishing aquatic resources, the lack of user and access rights, exposure to climate and weather risks and political and social marginalisation can lead fishing- and aquaculture-dependent communities – men and women – to become trapped in a vicious circle of poverty (Binet et al, 2012). Most fisherfolks in the fisheries and aquaculture sector in Africa are poor, having few rights of tenure over the resources needed for their livelihoods and few other livelihood options. These small-scale fishers, who are likely to have been less educated and less organised are often excluded from the decision-making process, and with little economic or political weight. Fishing and aquaculture are the only available source of income and animal protein, and the constraints associated with this – particularly in the context of already depleted fish stocks, represent a significant policy and development challenge for many governments. Nonetheless, poverty eradication remains high in the developmental agenda of all African States. Governments should direct their poverty eradication efforts towards improving the governance of the sector and empower fishing communities to gain more control over the basic conditions that determine their well-being.

IUU Fishing

IUU fishing adversely affects fishing communities' economic and social well-being, especially in countries where coastal communities rely overwhelmingly on fishing for their food security and livelihoods. For example, across West Africa, one of the regions with the highest levels of IUU fishing, fish is vital to food security, providing essential nutrition and accounting for over 50% of animal protein intake in countries such as Ghana and Sierra Leone. Action is needed now by African countries to eliminate IUU fishing by strengthening national fisheries laws and regulations, taking punitive action against perpetrators, establishing mechanisms that encourage compliance, implementing the provision of the Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (PSMA), adopting and implementing National Plans of Action, introducing catch documentation schemes for traceability of fish, and ensure that subsidies or any other benefits that they grant to their fishing sectors do not encourage IUU fishing. The RFMOs and Regional Fisheries Bodies are uniquely and strategically positioned to take a leading role in regional and global efforts in the fight against IUU. These entities can compile an IUU fishing vessels list as a tool to combat illegal fishing and broader fisheries crime.

The list of IUU vessels available from RFMOs (CCAMLR, SEAFO, NEAFC, NAFO and Southern Indian Ocean Fisheries Agreement) contains several African flagged vessels (non-Africans most likely own these flag of convenience). Article 8 of the FAO Code provides that flag States should ensure that no fishing vessels entitled to fly their flag fish on the high seas or in waters under the jurisdiction of other States unless such vessels have been issued with a Certificate of Registry and have been authorised to fish by the competent authorities (FAO, 1995). The Code therefore exists to limit the practice but once again, the absence of monitoring and surveillance permits it to occur commonly in reality.

Transhipment is rampant, diverse and complex, with impacts ranging from increased requirements for monitoring, compliance and surveillance, lack of implementation of conservation and management measures, facilitation of fishery crimes and social-economic damage to local fishing communities and government revenues. This is demonstrated by the case study of types of transhipment identified by the Fisheries Committee for the West Central Gulf of Guinea (FCWC) and believed to cost Ghana, as one example, around $10 million a year in illegal fishing.[70]

[70] *Ghana is estimated to lose $10 million annually through transhipment from the country's territorial waters. https://fcwc-fish.org/other-news/ghana-the-country-loses-10-million-annually-through-transhipment.*

Box 5: Transhipment and the FCWC region case study

Case Studies: Transhipment types identified by and the Fisheries Committee for the West Central Gulf of Guinea (FCWC) Region: https://stopillegalfishing.com/publications/transhipment-and-the-fcwc-region-case-studies/

