Special Report

Appendix 2

Country Review: Mozambique

November 2019

Marine and Coastal EbA for Enhanced Resilience in Southern Africa

Country Review: Mozambique

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African perspectives
Global insights

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Executive summary

Mozambique is located in south-east Africa on the Indian Ocean, bordered by Tanzania, Malawi, Zambia, Zimbabwe, South Africa and Swaziland. It has a coastline of 2 500km. About two-thirds of its population of 28 million (2017) live in the coastal area. Agriculture is the main economic activity in the country, while other sectors such as mining, the food industry and tourism are growing. In 2016 the fishing sector contributed 10% of the gross domestic product and shrimp alone was the ninth biggest export product. It is estimated that the sector provides direct and indirect livelihoods to some 400 000 people.

Frelimo (Front for the Liberation of Mozambique) and Renamo (Mozambican National Resistance) are the country's main political forces, followed by the Mozambique Democratic Movement. Economically, Mozambique continues on the slow growth trajectory that followed the 2016 hidden debt crisis. Its main challenges include maintaining macroeconomic stability, considering its exposure to commodity price fluctuations and the general elections of 15 October 2019; and re-establishing confidence through improved economic governance and increased transparency, including the transparent handling of the hidden debt investigation. Moreover, structural reforms are needed to support the currently struggling private sector.

Mozambique has considerable coastal and marine biodiversity, with several areas of outstanding ecological and biological importance (ecologically and biologically significant marine areas), where critical habitats and species of special interest (rare, endemic, protected, vulnerable and threatened) are found. The country has the second-most extensive mangrove forests on the continent, as well as diverse and among the most climate-resilient reefs in the region. It is also home to the endangered *Zoostera capensis* seagrass species.

However, human action endangers the health and resilience of all these ecosystems – mangroves are threatened by urban expansion and logging for wood; coral reefs are threatened by overfishing, tourism malpractice and coral bleaching; and seagrasses are endangered by pollution, urban expansion and trampling during invertebrate collection.[1] Some threats are also present in marine protected areas (of which Mozambique has six), which often fail to enforce regulations or even include relevant habitats within the protected area.

Climate change is also having devastating ecological and socioeconomic impacts on Mozambique. It is estimated that by 2050, $7 billion will have to be spent addressing climate hazards (flooding, droughts, cyclones, erosion and sea-level rise). Average temperatures have already increased by at least 1.5 C° (2012) and are predicted to increase

1 During low tide the *communities* go to seagrass beds and collect bivalves, gastropods, sea cucumber and others. Sometimes fish are also caught, particularly moray eel.

by up to 6˚C by 2100. Food insecurity, loss of biodiversity and the spread of diseases will be some of the impacts.

Rainfall is anticipated to become less predictable, and concentrated over a shorter period, although the amount of rain may not change. This will increase the frequency and severity of droughts and flooding events, with negative effects on crop production, human health, water availability and saltwater intrusion. Cyclones are also likely to become more intense, causing major human and infrastructure losses. In 2019 the Mozambican coast was hit by two severe cyclones only two months apart (Idai on 14 March in central Mozambique and Kenneth on 25 April), causing serious damage. Natural habitats such as mangroves, seagrass beds and coral reefs will also suffer negative impacts from severe cyclones, as was recorded in 2000 (Cyclone Eline) and 2019 (Cyclone Idai). In addition, the sea level is projected to rise by up to 500cm by 2100, causing coastal inundation (loss of infrastructure, population displacement), saltwater intrusion (loss of agricultural areas and of potable water availability) and loss of habitat.

A study by the World Bank projects that $103 million will have to be spent every year by 2040 to address climate-related issues in Mozambican coastal areas. However, this amount can be significantly reduced by the adoption of appropriate adaptation measures. This includes making changes to development policies, agricultural practices (irrigation, research, extension) and education, and increasing the resilience of natural habitats through restoration, rehabilitation and sustainable management of marine and coastal ecosystems. Ecosystem-based adaptation (EbA) approaches can contribute to both mitigation and adaptation to climate change, and can provide long-term, cost-effective and sustainable solutions.

A number of social and economic management instruments, such as Mozambique's Five-Year Government Plan, its Annual Socio-Economic Plan, and, at the local level, the Strategic Plan for District Development, include aspects related to climate adaptation. Mangrove forests, seagrass beds and coral reefs are described as important coastal habitats that provide socio-economic and ecological goods and services to coastal communities for EbA and climate mitigation. Other systems, such as coastal dunes, are mentioned less frequently but should also be considered for EbA.

Several prominent institutional actors deal with aspects of EbA in Mozambique. The Ministry of Land, Environment and Rural Development is the focal point for climate change adaptation, while the Ministry of Sea, Inland Waters and Fisheries (MIMAIP) manages most of the coastal and marine habitats, including mangroves, coral reefs and seagrass beds. Both ministries host most of the institutions that deal with the environment, climate change, ecosystem management and relevant policy-making and regulation. Other ministries with an interest in environmental and climate-related issues are involved in the decision-making process through the National Sustainable Development Council (although it has not been functional since early 2019). At the local level, climate-related issues are dealt with by the District Services of Economic Activities and District Services of Planning

and Infrastructure. Local communities also participate in climate actions through Natural Resource Management Committees and Community Fishing Councils.

Although institutional arrangements for EbA are comprehensive and inclusive, effective implementation is still a challenge. In general, most institutions do not have the necessary technical and financial capacity for planning and implementation, while there is also a lack of institutional and inter-sectorial communication and coordination. Frequent changes to the governing structure also create confusion and misinterpretation of mandates and responsibilities. This has been the case since 2015, when MIMAIP was tasked with the management of marine and coastal ecosystems, a role that traditionally fell under the former environment ministry, namely the Ministry for Coordination of Environmental Affairs.

Civil society and non-governmental organisations (NGOs) play various roles in EbA actions, such as raising awareness, providing advocacy and environmental advice, influencing the design/adoption of new environmental policies and strategies, providing financing, and implementing conservation, restoration and sustainable management projects. This work could be enhanced through better communication between such organisations and other stakeholders, and by creating synergies among them. While NGOs sometimes provide funding and technical support for conservation, innovative models for financing, conservation and EbA must also be explored. In addition, NGOs could help coordinate and bring together other EbA stakeholders such as the private sector, which thus far has made few contributions to EbA but could reap significant benefits.

Academia and research institutions are another important EbA stakeholder. Mozambique has a number of research institutions that work with marine and coastal habitats, but important research gaps need to be filled. These include understanding the impact of climate change on the functioning of a particular ecosystem, the unique system's carrying capacity, restoration science and delivery of ecosystems' ecological services. Financial and technical capacity for research also needs to be improved.

The role of local communities in EbA is increasingly recognised, but there is still an urgent need for community empowerment and capacity building. Communities should be included and their sense of ownership increased in order to insure the long-term sustainability of such initiatives.

In terms of the policy and regulatory landscape, the most relevant EbA instruments in Mozambique are the National Adaptation Plan, the Sea Policy and Strategy, the REDD+ Strategy (biodiversity offsets, conservation trust fund, conservation of forest carbon stocks, sustainable management of forests and enhancement of forest carbon stocks); and the Strategy and Action Plan for the Integrated Management of Coastal Zones. Climate change and ecosystem-based approaches should also be included in other instruments, such as the National Development Strategy for Mozambique and the country's Nationally Determined Contribution, which should be revised to include mangrove and seagrasses in blue carbon.

Several EbA initiatives in Mozambique are funded by development partners, such as the Global Environmental Facility (GEF), the World Bank, the Food and Agriculture Organization (FAO), the US Agency for International Development, the Nairobi Convention, and other bilateral cooperation partners such as Denmark, Sweden, France, Norway, Germany and the Netherlands.

Most EbA initiatives are poorly documented and the information is not accessible. This makes it difficult to know what lessons have been learnt, and to ensure the replication and scaling-up of initiates. Given their extent, mangroves, coral reefs and seagrass beds are the most targeted ecosystems, but others such as coastal dunes should also be managed and protected. There is also a need to create innovative funding to support EbA and extend the local capacity of the broader EbA community to fully exploit other regional initiatives and funding opportunities. Other recommendations include raising awareness; creating (or enhancing existing) national platforms for inter-sectoral communication and coordination; building capacity; creating an EbA database; promoting applied research; investing in natural capital; and involving the private sector in conservation and adaptation initiatives.

Abbreviations & acronyms

AFD	Agence Française de Développement
AMA	Environmental Association (Associação Meio Ambiente)
ANAC	National Administration of Conservation Areas
AQUA	National Agency for Environment Quality Control
BANP	Bazaruto Archipelago National Park
CCAP	Coastal City Adaptation Project
CCPs	Community Fishing Councils (Concellho Comunitário de Pescas)
CDS-ZC	Centre for Sustainable Development – Coastal Zones
CGRNs	natural resource management committees (Comités de Gestão de Recursos Naturais)
CONDES	National Sustainable Development Council
ESP	Mozambique Environment Programme Support
EbA	ecosystem-based adaptation
EBSA	ecologically and biologically significant marine area
FNDS	National Fund for Sustainable Development
Frelimo	Front for the Liberation of Mozambique
GDP	gross domestic product
GEF	Global Environmental Facility
IIP	National Institute for Fisheries Research
INAM	National Institute of Meteorology
INGC	National Institute for Disaster Management
LAP	Local Adaptation Plan
MEF	Ministries of Economy and Finance
MICOA	Ministry for Coordination of Environmental Affairs
MIMAIP	Ministry of Sea, Inland Waters and Fisheries
MITADER	Ministry of Land, Environment and Rural Development
MPA	marine protected area
NBSAP	National Biodiversity Strategic Plan
NDC	Nationally Determined Contribution
NDS	National Development Strategy
NGO	non-governmental organisation

PA	Protected Areas
PES	Payment for ecosystem services
POLMAR	Sea Policy and Strategy
REDD+	Reduced Emissions from Deforestation and Forest Degradation
Renamo	Mozambican National Resistance
QNP	Quirimbas National Park
SDAE	District Services of Economic Activities (Serviços Distritais de Actividades Económicas)
SDPI	District Services of Planning and Infrastructure
SPDD	Strategic Plan for District Development
SWIOFish	South West Indian Ocean Fisheries Governance and Shared Growth Programme
UNFCCC	UN Framework Convention on Climate Change
USAID	US Agency for International Development
WIO	Western Indian Ocean

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Cover image

Fishers and mangrove swamps, Mozambique (Romy Chevallier)

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Country context: Geography, socio-economic, political and biophysical situation analysis

Geography, political and socio-economic context

The Republic of Mozambique is located in south-east Africa, bordered by Tanzania to the north, Malawi and Zambia to the north-west, Zimbabwe to the west, South Africa and Swaziland to the south-west and the Indian Ocean to the east. The country has a total area of 799 380km^2, with a long coastline of 2 515km (from the mouth of the Rovuma River down to Ponta do Ouro)[1] along the Indian Ocean.