Transhipment to reefers: Reefer vessels frequently make journeys involving several ports. The point of loading or offloading fish entering and departing the FCWC region will, in many cases, not be the previous or next port visited, whether within or outside of the FCWC region. Reefers that are dedicated to fish transport are mainly characterised by direct port-to-port transits, or journeys to fishing grounds to conduct at-sea transhipment operations. Whilst vessels change their pattern of operations according to demand and market factors, knowing the expected broad operating pattern of a vessel can provide insights into the type of operations and risk factors that should be considered. Transhipment to factory vessels: Several vessels have operated in West Africa as factory vessels to provide fish and fishmeal to both local and international markets in recent years. Frequently these vessels are ex-fishing vessels converted to factory vessels. These vessels may be sourcing fish from industrial fishing vessels or local small-scale fisheries. Transhipment to converted fishing vessels: More recently, fishing vessels have switched operations from fish catching to fish transport. Visually these vessels can be challenging to distinguish from active fishing vessels. They may be reconfigured to have larger cargo and freezing capacity and deck cranes and booms to conduct at-sea transhipment operations, and they may carry fenders to enable them to come safely alongside another vessel at sea. Or they may, at the simplest, have the fishing gear removed or stowed, and the holds are used to store transhipped fish. Transhipment to small transport vessels: Transhipment of fish from industrial fishing vessels to smaller vessels started to 'barter' fish for goods. In some fisheries, it has developed into a lucrative business, providing a way for industrial fishing vessels to land unwanted, damaged, undersized or illicit catch outside a port, evading controls. In trawl fisheries, the practice is considered to have a devastating impact on stocks as it creates a demand for cheaper undersized fish. Transhipment to containers: The growth in the use of containers to transport fish has taken place over the last twenty years. Container vessels are a significant means for importing fish into and exporting out of the FCWC region. Fishing vessels and reefers offload direct into containers in ports. These vessels generally operate outside of the remit of fisheries authorities, visiting areas of port that are inaccessible to fisheries personnel.

Migratory fishing

In recent decades, there has been a considerable increase in cross-border migratory flows to and from coastal African countries (Failler et Deme, 2020) as well as within inland fisher communities (Njaya, 2009). This is predominantly due to the depletion of fishery resources in traditional fishing areas (Bâ et al., 2016) and ocean changes associated with climate change (Failler et al., 2020c). Further pressures driving this phenomenon include the restriction or enclosure of their fishing grounds due to other marine activities such as oil exploration, aquaculture or conservation measures (Bennett et al, 2015). These unprecedented migration rates have been forced by the need to adapt to variations in fish stock abundance (Failler & Binet, 2010), the necessity to seek out further sources of income, and the desire of young fishermen to escape the social pressures and financial duties associated with family (Sall et al., 2021). The settlement of migrant fishermen and their associated catches in host countries naturally creates impacts associated with their economic inputs, socio-cultural differences and technological capacity (Failler and Ferraro, 2021). Their impacts and the volumes of fish caught by migrant fishers has only in recent years gained attention by researchers, and in many areas still remains unknown to policy makers (Failler et al, 2020).

The key challenges and threats associated with migrant fishers are: a) fisheries statistics do not include migratory fishery, resulting in skewed values for both origin and host countries, and thwarting any attempt to establish fisheries policies based on accurate data; b) migrants are under intense pressure in their host countries, often leading to conflicts over access to marine resources and land, resulting in increased pressure on fishery resources (Deme et al., 2021a); c) migration is insufficiently taken into account in the national and regional fisheries management decision-making process; not studied qualitatively or quantitatively and little known by research institutes and policy makers; and finally, d) the capacity to manage migrant fisher movements is limited by administrative boundaries (Wanyoni et al, 2016), often exacerbating illegal or unregulated fishing activities. Migrant fishing should also be considered in the formulating policies in such a way as to ensure the effectiveness of the regulations governing access, control and surveillance (Failler et al. 2020d) and how they are communicated.

Bycatch and discards

This issue is particularly concerning for removing long-lived top predators with low reproductive rates, including marine mammals, sea birds, sea turtles, sharks, and other groups, and eliminating their prey (Hall 1996). The by-catch issue is also wasteful in that it generates additional costs without improving revenues and may hinder profitability. It also causes conflicts among fisheries and frequently negatively affects the resources harvested through the mortality of juvenile and undersized target species individuals before they reach their optimal yield and profitability size. Incidental catches in certain fisheries such as longline and trawl fisheries of seabirds, sharks and sea turtles are well-documented (e.g., Zollett and Swimmer 2019). However, where incidental catches are not accounted for in other fisheries, stock assessments often contain inaccurate data given the missing inputs.