A former Portuguese colony, Mozambique became independent in 1975. Civil war between the ruling Frelimo and Renamo (Mozambican National Resistance) parties began shortly afterwards. A peace deal was signed in 1992, followed by the first democratic elections. General elections (to elect the head of state and Parliament) are held every five years, interspersed by municipal elections. The country has had four presidents since independence (three of whom were elected in democratic processes), all belonging to Frelimo. The seventh general election was held on 15 October 2019, ending the first term of President Filipe Jacinto Nyusi. Renamo maintained its militia after the peace accord of 1992 and parts of the central region still see sporadic armed conflict. In 2016 a new round of peace talks was initiated by Nyusi and a breakthrough agreement was announced in February 2018 in the form of a constitutional amendment, submitted to Parliament for ratification. A new peace agreement was signed in August 2019, although the sections dealing with the demilitarisation and social reintegration of Renamo fighters do not find consensus within the party. Armed attacks continue in central Mozambique (October 2019), conducted by the self-proclaimed 'Junta Militar of Renamo'.

Mozambique emerged from its civil war with a commitment to social and economic recovery and the construction of a democratic state.[2] Mostly as a result of the hidden debt crisis in 2016, its gross domestic product (GDP) growth rate dropped to 3.8% in 2017 compared to the 7% achieved on average between 2011 and 2015 (see Table 1).[3] The revelations of hidden debts emerged during an economic downturn brought on by low commodity prices and a regional drought.[4]

Mozambique has ample natural resources – arable land, forests, wildlife, water, energy, mineral resources and newly discovered natural gas offshore. Despite this wealth, it is one of the poorest countries in the world. According to the national census of 2017, its population is estimated at 28 861 863 (36.1 individuals/km^2), with a growth rate of 2.45%, predicted to double by 2050. More than 70% of the population live in rural areas, and an estimated two-thirds in coastal areas. Urbanisation is growing at a rapid pace, bringing poverty,

1 INE (Instituto Nacional de Estatística), *Anuário estatístico 2017 Moçambique*. Maputo: INE, 2018.

2 WWF (World Wide Fund for Nature), *Mozambique Country Strategic Plan (2016–2020)*, http://awsassets.wwfmz.panda.org/img/original/wwf_mozambique_strategic_plan.pdf, accessed 23 August 2019.

3 World Bank, 'A Two-speed Economy: Mozambique Economic Update', 2017, pp. 3–4, http://documents.worldbank.org/curated/en/790351501245021584/pdf/117784-REVISED-MEU-2017-English-Digital-Version.pdf, accessed 23 August 2019.

4 Deloitte, *Mozambique's Economic Outlook Governance: Challenges Holding Back Economic Potential*, December 2016, https://www2.deloitte.com/content/dam/Deloitte/za/Documents/africa/ZA_Mozambique%20country_report_25012017.pdf, accessed 23 August 2019.

social inequality and environmental degradation to the predominantly coastal cities. A demographic shift is taking place with 40% of the population expected to live in cities by 2040.[5]

Natural resource exploitation

Dependence on natural resources is high. As many as eight in 10 jobs rely on natural resources (for example, agriculture, fisheries and mining). Some estimates suggest that up to 50% of GDP is derived from natural capital and a significant amount of revenue from related environmental taxes and charges. According to a World Bank analysis, Mozambique is on the verge of becoming a two-speed economy, driven by some sectors (natural resource extraction, mainly oil, gas and gemstones)[6] with others falling far behind (eg, agriculture and small business development). Inflation remains high at 18%.[7] The extractive sector presents a major environmental challenge, as some of the most important deposits are located in or near sensitive ecosystems and biodiversity hotspots.[8]

TABLE 1 MOZAMBIQUE'S MAIN SOCIO-ECONOMIC INDICATORS	
GPD (2018)	$12.3 billion
GPD gross rate (2018)	3.7%
Debt (% GDP) (2017)	118.76%
Unemployment rate (2017)	25.04%
Trade balance (2017)	-$983.2 million
CO_2 tonnes per capita (2016)	0.2
Human Development Index (2017)	0.437
Life expectancy at birth (2017)	58.9
Gender Development Index	0.904
Gender inequality index	0.552

Source: Countryeconomy.com, 'Mozambique', https://countryeconomy.com/countries/mozambique, accessed 2 November 2018

Agriculture is the main economic sector in Mozambique, with family and smallholding farming accounting for 95% of production. The sector provides work for 80% of the economically active population, although its contribution to GDP is about 25–30%. The main export products are sugar cane, cashew nuts and tobacco.[9] Other major contributors

5 Deloitte, *op. cit.*
6 Deloitte & EITI (Extractive Industries Transparency Initiative), *Relatório final*, February 2018, http://www.itie.org.mz/images/docs/7-relatorioPT.pdf, accessed 28 October 2019.
7 World Bank, *op. cit.*
8 Taju A, 'Environmental Oil and Gas Scoping Study in Mozambique: Preliminary Results', Paper presented at Simpósio de Biodiversidade e Desenvolvimento, Maputo, 26–28 September 2018.
9 *Ibid.*, p. 1.

to the GDP are services (53%), manufacturing (10%) and industry (12%) (including mining, construction, electricity, water and gas), with industry showing a steady growth.[10]

In 2016 the fishing industry's contribution to national GDP was 10%, shrimp being the ninth most important export product. Artisanal fisheries comprise 90% of production in the sector, and are the main source of income, self-employment and animal protein for coastal communities. According to the National Census of Artisanal Fisheries, about 400 000 people are directly or indirectly dependent on this activity, either through their direct involvement or through associated services such as processing, transporting, trading and boat building and repair.[11]

The tourism industry is expected to grow in the coming years. In 2017 it contributed 3.4% or $504 million to the GDP.[12] According to the World Travel and Tourism Council, Mozambique will be one of the fastest growing African destinations for leisure travel between 2016 and 2026. The sector relies heavily on the country's biodiversity wealth.

Biophysical setting

The country's climate ranges from subtropical to tropical from the south to the north, with a wet, warm and cyclone-prone season from October–March and a dry cooler season the rest of the year (average temperatures between 25˚C and 30˚C).[13] Annual precipitation ranges from 60–1 500mm. The tides are semi-diurnal – with two low and two high tides a day – and a range that varies between 30 and 480cm.[14] Mozambique has more than 100 rivers and 58 main watersheds, with the most important being the Zambezi, Rovuma, Lúrio, Limpopo, Messalo, Licungo, Save, Buzi and Maputo. The biggest natural lakes are Niassa and Chiúta (shared with Malawi and Tanzania). The southern coast also has numerous natural lagoons, such as Piti and Bilene. These lagoons are sites of high biodiversity, and some of them are also important tourism attractions.

The country has some of Africa's largest and most diverse coastal and marine biodiversity. It contains 14 different ecological regions, seven sites of outstanding biodiversity (ecologically and biologically significant marine area [EBSA] sites, Table 2),[15] a high level of endemism, and a number of endangered species of global importance.[16]

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10 *Ibid.*, p. 5.

11 *Ibid.*, p. 2.

12 Tourism Review, 'Mozambique is proud of the booming tourism sector', 22 October 2018, https://www.tourism-review.com/mozambique-is-proud-of-the-booming-tourism-sector-news10791, accessed 23 August 2019.

13 INE, *op. cit.*

14 Sete CI, Ruby J & V Dove, 'Seasonal Variation of Tides, Currents, Salinity and Temperature along the Coast of Mozambique', UNESCO-IOC (Intergovernmental Oceanographic Commission of UNESCO), 2002, https://www.oceandocs.org/bitstream/handle/1834/188/MOZAMBIQUE_%20COAST__Final.pdf?sequence=1&isAllowed=y, accessed 23 August 2019.

15 Ecologically or Biologically Significant Marine Areas, https://www.cbd.int/ebsa/, accessed 23 August 2019. EBSA sites are special areas in the marine environment that support the healthy functioning of habitats. EBSA sites are identified based on scientific information provided by states and competent intergovernmental organisations. EBSA criteria include uniqueness or rarity; special importance for life history stages of species; importance for threatened, endangered or declining species and/or habitats; vulnerability, fragility, sensitivity, or slow recovery; biological productivity; biological diversity; and naturalness.

16 WWF, *op. cit.*

The Mozambican coastline can be divided into three sections with distinct geomorphological characteristics:

- The southern coast from Ponta do Ouro to the Bazaruto Archipelago is characteristically a dune coast, dominated by sandy beaches, coastal dunes as high as 125m and brackish coastal lagoons.
- The central coast is swampy, with shallow muddy beaches, rich organic fluvial sediments and more than 24 rivers discharging in this section. It extends from the Bazaruto Archipelago to Angoche.
- The northern part of the country has a coral coast extending from Angoche to the Rovuma estuary bordering Tanzania. This section is dominated by coral reefs.

In addition to these three main regions, deep-water pelagic and seabed ecosystems contribute to the country´s exclusive economic zone.[17]

TABLE 2 EBSA SITES IN MOZAMBIQUE

EBSA site	Main features
Pemba Bay – Mtwara (also part of the Mozambique Channel EBSA)	The most species-diverse reef system in the Western Indian Ocean (WIO) region (Quirimbas Archipelago); several endangered, rare and endemic species, including turtles, whales and dugongs; a marine protected area (MPA) in the Quirimbas Archipelago
Baixo Pinda – Pebane (Primeiras and Segundas Islands)	Among the best-preserved coral reefs in the country; complex coastal lagoons and intertidal areas; unique environments in several canyons off Nacala and Mozambique Island; endemic macro-algae species *Kapaphycus alvereii* in the area
Zambezi River Delta	Part of the largest and most productive fishing area in the country; comprises the most extensive mangrove forest in the region; charismatic fauna such as whales (humpback and minke), dolphins (bottlenose, humpback, rough-toothed), sharks (Zambezi), sea turtles and birds
Save River to San Sebastian	The most viable dugong population in Eastern Africa; other species such as turtles, dolphins and marlins; seagrass beds, mangroves, rocky shores and sandy beaches abound
Morrumbene to Zavora Bay	Habitat of some of the largest populations of rays (giant manta ray and reef manta) and whale shark globally; dugongs, turtles, unique coral reefs, mangroves, seagrass beds; new species of nudibranchs (sea slugs) have been identified in the area
Incomáti River to Ponta do Ouro	Diverse species, including dugongs, dolphins, sea turtles, sharks, seahorses and birds; the second most important fishing ground in the country; some of the important habitats are protected in the Ponta do Ouro Partial Marine Reserve; connects sea turtles and whales to other EBSA site

17 Pereira MAM *et al.*, *Mozambique Marine Ecosystems Review*, Biodinâmica & CTV (Centro Terra Viva), Technical Report, December 2014, https://www.researchgate.net/publication/271510319_Mozambique_marine_ecosystems_review, accessed 23 August 2019.

EBSA site	Main features
Delagoa Shelf Edge, Canyons and Slope	Habitat of species of special interest, including coelacanths, marine mammals and sharks; unique seascape with submarine canyons and cold-water deep reefs; protected areas include Maputaland, Santa Lucia MPA and iSimangaliso Wetland Park (which forms part of a transboundary protected area with South Africa)

Source: https://chm.cbd.int/database/record?documentID=204003, accessed on 23 August 2019; https://chm.cbd.int/database/record?documentID=203999, accessed on 23 August 2019; https://chm.cbd.int/database/record?documentID=203995, accessed on 23 August 2019; https://chm.cbd.int/database/record?documentID=203993, accessed on 23 August 2019; https://chm.cbd.int/database/record?documentID=203994, accessed on 23 August 2019; https://chm.cbd.int/database/record?documentID=203991, accessed on 23 August 2019; https://chm.cbd.int/database/record?documentID=203992, accessed on 23 August 2019

Marine and coastal ecosystems suitable for ecosystem-based adaptation: Characteristics and ecological condition

There have been a number of ecosystem-based adaptation (EbA) country initiatives, mostly targeting coastal and marine ecosystems, including mangroves, coral reefs and seagrass beds. However, other systems, such as sand dunes and rocky shores, are also suitable for EbA and can be found throughout the country. These ecosystems provide a number of socioeconomic benefits to the Mozambican population. Table 3 gives a brief description of the current ecosystems for EbA in Mozambique.

TABLE 3 CRITICAL COASTAL AND MARINE ECOSYSTEMS IN MOZAMBIQUE

Ecosystem	Key services	Important sites	General condition/threats
Mangrove forests	• Sites of high biodiversity • Coastal protection[a] • Supporting fisheries • Harvesting of invertebrates • Wood provision • Carbon sequestration[b] • Nutrient cycling (water quality control) • Temperature regulation • Economic activities (aquaculture, salt pans) • Aesthetic services and tourism value	• Maputo Bay • Save River Delta • Púngue-Buzi River estuaries • Zambezi River Delta • Angoche-Moma-Nacala-Mossuril Complex • Pemba Bay • Rovuma River estuary	• Affected around major human settlements such as Maputo Bay, Beira and Quelimane by wood extraction (firewood and building materials), urban expansion, pollution, salt pans[c] • Natural threats such as cyclones, sedimentation, erosion, floods[d] • Expanding or stable in remote areas such as the Zambezi Delta and Pemba Bay[e]
Coral reefs	• Sites of biodiversity • Coastal protection and sediment stabilisation • Support fisheries • Fishing grounds • Tourism	• Inhaca Island • Bazaruto Archipelago • Pemba Bay • Quirimbas Archipelago	• Overfishing • Sedimentation • Coastal erosion • Climate change

Ecosystem	Key services	Important sites	General condition/threats
Coral reefs cont.	• Habitat, food and shelter of marine fauna • Source of nitrogen and other minerals in the marine food chain • Carbon and nitrogen fixing; nutrient cycling, bio-filtering and water quality • Climate research • Pharmaceutical industry and building materials • Social, cultural and recreational activities	• Ilhas Primeiras e Segundas • Vamize	• Coral bleaching and ocean acidification • Boat operator and tourism malpractice
Seagrass beds	• Balance coastal and marine habitats • Sediment stabilisation and coastal protection • Sites of biodiversity (shelter, breeding, nursery, habitat for marine fauna) • Primary production • Support for fisheries • Harvesting grounds • Dugong and sea turtle habitats • Carbon sequestration and storage • Water quality control	• Maputo Bay • Inhambane Bay • Mozambique Island • Nacala Bay • Quirimbas Archipelago • Mozambique Island	• Pollution • Urban expansion • Coastal development • Trampling (invertebrate collection) • Motor boat activity

a Massuanganhe E *et al.*, 'Deltaic coasts under climate-related catastrophic events – insights from the Save River Delta, Mozambique', *Ocean and Coastal Management*, 116, 2015, pp. 331–40.

b Stringer CE *et al.*, 'Carbon stocks of mangroves within the Zambezi River Delta, Mozambique', *Forest Ecology and Management*, 354, 2015, pp. 139–48.

c Bosire JO *et al.* (eds), *Mangroves of the Western Indian Ocean: Status and Management*. Zanzibar: WIOMSA (Western Indian Ocean Marine Science Association), 2016, pp. 51–73.

d Bandeira S & H Balidy, 'Limpopo estuary mangrove transformation, rehabilitation and management', in Diop S, Shren P & J Machiwa (eds), *Estuaries: A Lifeline of Ecosystem Services in the Western Indian Ocean*. New York: Springer, 2016, pp. 227–237.

e Ferreira MA *et al.*, 'Analysis of cover change (1995–2005) of Tanzania/Mozambique trans-boundary mangroves using LandSat imagery', *Aquatic Conservation*, 19, 2009, pp. 38–45; Macamo CCF *et al.*, 'Spatial dynamic and structure of human disturbed mangrove forests in contrasting coastal communities in Eastern Africa', *Wetlands*, 38, 3, 2018, pp. 509–524; Shapiro AC *et al.*, 'The mangroves of the Zambezi Delta: Increase in extent observed via satellite from 1994 to 2013', *Remote Sensing*, 7, 12, 2015, pp. 16504–18.

Sources: Paula J *et al.*, 'Mangroves of Maputo Bay', in Bandeira SO & J Paula (eds), *The Maputo Bay Ecosystem*. Zanzibar: WIOMSA, 2014; Macamo C *et al.*, 'Mozambique', in Bosire JO *et al.* (eds), *Mangroves of the Western Indian Ocean: Status and Management*. Zanzibar: WIOMSA 2016; Pereira *et al.*, 2014 *op. cit.*; Green EP (ed.), *The Seagrasses of Mozambique and Southeastern Africa*. Berkeley: University of California Press, 2003, pp. 93–100

Mangrove forests

Mangrove forests grow in the intertidal areas of protected bays, river mouths and estuaries of major rivers such as the Rovuma, Zambezi, Buzi and Limpopo, extending for 3 050km² along the coast[18] (Figure 1).

18 Bosire JO *et al.* (eds), *op. cit.*; Fatoyinbo T & M Simard, 'Height and biomass of mangroves in Africa from ICESat/GLAS and SRTM', *International Journal of Remote Sensing*, 34, 2013, pp. 668–81.

Figure 1 Mangrove distribution in Mozambique

Source: Macamo C, 'Mangroves of Mozambique: Pathways to Conservation through Sustainable Management', unpublished PhD thesis, Nelson Mandela University, 2018, p. 173

Mozambique is home to the second most extensive area of mangroves in Africa and is ranked 13th in global estimates. Nine species of mangrove that are common to East Africa occur in the country. In southern Mozambique, important formations are those of Maputo Bay, Inhambane Bay and Govuro River mouth. In central Mozambique mangroves are found from the Save Delta up to Angoche. The Zambezi Delta is home to the longest formation in the WIO region, stretching for more than 200km along the coast. In the north of the country mangroves occur in the Rovuma Estuary, Nacala Bay, Quirimbas Archipelago, Pemba Bay and Lumbo. These forests deliver important ecological and socio-economic services, with a significant impact on coast communities. They also contribute to the country's economy[19] (see Table 3).

Coral reefs

Three main types of coral reef can be found in Mozambique: fringing, barrier and platform reefs.[20] They cover an estimated area of 1 890km^2. These ecosystems are a common feature particularly on the northern coast, where they occur almost continuously from northern Mozambique up to the Primeiras and Segundas islands.[21] The central coast is in general inhospitable to coral reef growth given the muddy nature of the habitat. In the south there are a few patches of non-biogenic corals growing from the Bazaruto Archipelago down to Ponta do Ouro (see Figure 2).