The Atlantic coast of Africa is one of the most important regions for sea turtles globally, hosting five species: loggerhead turtle, olive ridley turtle, leatherback turtle, green turtle and hawksbill turtle. Globally, the first three are vulnerable; the fourth is endangered, and the fifth is critically endangered[71]. With the exception of the loggerhead, these turtles forage and have nesting grounds in the Gabonese waters (Casale et al. 2016). Gabon has already declared 23.8% of its exclusive economic zone, as a MPA[72] and sea turtles are protected by law (Casale et al., 2016) but they are caught incidentally in trawl and longline fisheries and sometimes are targeted for their meat, eggs and shells. Aside from accidental or purposeful fishing they also die due to marine litter, including plastic ingestion, are threatened by global warming and coastal development. Due to their cosmopolitan distribution, conservation measures are necessary along Africa's entire tropical, subtropical and equatorial regions. The use of Turtle Excluder Devices (TEDs) has proven an effective solution to the problem of turtle bycatch in the Gabonese shrimp trawling industry (Casale et al. 2016; Banks and Macfadyen, 2011) and also in tuna fisheries (IOTC SC, 2020; ICCAT, SCRS 2019). Similarly, public outreach information and education campaigns targeting fishers, with a specific focus on best practices to reduce post-release mortality of captured turtles, has led to positive results in Gabon (Casale et al., 2016).

Shrimp trawling is considered one of the most unselective and damaging fishing methods in the world because bycatch of commercial and non-commercial species may significantly outweigh the catch of target species (Banks and Macfadyen, 2011; Hall, 1996). For illustration, the ratio of shrimp to other species in landed catch weight ranges from 1:8 in West Africa (Banks and Macfadyen, 2011) to 1:1 in some fisheries with effective selectivity devices such as Madagascar (Banks and Macfadyen, 2011). Mozambique and Madagascar employed output controls in shrimp fisheries, including TAC, to restrict bycatch in shrimp fisheries (Banks and Macfadyen, 2011). Noteworthy in the case of Mozambique was the system employed to recover the by-catch of shrimp boats by specialised vessels that supply the national marker with those fish products. In the past in Madagascar, skippers and crew are awarded premium wages for catching larger-sized shrimps (Banks and Macfadyen, 2011). Other countries have applied technical measures such as minimum mesh sizes, headrope length and bycatch reduction devices (BRDs (Banks and Macfadyen, 2011).

Pelagic shark populations are vulnerable to overfishing because of their organism's essential traits: slow growth, low fecundity, late age at maturity, and a long natural lifespan (Gilmman et al., 2008). Blue sharks *(Prionace glauca)*, shortfin makos *(Isurus oxyrinchus)* and porbeagle sharks *(Lamna nasus)* are vulnerable to both high-seas fishing fleets and local fleets (Gareth et al. 2020), and are the most important bycatch species caught by pelagic longline and gillnet fisheries, which targets mainly swordfish and tuna in the Atlantic Ocean (Santos et al., 2021) and considered to be at most significant risk of overexploitation (Cortés et al., 2015). A recent stock assessment by ICCAT (Santos et al., 2021) showed that the South Atlantic stock of shortfin makos had a 32% probability of overfishing and a 42% probability of experiencing overfishing. In the South Africa study (Alan, 2013), a pelagic longline fishery targeting swordfish, blue shark and shortfin mako shark made up 22.5% of shark bycatch along the upper east coast. The conservation status of many sharks caught as bycatches in African fisheries is classified vulnerable by IUCN (www.iucnredlist.org), and some species are listed on the Convention on International Trade in Endangered Species of Wild Fauna and Flora Appendix II (www.cites.org). Mammals are incidentally killed through bycatch and vessel strikes, pollution, noise, loss or degradation of breeding habitat, disturbance, blasting, infectious diseases and climate change (Wilson and Mittermeier, 2014). African coastal states must implement to the fullest extent, their national laws and the FAO Code (FAO, 1995) and the International Plan of Action for Conservation and Management of Sharks and the International Plan of Action to Reduce Incidental Catch Seabirds in Longline Fisheries.

Post-harvest losses

Fish post-harvest losses and waste in Africa pose another serious threat to African governments' efforts to reduce food insecurity. Slightly over a quarter of the entire fish harvest is lost post-harvest in sub-Saharan Africa (Affognon et al., 2015), with underdeveloped cold chains for fisheries other than small pelagics being recognised as a key area of intervention which would undeniably increase resource use efficiency and profits for value chain actors (Chan et al. 2019). FAO studies (FAO SOFIA 2018) have found that 65% of post-harvest fish loss and waste is due to technical, technological or infrastructure deficiencies, together with inadequate knowledge and skill in handling. The remaining 35% of loss and waste is linked to the social and cultural dimensions of vulnerability, governance, regulations, and lack of enforcement. Post-harvest loss and waste can easily offset the food security and nutrition benefits of fish and fish products, typically occurring in those countries that can least afford to waste a valuable source of food and nutrition (FAO SOFIA, 2018). Gustavsson et al. (2011) estimated that the food loss and waste for the whole fisheries sector amounted to 35% of global catches, with between 9 and 15% of these losses due to fish discards at sea, mostly in trawl fisheries. However, loss and waste can be found along the whole value chain, from production to the consumer.

[71] *See: https://www.iucn-mtsg.org/statuses*
[72] *See: https://www.openchannels.org/*

Annex 1e:
List of fishing agreements

TABLE 16: Sustainable Fishing Partnership Agreements between African coastal countries and EU[73]

Coastal Country	Expiry date	Type	Total EU contribution per year	Sectorial support per year
Cabo Verde	19.5.2024	Tuna	€750 000	€350,000
Comoros	*Protocol expired on 31.12.2016. Agreement revoked.*			
Côte d'Ivoire	31.7.2024	Tuna	€682,000	€352,000 (2yrs) - €407,000
Equatorial Guinea	*Protocol expired on 30.6.2001.*			
Gabon	28.06.2026	Tuna	€2,600,000	€1,000,000
Guinea-Bissau	14.6.2024	Mixed	€15,600,000	€4,000,000
Liberia	*Protocol expired on 8.12.2020.*			
Madagascar	*Protocol expired on 31.12.2018.*			
Mauritania	15.11.2026	Mixed	€57,500,000 (access only)	€3,300,000 (for the entire period)
Mauritius	7.12.2021	Tuna	€575,000	€220,000
Morocco	17.7.2023	Mixed	€208 million over a 4 year period	€17.9 - €20.5 million
Mozambique	*Protocol expired on 31.1.2015.*			
São Tomé and Principe	18.12.2024	Tuna	€840,000	€440,000
Senegal	17.11.2024	Tuna + hake	€1,700,000	€900,000
Seychelles	23.2.2026	Tuna	€5,300,000	€2,800,000
The Gambia	30.7.2025	Tuna + hake	€550,000	€275,000

African coastal States also have bilateral fishing agreements with countries like China, Russia, and Korea. They grant access to their EEZ to private companies through licence fees and joint ventures scheme mainly. About 25 coastal States provide such private access to foreign fishing vessels.