Coral diversity in Mozambique is very high, with Cabo Delgado province, Bazaruto Archipelago and Maputo Bay being among the most studied sites. At least 149 species of soft and hard coral have been identified across the country, but the actual figure is probably much larger.[22] Coral reefs harbour a wide diversity of associated fauna, including molluscs, echinoderms (sea urchins, sea stars and sea cucumbers), algae and reef fish. More than 900 species belonging to 97 families of fish have been identified.

Coral reefs are the primary fishing ground for artisanal fisheries, providing an important source of animal protein to coastal communities. Much of the tourism industry in Cabo Delgado and Inhambane provinces (the two most important coastal tourism destinations in the country) is based on beach tourism and associated reef recreational diving.

Mozambique's coral reefs are impacted by human and natural factors. Overfishing and unsustainable fishing practices, collection of invertebrates, the curio trade and coral mining in northern Mozambique are among the main threats. Bad tourism practices have also led to the loss of coral cover in some areas, as in Maputo Bay and Bazaruto.[23] In other

19 WWF, 'Mangal do Delta do Zambeze avaliado em mais de 1 bilião de dólares americanos', 12 June 2017, https://www.wwf.org.mz/?2860/Mangal-do-Delta-do-Zambeze-avaliado-em-mais-de-1-bilio-de-dlares-americanos, accessed 23 August 2019.

20 Wilkinson C (ed.), *Status of Coral Reefs of the World*. Townsville: Global Coral Reef Monitoring Network, 2002, pp. 63–78.

21 McClanahan TR, Sheppard C & D Obura (eds), *Coral Reefs of the Indian Ocean: Their Ecology and Conservation*. New York: Oxford Press University, 2000, pp. 113–33.

22 Pereira MAM *et al.*, *Mozambique Marine Ecosystems Review*, Final Report submitted to Fondation Ensemble. Maputo: Biodinâmica & CTV, 2014; Bandeira SO & J Paula, *Mangroves of Maputo Bay*. Zanzibar Town: WIOMSA, 2014, pp. 187–206.

23 *Ibid*., p. 10.

places such as Vamizi Island and the Quirimbas National Park (QNP), tourism has boosted coral conservation. Some studies have reported that reefs in protected areas are in better condition than unprotected reefs. However, few areas are under protection.[24]

Figure 2 Distribution of coral reefs in Mozambique

Source: Maina J *et al.*, 'Modelling susceptibility of coral reefs to environmental stress using remote sensing data and GIS models', *Ecological Modelling*, 212, 2008, pp. 180–199

24 Motta H, Rodrigues MJ & M Schleyer, 'Coral Reef Monitoring and Management in Mozambique', 2000, https://www.oceandocs.org/bitstream/handle/1834/471/CORDIO4.pdf?sequence=1&isAllowed=y, accessed 23 August 2019.

The El Niño bleaching event of 1998 caused massive coral mortality in several locations in the WIO region. Mozambique was no exception. Surprisingly, the reefs of Cabo Delgado province (QNP and Vamizi) were not badly affected.[25] Other natural threats to coral reefs are coastal erosion, bioturbation and the impacts of climate change in general.[26]

Seagrass beds

Seagrasses are distributed all along the coast of Mozambique, covering an estimated area of 439km^2.[27] Some of the important sites of occurrence are Maputo Bay, Inhambane Bay, Inhassoro and Bazaruto islands, Mecúfi-Pemba, the Quirimbas Archipelago, and from Mozambique Island to Nacala Bay[28] (see Figure 3). Eleven species are found in Mozambique, and the Maputo Bay area has the largest global coverage of eelgrass (*Zoostera capensis*), a vulnerable species on the International Union for Conservation of Nature's Red List.[29]

Seagrass beds support a wide diversity of associated macro-algae species. Faunal diversity is dominated by echinoderms (sea stars, sea urchins), molluscs (gastropod and bivalve), crustaceans (crabs, shrimp and others), fish and other groups.[30]

Seagrass is important to the balance of coastal and marine life. In northern Mozambique it was demonstrated that seagrass fisheries sustained over 400 fishermen with an annual yield of approximately 500 tonnes, at a market value of $120,000.[31] Seagrass beds are also important sites for invertebrate collection during low spring tides. This is an activity mostly carried out by women and children, and the harvest constitutes an important source of protein and livelihood for communities.[32]

25 Hill NAO *et al.*, 'Coral and reef fish in the northern Quirimbas Archipelago, Mozambique: A first assessment', *Western Indian Ocean Journal of Marine Sciences*, 8, 2011, pp. 113–25; Samoilys MA *et al.*, 'A rapid assessment of coral reefs at Metundo Island, Cabo Delgado, northern Mozambique', August 2011, https://www.academia.edu/2676936/A_rapid_assessment_of_coral_reefs_at_Metundo_Island_Cabo_Delgado_northern_Mozambique, accessed 23 August 2019.

26 Pereira MAM *et al.*, 2018, *op. cit.*; Sheppard C, *World Seas: An Environmental Evaluation*, Volume 2. Amsterdam: Elsevier Academic Press, 2019.

27 Green EP & ED Short (eds.), *The Seagrasses of Mozambique and Southeastern Africa*. Berkeley: University of California Press, 2003, pp. 93–100.

28 Massingue AB & SO Bandeira, 'Distribution of seagrasses and common seaweeds around Nampula province (northern Mozambique) with emphasis on Mozambique Island', *Western Indian Ocean Journal of Marine Sciences*, 4, 2005, pp. 175–183; Bandeira SO & J Paula, *op. cit.*; Green EP & FT Short (eds), *World Atlas of Seagrasses*. Berkeley: University of California Press, 2003, pp. 93–100.

29 Bandeira SO & J Paula, *op. cit.*; IUCN (International Union for Conservation of Nature), 'Red List of Threatened Species', https://www.iucnredlist.org/, accessed 23 August 2019.

30 Bandeira SO & J Paula, *op. cit.*; Massingue AB & SO Bandeira, *op. cit.*; Gullström M *et al.*, 'Seagrass ecosystems in the Western Indian Ocean', 31, 2002, pp. 588–596.

31 Gell FR, 'Fish and Fisheries in the Seagrass Beds on the Quirimba Archipelago, northern Mozambique', unpublished PhD Thesis, University of York, York, 1999, p. 300.

32 Fernando S & S Bandeira, 'The sea urchin *Tripneustes gratilla*: Insight to an important food resource at Inhaca Island', in Bandeira SO & J Paula (eds), *The Maputo Bay Ecosystem*. Zanzibar: WIOMSA, 2014, pp. 335–340; Vicente EI & SO Bandeira, 'Socio-economic aspects of gastropod and bivalve harvest from seagrass beds – comparison between urban (disturbed) and rural (undisturbed) areas', in Bandeira S & J Paula (eds), 2014, *op. cit.*

Figure 3 Seagrass distribution in Mozambique and the rest of the WIO region

Source: Ocean Data Viewer, http://data.unep-wcmc.org/datasets/10, accessed 7 October 2018

Most threats to seagrass beds come from human activities, but climatic events and sedimentation have also caused losses in some areas (eg, Inhambane Bay, Save River Delta, Inhaca Island and Bairro dos Pescadores in Maputo Bay).[33] Human threats to seagrass beds include trampling and digging for invertebrates, motorboat activity, overfishing and the use of inappropriate fishing gear (beach seine net, trawling).[34]

The contribution of marine protected areas to coastal and marine ecosystem conservation

MPAs can play an important role in maintaining coastal and marine biodiversity by protecting key ecosystems such as mangroves and coral reefs. They can also generate opportunities for tourism, which brings jobs and income to local communities.[35] Mozambique has six MPAs (see Figure 4 and Table 4). The Maputo Reserve is part of the Ponta do Ouro Marine Partial Reserve with mangroves, coral reefs and seagrass beds.

According to the World Bank, the Protected Areas (PA) network in Mozambique faces a number of threats to its long-term integrity and sustainability.[36] A pressure analysis conducted by the Mozambican government in 2014 showed that uncontrolled forest fires, tree logging, land conversion and illegal fisheries place severe pressure on biodiversity and ecosystems within PAs. For instance, mangrove cutting has been observed in the QNP, Ilhas Primeiras and Segundas Environmental Protected Area and Ponta do Ouro Partial Marine Reserve.[37] Similarly, coral reefs in protected areas are not entirely safe from human threats.[38] Interestingly, the community-managed sanctuaries being created in the QNP seem to be in a better condition than those under park management. This case is discussed in greater detail below.

Without swift action, these will likely remain significant threats to conservation efforts. In addition, the revenues currently generated by activities in PAs, such as tourism and sports hunting, are not enough to finance the management of these PAs. Little of these revenues are also being re-invested in the PAs themselves. As a result, PAs are heavily dependent on donor funding, and mechanisms to contribute to financial sustainability are sorely needed.

33 Amone-Mabuto M, Bandeira SO & A da Silva, 'Long-term changes in seagrass coverage and potential links to climate-related factors: The case of Inhambane Bay, southern Mozambique', *Western Indian Ocean Journal of Marine Sciences*, 16, 2, 2017, pp. 13–25; Bandeira SO *et al.*, 'Seagrass meadows in Maputo Bay', in Bandeira SO & J Paula (eds), 2014, *op. cit.*

34 Gullström M *et al.*, *op. cit.*

35 IUCN, 'Marine Protected Areas – why do we need them?', 9 February 2010, https://www.iucn.org/content/marine-protected-areas-%E2%80%93-why-do-we-need-them, accessed 23 August 2019.

36 World Bank Group, 'Um Sistema agregado de contrabalanços de biodiversidade: um roteiro para Moçambique', 2016, http://combo-africa.org/wp-content/uploads/2017/03/MZ-BIODIVERSITY-OFFSETS-ROADMAP-PT-FINAL.pdf, accessed 30 October 2019. Na agregated system for biodiversity offsets: a roadmap for Mozambique.