[73] *See:https://ec.europa.eu/oceans-and-fisheries/fisheries/international-agreements/sustainable-fisheries-partnership-agreements-sfpas_fr#ecl-inpage-59*

Annex 2a:
Marine Spatial Planning

Conflict between competing marine industries

Conflicts act as both governance and socio-economic challenges between competing marine sectors are common in Africa's ocean space, largely due to the absence of regulatory and institutional frameworks. In most coastal states, industrial fishing vessels harvest illegally in areas reserved for small-scale fishers, creating inter-sector conflict (which has led to some fatalities), while also jeopardising the sustainability of fish stocks (AUC-NEPAD, 2014). The extent of such operations has resulted in severe economic, food security and maritime safety issues. Industrial fleets spent 3%–6% of their time fishing within inshore areas reserved for small-scale fisheries between 2012 and 2016, within the EEZs of African countries (Belhabib et al., 2019). Catches of tuna species in southern Namibia declined significantly since 2011, and in 2017 dropped to non-commercial catch rates, which the fishing industry attributed to the increased seismic surveys in the area. The oil industry disputed the claim. Fishing has been banned within a 500-meter radius of offshore oil rigs and other infrastructure, leading to conflicts and growing resistance from small-scale fishers as their livelihoods and food security are threatened in Ghana. In Sierra Leone, conflicts among sectors (including agriculture, tourism, coastal infrastructure projects and oil exploration, palm production, iron ore mining) are common and often resolved through courts, government authorities, and customary systems such as tribal councils (Baio and Sei, 2018).

Another such example is where MPAs are designed without proper analysis or consultation with fisheries and associated sectors, as is in Senegal, where the MPAs decreed in 2004 are in front of the largest fishing ports. With the blue economy swiftly emerging, conflicts among sector and intra-sector will increase. However, managing human activities is an important outcome of Marine Spatial Planning (Ehler and Douvere, 2009) that many African countries are institutionalising and becoming a mechanism to further the implementation of the ecosystem approach.

Introduction to Marine Spatial Planning

The blue economy that many African countries have embarked upon requires the application of area-based planning tools such as marine spatial planning processes, underpinned by scientific information and understanding of the marine environment (UNEP-Nairobi Convention and WIOMSA, 2021).

Box 6: Marine Spatial Planning

Marine spatial planning (MSP) is a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that are usually specified through a political process (Ehler and Douvere, 2009). Key characteristics of effective marine spatial plans are:

- Ecosystem-based, balancing ecological, economic, and social goals and objectives toward sustainable development;
- Integrated, across sectors and agencies, and among levels of government;
- Location-based or area-based;
- Adaptive, capable of learning from experience;
- Strategic and anticipatory, focused on the long-term; and
- Participatory, with stakeholders actively involved in the process.

Source: GEF LME:LEARN, 2018.

MSP therefore provides for the implementation of the ecosystem approach in ways that marine and coastal biodiversity is protected, conflicts between sectors are avoided proactively, synergies between marine uses are enhanced, and framework conditions for better ocean governance and wealth distribution are established. As such, MSP provides the spatial foundation for a growing blue economy and enables linkages across the land-sea interface by bridging their use planning in the coastal zones.

There has been a relatively rapid introduction of the MSP process in Africa. The Mami Wata pilot project partners and the Benguela Current Convention (BCC) organised a training and capacity development programme on MSP for participants from west, central and southern Africa. Parties to the Benguela Current Convention, namely, Angola, Namibia and South Africa, are implementing the MSP through support from the German government. In the Western Indian Ocean, parties to the Nairobi Convention, supported by UNEP, are at varying levels of introducing MSP. Mozambique, Tanzania, and Kenya are at the initial stages of introducing the MSP in their management regimes. Three countries are at advanced stages of institutionalising MSP including Mauritius, which has advanced this planning in key maritime sectors such as port infrastructure, shipping, tourism, seafood, fisheries, and marine renewable energy to strengthen its economic diversification and blue economy; the Seychelles and Mauritius have established a joint management area over an expanse of seabed in the Mascarene Plateau Region. The former has an Executive Committee, Steering Committee, and Technical Groups devoted to MSP; South Africa, whose National Assembly passed an MSP bill in 2018, is currently developing its first marine area plan and an approach to its zoning plan under Operation Phakisa.