37 Nicolau DK *et al.*, 'Mangrove change detection, structure and condition in a protected area in Eastern Africa: The case of Quirimbas National Park, Mozambique', *Western Indian Ocean Journal of Marine Science*, 16, 1, 2017, pp. 47–60; Pereira MAM *et al.*, *Levantamento ecológico de base sobre recifes de coral e florestas de mangal dentro ou próximo de cinco áreas de pesca de gestão comunitária*. Maputo: IDEPA, CTV & Rare, 2018.

38 *Ibid.*

Figure 4 Marine protected areas in Mozambique

Source: Macamo C, 'Mangroves of Mozambique: Pathways to Conservation through Sustainable Management', unpublished PhD thesis, Nelson Mandela University, 2018

TABLE 4 CONDITION OF AND THREATS TO CRITICAL HABITATS IN MPAs IN MOZAMBIQUE			
Total protected area	**Area (km²)**	**Ecosystems covered**	**Condition/main threats**
Ponta do Ouro Partial Marine Reserve	678	Mangroves, seagrass beds, coral reefs	Mangroves are in good condition, but logging is a potential threat in the most populated areas. Impacted by floods in 2000. Important corals around Inhaca Island and Ponta do Ouro. *Zoostera capensis* (vulnerable seagrass species) can be found in this area
Pomene National Reserve	50	Mangroves, seagrass beds, coral reefs	Mangroves impacted by floods in 2000; overall good condition; coral reefs and seagrass believed to be in good condition. Important systems are outside the reserve limits
Bazaruto Archipelago National Park	1 430	Seagrass, coral reefs, mangroves, sandy beaches	Mangroves are patchy, but in good condition. Extensive seagrass beds, impacted by the use of dragnets. In general, coral reefs are well preserved. Destructive fishing gear threatens dugongs and turtles
Marromeu National Reserve	1 500	Mangrove forests	Mangroves in good condition. Main threats: logging, freshwater diversion
Primeiras e Segundas Environmental Protected Area	10 409	Mangrove, coral reefs, seagrass beds	Mangrove logging at Angoche; corals in good condition and among the most pristine and resilient in the WIO region
Quirimbas National Park	9 130 (12.6% marine)	Coral reefs, mangroves, seagrass beds	Mangroves' regeneration potential and coral fish biomass are below the recommended sustainable level. Unsustainable fishing practices on coral reefs and seagrass beds; use of destructive gear. Corals in good condition in some areas

Sources: MITADER (Ministry of Land, Environment and Rural Development), *National Strategy and Action Plan of Biological Diversity of Mozambique (2015–2035).* Maputo: MITADER, 2015, p. 15; Pereira MAM *et al.*, *Levantamento ecológico de base sobre recifes de coral e florestas de mangal dentro ou próximo de cinco áreas de pesca de gestão comunitária*. Maputo: IDEPA, Centro Terra Viva & Rare, 2018; Samoilys MA *et al.*, 'A rapid assessment of coral reefs at Metundo Island, Cabo Delgado, northern Mozambique', August 2011, https://www.academia.edu/2676936/A_rapid_assessment_of_coral_reefs_at_Metundo_Island_Cabo_Delgado_northern_Mozambique, accessed 23 August 2019; Nicolau DK *et al.*, 'Mangrove change detection, structure and condition in a protected area in Eastern Africa: The case of Quirimbas National Park, Mozambique', *Western Indian Ocean Journal of Marine Science*, 16, 1, 2017, pp. 47–60

Some MPAs also fail to extend critical habitats into the protected area. Such is the case in the Pomene National Reserve, which does not include the eastern marine area and the northern estuary area, where a new species of fish was recently discovered.[39] Both areas harbour critical ecosystems and marine species of special interest, such as sea turtles, dugongs, dolphins, whales, rays and whale sharks.

39 MITADER, *National Administration Of Conservation Areas, Management Plano f the Pomene National Reserve: Volume I.* Maputo: MITADER, 2016.

The National Biodiversity Strategic Plan[40] (NBSAP) suggests the comprehensive categorisation of protected areas, in which 10 categories are grouped into total protection areas (three categories), and areas of conservation and sustainable use (seven categories).[41] This categorisation will allow a more robust and flexible response to the conservation of biodiversity, and the involvement of local communities in their management.

The impacts of climate change in Mozambique

Mozambique is already experiencing the impacts of climate change (see Table 5).

TABLE 5 CLIMATE CHANGE TRENDS, PREDICTIONS AND IMPACTS IN MOZAMBIQUE

Parameter	Observed trends (1960–2012)	Predictions (2046–2100)	Socio-economic and ecological impacts
Temperature	• Increase in minimum and maximum average temperature (up to 1.65˚C) • Most significant increases in central Mozambique	• Average maximum temperature will increase by 2.5˚C to 3˚C • By 2100 temperatures in central Mozambique are predicted to increase by up to 6˚C	• Expansion of diseases (eg, malaria) to new areas • Coral bleaching and mortality • Reduction of fish stocks • Loss of biodiversity • Food insecurity
Rainfall	• Change in rainfall patterns (variable and unpredictable) • Shorter rainy season • Average total precipitation unchanged • More consecutive dry days	• Increased variability and unpredictability of rainfall • Slight increase in rainfall in some areas • Increased flooding in central Mozambique and some extensions of the coastal area • Extended dry season • Reduction of the Zambezi River flow • Saltwater intrusion	• Increased frequency of floods • Loss of infrastructure • Crop production reduced • More waterborne diseases and other health impacts • Water shortages • Saltwater intrusion in agricultural areas (documented in the Umbeluzi, Incomati, Limpopo, Zambeze)
Cyclones	• Increased frequency and intensity	• Increase in intensity, possible increase in frequency as well	• Loss of human lives, loss of infrastructure, agricultural losses • Loss of mangroves, seagrass beds (documented at the Save Delta and other areas nearby) and coral reefs

40 MITADER, *National Strategy and Action Plan of Biological Diversity of Mozambique (2015–2035).* Maputo: MITADER, 2015.

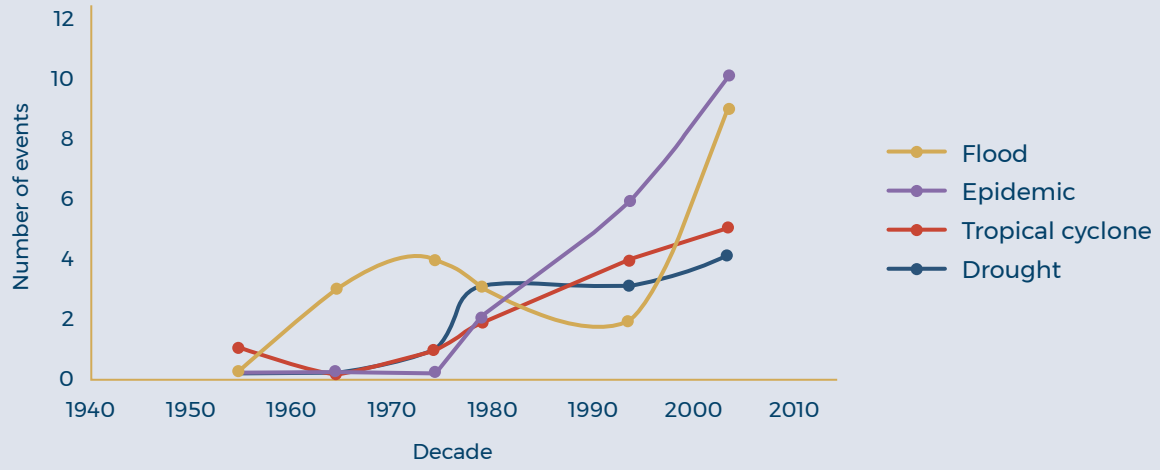
41 Total protection areas: (1) natural integral reserve; (2) national park; and (3) natural and cultural monument. Conservation and sustainable use areas: (1) special reserve; (2) environmental protection area, (3) official coutada; (4) community conservation area; (5) sanctuary; (6) wildlife farm; and (7) municipal ecologic park.

Parameter	Observed trends (1960–2012)	Predictions (2046–2100)	Socio-economic and ecological impacts
Sea-level rise	• No significant previous data available	• Projected to rise 10cm by 2030, 20–100cm by 2060 and 30–500cm by 2100, depending on the level of ice melt	• Coastal inundation • Loss of infrastructure • Saltwater intrusion

Sources: INGC (National Institute for Disaster Management), *Study on the Impact of Climate Change on Disaster Risk in Mozambique*, Synthesis Report, Second Version [translated from the Portuguese by author]. Maputo: INGC, 2009; World Bank Group, *Economics of Adaptation to Climate Change*. Washington DC: World Bank, 2010

This consists of the increased frequency and/or intensity of five major natural hazards: flooding, drought, cyclones, erosion and sea-level rise (see Figure 5).

Figure 5 Number of climate-related events in Mozambique between 1960 and 2012



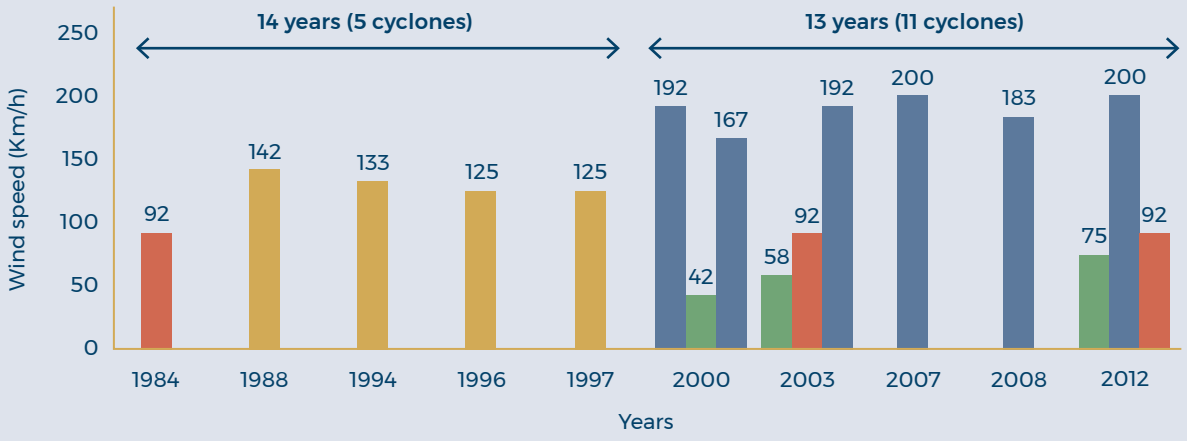
Source: Adapted from MITADER, 'Intended Nationally Determined Contribution (INDC) of Mozambique to the UN Framework Convention on Climate Change (UNFCCC)', https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Mozambique%20First/MOZ_INDC_Final_Version.pdf, accessed 25 November 2018

The level of exposure to these threats is not uniform, with the northern zone being more exposed.[42] The economic costs of such hazards accounted for more than $1.74 billion between 1980 and 2003, and are likely to increase to $2–7 billion until 2050. Between 2000 and 2015 floods affected more than 4 629 000 people, caused the death of another 1 204, destroyed infrastructure, and led to the loss of thousands of hectares of crops.

42 Cabral P *et al.*, 'Assessing Mozambique's exposure to coastal climate hazards and erosion', *International Journal of Disaster Risk Reduction*, 23, 2017, pp. 45–58.

Flooding also destroyed more than 50% of the mangrove forests at the Limpopo estuary in 2000, and local communities have since reported a decline in fishing.[43] In 2016–2017 the El Niño drought affected more than 2.1 million people, who suffered food insecurity and malnutrition and had no access to safe drinking water.[44] In 2019 the country was hit by two major cyclones only one month apart. Cyclone Idai – the second deadliest cyclone yet in the southern hemisphere – made landfall near Beira in central Mozambique on 15 March. In Mozambique 602 people were killed, thousands went missing and 1 850 000 were affected. The damages were estimated at $773 million. Cyclone Kenneth made landfall north of Pemba on 25 April. Forty-five people were killed and damages in Mozambique and Comoros were estimated at $100 million.

Figure 6 Growing frequency and intensity of cyclones hitting the Mozambican coast between 1984 and 2012



Source: MITADER, 'Intended Nationally Determined Contribution (INDC) of Mozambique to the UN Framework Convention on Climate Change (UNFCCC)', p. 26, https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Mozambique%20First/MOZ_INDC_Final_Version.pdf, accessed 25 November 2018

Without adaptation, climate changes will reduce agricultural yields by 2–4% over the next 40 years, and the sector GDP could decrease between 4.5 and 9.8%. Transport will also be significantly affected by the current and future need for investment in road infrastructure throughout the country, while on the coast up to 4 850km^2 of land could be lost, forcing the migration of 916 000 people in Zambezia, Nampula, Sofala and Maputo provinces.[45] A study by the World Bank estimates that $103 million will have to be spent every year

43 Bandeira SO & H Balidy, *op. cit.*

44 UNICEF, *Mozambique Drought Humanitarian Situation Report*, 2016, https://reliefweb.int/report/mozambique/mozambique-drought-humanitarian-situation-report-october-2016, accessed 3 December 2018.

45 Cabral P *et al.*, *op. cit.*

to address climate-related issues in coastal areas by 2040.[46] Yet these impacts can be significantly reduced through the adoption of adaptation measures. These include changes in development policies, increased agricultural research, enhanced irrigation, investment in education,[47] and preservation of natural habitats (particularly in coastal areas).[48] EbA can provide effective nature-based solutions to climate change that not only address climate change adaptation but also contribute to biodiversity and enhance local economy. It is also more cost-effective than engineered solutions.

Institutional arrangements for EbA in Mozambique

State actors

Since 2015 the management of coastal habitats falls under the Ministry of Sea, Inland Waters and Fisheries (MIMAIP). MIMAIP's responsibilities are mainly directing, coordinating, planning and executing policies, strategies and activity plans in terms of the sea, inland water and fisheries. It also supervises other institutions such as the Institute for the Development of Fisheries and Aquaculture and the National Institute for Fisheries Research (IIP).

The general management of seagrass beds and coral reefs falls under MIMAIP, while coastal dunes are under the Ministry of Land, Environment and Rural Development (MITADER). Since mangroves are forests situated in the transition zone between the land and the sea, they are managed by both. MITADER also has a say in the management of other ecosystems through its directorates or agencies, such as the National Agency for Environment Quality Control (AQUA), the National Fund for Sustainable Development (FNDS) and the National Administration of Conservation Areas (ANAC). MITADER is also the focal point for climate change. Other institutions and public entities supervised by MITADER and linked to the management of critical coastal habitats are the National Forests Directorate, the Environment National Directorate (Management of the Coastal and Marine Environment; Department of Adaptation to Climate Change), National Directorate of Planning and Resettlement (through the Department of Urban Planning), and the Directorate of Planning and Cooperation (policy planning and analysis).

In addition, the Ministries of Economy and Finance (MEF, mobilises local funds for environmental conservation and climate change adaptation; applications for climate financing (UNFCCC) are submitted through this ministry), of Agriculture, of Mineral Resources, of Public Works and Housing, of Industry and Commerce, and others, are all represented at the National Sustainable Development Council (CONDES).[49]

46 World Bank, *op. cit.*
47 *Ibid.*
48 *Ibid.*
49 CONDES has been temporarily non-operational since early 2019 for restructuring.

Both MITADER and MIMAIP are represented at the provincial level by the respective provincial directorates, but at the district level many of their functions are concentrated in the District Services of Economic Activities (Serviços Distritais de Actividades Económicas, or SDAE – management and monitoring of main economic activities) and District Services of Planning and Infrastructure (Serviços Distirais de Planeamento e Insfraestrutura, or SDPI – climate change adaptation). Communities are also involved at the local level through local management structures such as natural resource management committees (Comités de Gestão de Recursos Naturais, or CGRNs) and community fishing councils (Conselho Comunitário de Pescas, or CCPs).

Relevant EbA institutions also include the National Institute for Disaster Management (INGC) and the National Institute of Meteorology (INAM).

In 2015 the country experienced great institutional changes that affected the environmental sector in particular. Until then, all environmental matters were coordinated by the Ministry for Coordination of Environmental Affairs (MICOA), which was not an 'action' agency. In 2015 the management of coastal and marine ecosystems was delegated to MIMAIP, a new assignment for a ministry that traditionally managed mainly fisheries. While this change is expected to produce positive results, there are still a few challenges. One is the creation of a robust management structure, which for the time being is located in the IIP. The lack of technical capacity is a restraining factor in all sectors and at all levels. Moreover, while the fisheries ministry inherited the management function, infrastructure and staff remained with the environmental ministry, creating a gap in terms of MIMAIP staff's technical capacity. For example, the Centre for Sustainable Development – Coastal Zones (CDS-ZC, under MICOA) carried out several integrated coastal management activities, with considerable experience in the control and mitigation of coastal erosion, land use plans, coral reef management, mangrove restoration and others. The CDS-ZC has since been integrated into AQUA (at MITADER).

Furthermore, frequent changes within the institutional machinery of government have created uncertainties regarding specific roles and responsibilities, and have led to the loss of institutional knowledge, overlap and confusion in the interpretation of functions. For instance, the management of conservation areas (including MPAs) fell to ANAC,[50] an independent body under MITADER's administration, but a recent decree states that MPAs should be the responsibility of MIMAIP.[51] There is also a need to improve inter-institutional coordination, and to enhance the climatic conscience of non-environmental sectors. Other issues that were noted were insufficient data and information availability, weak data management, inadequate data and information dissemination and weak communication with other stakeholders.[52]

50 Resolution n° 8/2014 of 13 June 2014.

51 Presidential Decree 2/2017 of 10 July 2017.

52 Sietz D, Boshütz M & RJT Klein, 'Mainstreaming climate adaptation into development assistance: Rationale, institutional barriers and opportunities in Mozambique', *Environmental Science and Policy*, 14, 2011, pp. 493–502; COMBO (Conservation, Impact Mitigation and Biodiversity Offsets in Africa) Project, 'Gap Analysis on Law and Policy, Experience and Capacity of the Government of Mozambique Institutions for Delivery of No Net Loss (or Net Gain) of Biodiversity'. Maputo: COMBO Project, 2017.

Civil society and non-governmental organisations

Civil society and non-governmental organisations (NGOs) have been supporting the Mozambican government in implementing EbA initiatives by providing technical and financial support, advocating for national and local management practices and training; raising awareness; giving advocacy and environmental advice; influencing the design and implementation of relevant environmental policies and strategies; and implementing conservation, restoration and climate adaptation projects across the country (see Table 6).