In the context of increasingly busy ocean spaces, MSP can encourage multi-uses and identify appropriate sites for new and emerging uses. It can also be used as a tool for increasing investor confidence by introducing transparency and predictability, which can act as a catalyst for investment in innovation and developing blue technologies. In the transboundary context, MSP can foster collaboration across borders for regional development. The key for developing a sustainable blue economy will be better knowledge for marine management and innovation as well as strong collaboration among different stakeholder groups (UNESCO-IOC, 2021). With this development of the MSP across Africa, the fisheries sector is better able to co-exist with other blue economy sectors, and what is required is to manage the fisheries sustainably. It must be acknowledged that MSP will not offer a remedy for all the challenges amongst the sectors, particularly where the shared fish stocks are periodically moving in and out of a given space, but it provides a solid foundation for a way forward.

Annex 2b:
Regional Coordination Mechanisms in Africa

African LMEs include 38 coastal states. From the fisheries perspective, African LMEs possess significant marine biodiversity and habitats providing coastal countries with some of the world's most productive fishing grounds. Many of the resources, particularly the small pelagic fish in BCLME, CCLME and GCLME, are transboundary. Table 10 shows major transboundary priority concerns. The decline in commercial fish stocks and non-optimal harvesting of living marine resources is manifested in all four LMEs. Heavy fishing pressure is the major factor that has resulted in the overexploitation and depletion of several of the Africa LMEs. BCLME and ASCLME are subjected to uncertainties regarding their ecosystem status due to their more complex nature and high variabilities in these ecosystems, making it challenging to predict their status. Furthermore, the BCLME is characterised with a loss of biotic integrity and threats to biodiversity and is chronically impacted by harmful algal blooms. All LMEs are under severe threats from pollution as evidenced by the deterioration of the water quality. Similarly, there is serious concerns about general ecosystem health, manifested by habitat degradation, destruction, and alteration in all the LMEs.

TABLE 17: Main priority concerns of African LMEs

Transboundary priority concerns	ASCLME	BCLME	CCLME	GCLME
Decline in commercial fish stocks and non-optimal harvesting of living resources	X	X	X	X
Uncertainty regarding ecosystem status and yields in a highly variable environment	X	X		
Deterioration in or declining water quality	X	X	X	X
Habitat degradation, destruction and alteration	X	X	X	X
Loss of biotic integrity and threat to biodiversity/loss of ecosystem integrity		X		X
Inadequate capacity to assess ecosystem health		X		
Harmful algal blooms (macro and microalgae)		X		

Source: Satia (2016)

The business-as-usual approach will not protect the long-term security of African fisheries. Its reform is urgently needed (AU, 2014) and the signs of serious damage are already concerning. Because stocks are shared, management and conservation measures (e.g. curbing IUU fishing, undersized fish or overcapacity) taken in one jurisdiction can be undermined by another with weaker governance targeting the same stock. Fisheries yields are also impacted by anthropogenic stressors including climate change and variability, pollution and habitat destruction, degradation and alteration. Mitigating all of these stresses on ocean systems simultaneously is necessary to ensure the long-term sustainability of African LMEs and to protect the services they yield. The decline in commercial fisheries is likely to continue unless shared stocks are managed collaboratively through agreed and enforced regional management plans. The LME projects and programmes and regional fisheries bodies (e.g. Sub-Regional Fisheries Commission (SRFC), Fishery Committee for the West Central Gulf of Guinea, Regional Fisheries Committee for the Gulf of Guinea (COREP) and Benguela Current Convention) are excellent platforms for assessing and managing shared fish stocks. Sadly, not all of them have the power to make binding decisions and enforce them, given that the support they receive (including budgetary, technical, material, and human) from the RECs is limited.

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