TABLE 6 CONTRIBUTION OF NATIONAL AND INTERNATIONAL NGOs TO THE IMPLEMENTATION OF MARINE AND COASTAL EBA IN MOZAMBIQUE

NGO	Specific geographic area of activity (Project)	EbA activities carried out in the last five years
World Wildlife Foundation (WWF)	• Zambezi Delta • Primeiras e Segundas Environmental Protected Area • Quirimbas National Park (QNP) • Bazaruto Archipelago National Park (BANP)	• Assessment of mangrove carbon stocks • Mangrove ecosystem services economic valuation (basis for PES) • Promotion of marine climate change adaptions projects in QNP • Support environmental education in BANP • Support the creation of the environmental protection area of Ilhas Primeiras e Segundas • Implementation of Care-WWF Alliance focusing on conservation and livelihood
Associação Meio Ambiente (AMA, Environmental Association)	• Cabo Delgado province Our Seas Our Lives	• Mangrove replanting • Community capacity building in sustainable fisheries management and alternative livelihood • Micro financing for fisheries communities
Rare	• Maputo • Inhambane • Nampula • Cabo Delgado province	• Supporting and implementing fisheries management, including no-take zones • Capacity building in fisheries management
Centro Terra Viva (CTV)	• Mozambique	• Artisanal fisheries monitoring • Technical and scientific advising, influencing policies (board member of CONDES since July 2018) • MPA species and ecosystems monitoring
Ocean Revolution & Bitonga divers	• Inhambane	• Community-based fisheries management • Ecotourism and responsible diving • Environmental education
Agência de Desenvolvimento Local – Sofala	• Nhangau	• Mangrove restoration, alternative livelihood activities • Community awareness and capacity building (creation of the CGRN)

Wildlife Conservation Society	• Mozambique	• Development of policy and a policy framework for best practices and mechanisms for biodiversity offsets • Research and monitoring of flagship species
International Union for Conservation of Nature	• Resilient Coast Initiative Programme (Quelimane) • Dugong conservation at BANP (partnership with Endangered Wildlife Trust and Save Our Species)	• Elaboration of the 'Mangrove Restoration Strategy and Action Plan in Mozambique' • Community-based wetlands restoration in Quelimane (wetlands mapping, water pollution, assessment of filtering capacity) • Community involvement in dugong conservation; fisheries assessment in BANP
Associação Nacional de Extensão Rural	• Maputo, Nampula and Cabo Delgado	• Extractive industry advocacy • Mangrove reforestation and monitoring
Marine Megafauna Foundation	• Inhambane	• Marine species monitoring (manta ray, whales, sharks, sea turtles) • Fisheries research and management • Environmental education
All Out Africa	• Inhambane	• Marine species monitoring • Fisheries research and management • Environmental education

Sources: WWF, 'Seascape', https://www.wwf.org.mz/o_que_fazemos/seascapes/, accessed 12 October 2019; personal interview, Lara Muaves, WWF Mozambique Country Office, Maputo City, 7 September 2018; AMA, 'Partnerships and projects', https://ama-amigosdaterra.org/parcerias-e-projectos/, accessed 12 October 2019; Rare, 'Mozambique', https://rare.org/program/fish-forever-in-mozambique/, accessed 12 October 2019; CTV (Centro Terra Viva), http://www.ctv.org.mz/qsco.php, accessed 12 October 2019; personal interview, Tim Dykman, Ocean Revolution, Tofo Beach, 4 February 2019; personal Interview, António Sacramento, Bitonga Divers, Tofo Beach, 4 February 2019; personal interview, Amide Hassane, ADEL Sofala, Beira City, 8 April 2019; ADEL Sofala, http://www.adelsofala.org.mz/, accessed 24 October 2019; WCS Mozambique, https://mozambique.wcs.org/, accessed 14 October 2019; IUCN Mozambique, https://www.iucn.org/regions/eastern-and-southern-africa/our-work/resilient-coasts-initiative, accessed 14 October 2019; Associação Nacional de Extensão Rural (AENA), 'Programas', https://015ebd1f-8416-4d68-84ed-176404f9d400.filesusr.com/ugd/915171_22f084b404ec4a55b03e45f3d816383a.pdf, accessed 14 October 2019; Marine Megafauna Foundation, 'Future Ocean Guardians', https://marinemegafaunafoundation.org/blog/future-ocean-guardians/, accessed 14 October 2019; All out Africa, 'What do fishermen, robot sharks and volunteers have in common off the coast of Tofo, Mozambique and how are they coming together to save the world's biggest fish?', https://alloutafrica.com/blog/fishermen-robot-sharks-volunteers-common-off-coast-tofo-mozambique-coming-together-save-worlds-biggest-fish/, accessed 14 October 2019; Pereira MAM *et al.*, 2014, *op. cit.*

Many organisations provide backstops for government work on the ground and often work with local communities in promoting conservation and livelihood-integrated projects. The partnerships between NGOs and local organisations such as CGRNs, CCPs and other grassroots environmental associations are key in the implementation of EbA, by ensuring the long-term sustainability of initiatives (eg, through benefit-sharing mechanisms) and strengthening the capacity and effectiveness of law enforcement.[53]

53 Bandeira SO *et al.*, *Estudo de lições aprendidas e boas práticas de reabilitação de mangal: Avaliação do programa de restauração de mangal do Estuário do Limpopo (Gaza), Tsolombane em Matutuíne (Maputo), Nhangau (Sofala), Inhassunge e Macuze (Zambézia) e Mecúfi e Metuge (Cabo Delgado).* Maputo: NIRAS & MITADER, 2016.

The partnerships between NGOs and local organisations are key in the implementation of EbA, by ensuring the long-term sustainability of initiatives and strengthening the capacity and effectiveness of law enforcement

There are other important cooperation partners providing financing and/or technical support in MPAs, for example, African Parks (a for-profit organisation managing the BANP). Although NGOs provide key support for conservation, this support usually comes in programme packages, which can lead to inconsistencies or interrupt activities, with a negative impact on conservation. Innovative financing models are being explored, such as conservation trust funds. BIOFUND was created to address the long-term funding needed to sustain conservation, and its activities include the consolidation of the national system of conservation areas in Mozambique and other relevant biodiversity hotspots. Conservation trust funds ensure more consistent financing for conservation, and are currently being used to support operating costs in MPAs such as the QNP and BANP.

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While NGOs' contribution to EbA in Mozambique is significant, it is necessary to improve the communication channels among NGOs and their partners, to avoid duplication of efforts and create synergies instead (particularly among NGOs themselves). In addition, NGOs' projects are not always aligned with governments' priorities or communities' needs. As a result, these key stakeholders are not properly engaged and after the projects end the activities are discontinued. NGOs' capacity-building initiatives must also consider the intake capacity of the target group, and applicability. Securing long-term funds to support biodiversity conservation is another major challenge for most NGOs, and many of them lack long-term strategic plans. This makes it difficult to change behaviour in terms of conservation threats.

Private sector

The involvement of the private sector in environmental issues in Mozambique is still incipient. In most cases it is limited to conducting environmental impact studies, management and monitoring plans, and some social responsibility activities related to the

environment. Exceptions can be found in tourism areas, where some companies (hotels, dive operators, etc.) support local ecosystem-based initiatives, including data collection, monitoring, enforcement and conservation.[54] However, there is great potential to increase the involvement of the private sector while promoting benefits to both the environment and the sector. Simple interventions could be, for instance, making public environmental impact assessments and monitoring reports that are done before and during the implementation of exploration activities. Such reports often provide valuable baseline information on unstudied areas.

Payment for ecosystem services (PES) schemes are innovative financing mechanisms that can reduce the pressure on natural resources. The local private sector can be a valuable partner to leverage community-based activities, for example by being integrated in the value chain of certain products. The private sector may also be called upon to adopt environmentally sound practices that promote the conservation and resilience of habitats, and then reaping specific benefits according to the measures implemented. In PES schemes, the private sector can compensate local communities for their efforts to maintain or preserve critical habitats or species. Such models could be applied to mangrove management and the protection of coral reefs for tourism and fisheries. PES opportunities in marine and coastal habitats are yet to be tested and explored in Mozambique.

Considering the recent boom in natural resource exploration in the country, promising innovative financing mechanisms that can support biodiversity conservation and ecosystem-based adaptation in Mozambique are biodiversity offsets[55] schemes. In these, companies (mainly in the mining and gas sector) that generate residual impacts[56] on the environment compensate for this by implementing biodiversity offsets management plans, which ensure the long-term protection or restoration of critical habitats/species and support the government to achieve the conservation goals set out in the NBSAP. The implementation mechanism is still under development (July 2019) by MITADER, in partnership with the Wildlife Conservation Society through the COMBO Project and BIOFUND.

Academia and scientific research

Marine and coastal research in Mozambique covers different marine science disciplines, including hydrology, oceanography, coastal ecosystem ecology, biodiversity studies, and the impacts of climate change. It is mainly anchored in three academic and research institutions:

- The Eduardo Mondlane University, with the Faculty of Sciences (Department of Biological Sciences, Department of Physics and Oceanography), the Natural History

54 Pereira MAM *et al.*, 2018, *op. cit.*

55 See Forest Trends, 'The mitigation hierarchy', https://www.forest-trends.org/bbop/bbop-key-concepts/mitigation-hierarchy/, accessed 28 October 2019.

56 Biodiversity offsets are only implemented after the full implementation of the mitigation hierarchy, including avoidance, minimisation and restoration.

Museum, the Inhaca Marine Biology Research Station and the School of Marine and Coastal Sciences at Quelimane. The UniZambeze and UniLúrio universities were established more recently and part of their research also encompasses marine sciences, while the Pedagogical University has a relatively longer history in such matters, with particular emphasis on environmental education.

- The IIP, under MIMAIP, conducts scientific research on decision-making in fisheries management, conservation and optimisation of marine and coastal resource exploitation.
- The National Institute of Hydrography and Navigation conducts scientific and technical activities in Mozambique's territorial waters to ensure safe navigation and conservation of coastal and marine ecosystems.

In general, the number of scientific studies in Mozambique has grown in recent decades,[57] including on coastal and marine topics.[58] However, few studies focus on the functions of ecosystems, ecological services, or the resilience of both ecosystems and communities to climate change. In addition, the existing data is geographically restricted and not representative. Mangrove forests have been reforested across the country to increase the resilience of fisheries and enhance other ecosystem services. However, the impact of mangrove loss on fisheries has not been quantified or ranked against other threats such as overfishing or the use of destructive and illegal fishing gear. There are also questions about assessing the ecosystem's conditions and carrying capacity for a certain ecological service, and how long after restoration such ecological benefits can be collected. Other important research questions for EbA approaches include understanding the carrying capacity of an ecosystem, the best methods for ecosystem restoration and alignment with climate change impacts.

Donors and funding initiatives on EbA in Mozambique

In Mozambique climate mitigation actions are mainly financed by development partners such as the Global Environmental Facility (GEF), the Food and Agriculture Organization, Agence Française de Développement (AFD), the Foundation for Environmental Monitoring, the World Bank, Africa Climate Change Fund, the US Agency for International Development (USAID), the UK, Sweden, EU, Denmark, Ireland, Norway, the Netherlands and others.[59] Denmark was one of Mozambique's most important development impact partners between 1992 and 2016 with the ESP I and ESP II Projects (Mozambique Environment Programme Support), which focused on strengthening institutions, managing urban areas, and managing coastal and natural resources. ESP II (2011–2015) targeted climate

57 Impacto & Wildlife Conservation Society, 'Review and Gap Analysis of Data to Improve Availability and Use of Data for Planning Mitigation Activities by Industry and Development Projects', 2017, https://docplayer.net/103315158-Review-and-gap-analysis-to-improve-availability-and-use-of-data-for-planning-mitigation-activities-by-industry-and-development-projects.html, accessed 23 August 2019.

58 *Ibid*., p. 36.

59 NDC Partnership, 'Knowledge portal', http://ndcpartnership.org/country/mozambique, accessed 15 November 2018.

change adaptation and mitigation and strengthened decision-making mechanisms on environmental planning at the district level.[60] ESP II co-financed mangrove restoration initiatives in Matutuíne (Maputo province), Limpopo River estuary (Gaza province), Nhangau (Sofala province), Inhassunge and Macuze (Zambézia province) and Mecúfi and Metuge (Cabo Delgado province).[61]

Mozambique also has a number of projects approved for UN Environment funding, while a few others are under preparation,[62] for example the 'Building Resilience in the Coastal Zone through Ecosystem-based Approaches to Adaptation (EbA) in the Greater Maputo Area' Project (UN Environment, GEF) – a four-year project starting in 2019. The World Bank allocated funds for 2017–2021 ($40 million) to support activities that improve sustainability and resilience, while also financing regional programmes such as the South West Indian Ocean Fisheries Governance and Shared Growth Programme (SWIOFish, 2015–2030). SWIOFish is being implemented in the Comoros, Mozambique and Tanzania. One of the project's development objectives is to ensure the successful management of key fisheries within communities, and extending this to the national and regional level. The programme also intends to improve regional cooperation in fisheries and marine resource management. In Mozambique it is being implemented in a partnership between MIMAIP, the World Bank and conservation group Rare. A pilot project, Fisheries for Climate Resilience, is helping fishers to prepare local management plans, empowering them in exercising their rights to fishing grounds and adopting habitat-based management measures such as closing breeding areas.[63] Since 1981 the French government, through the AFD,[64] has been supporting the Mozambican government in tourism, sustainable agriculture, biodiversity conservation and climate adaptation actions, as well as the development of innovative financing (biodiversity offsets, conservation trust fund, REDD+ [Reduced Emissions from Deforestation and Forest Degradation]).

Local communities

Local communities are perhaps the most important part of the process of designing and implementing EbA, as they are the most affected. Mozambican legislation and several management tools promote the involvement of local communities, recognising their irreplaceable role in the management of ecosystems and in the enforcement of both formal regulations and those designed locally, as well as the importance of local ecological knowledge. Communities must be involved in EbA initiatives from the beginning and their concerns must be taken into account. They must be empowered and given a sense of

60 Denmark, Ministry of Foreign Affairs, Evaluation Department, 'Evaluation of Danish Engagement in Mozambique, 1992–2016', http://www.netpublikationer.dk/UM/evaluation_danish_engagement_mozambique_1992-2016/Pdf/evaluation_danish_engagement_mozambique_1992-2016.pdf, accessed 7 February 2018.

61 Bandeira SO *et al., op. cit.*

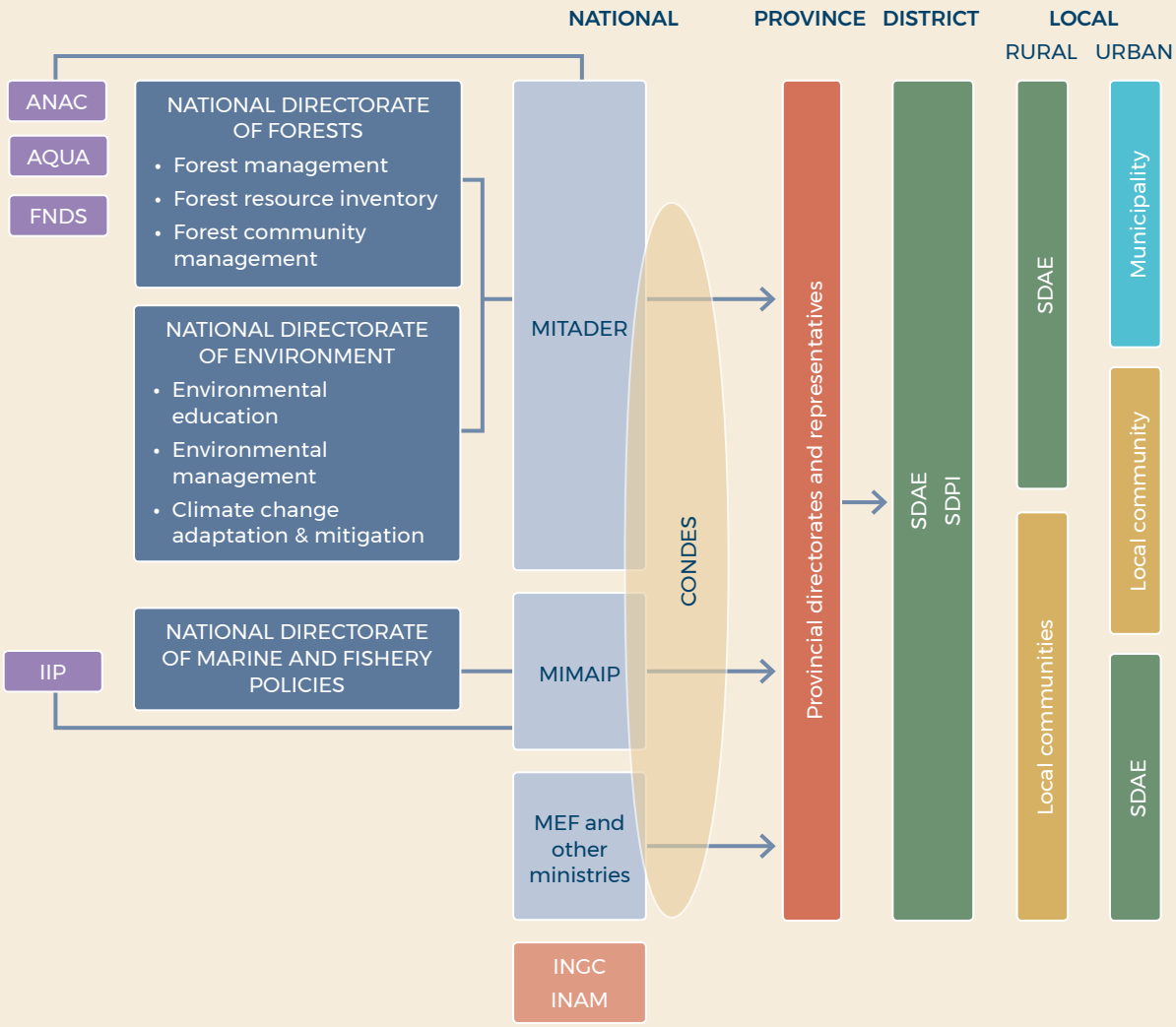
62 Personal interview, Alexandre Bartolomeu, Department of Climate Changes, MITADER, Maputo, 12 September 2018.

63 World Bank, 'Mozambique, Tanzania fishing communities help increase fish stocks', 17 September 2018, http://www.worldbank.org/en/news/feature/2018/09/17/mozambique-tanzania-fishing-communities-help-increase-fish-stocks, accessed 2 November 2018.

64 AFD (Agence Française de Développement), 'AFD and Mozambique', https://www.afd.fr/en/afd-and-mozambique, accessed 23 August 2019.

ownership of the resources and the EbA project. There are a number of initiatives across the country where community involvement has been key to the success of the project (an EbA initiative at Cabo Delgado discussed below is one such example). Neglecting to include the community or to address their concerns is a recipe for failure. However, many EbA initiatives are not broadly inclusive and therefore lack the full support of the community. Key elements to sustain community engagement in the long run include a sustainable and transparent incentives system (not necessary monetary incentives), institutional support from the government, community empowerment, inclusion and effective communication, knowledge (including the integration of local knowledge and cultural practices) and capacity building, and financial sustainability.

Figure 7 Institutional framework for EbA in Mozambique



Sources: MITADER, 'Organogram', https://www.mitader.gov.mz/sobre-nos/organograma/, accessed 17 October 2018; MIMAIP, 'Presidential Decree 17/2015', http://www.mimaip.gov.mz/wp-content/uploads/2019/06/Decreto-Presidencial_CriaAA%C2%A3o2015.pdf, accessed 7 June 2018; Macamo C & A Sitoe, 'Mangrove Governance and Management in Mozambique', Centro Terra Viva, 2016, http://www.ctv.org.mz/publicacao/RGA%20-%202016.pdf, accessed 3 February 2018; Pereira MAM *et al.*, 2018, *op. cit.*

Social and economic management instruments in the context of climate change

Mozambique's development policies aim to reduce poverty through measures relating to basic healthcare, food security and nutrition, water and sanitation, and access to clean and renewable energy, among others. The implementation of these policies, despite showing progress at various levels, has encountered challenges posed by extreme weather events. The country has sectoral instruments that are already aligned with the need to reduce vulnerability to climate change and promote low-carbon development, including the National Development Strategy (NDS), the National Plan for Poverty Reduction, the Strategic Plan for Agricultural Development, the Strategy for Basic Social Action, the Tourism Strategy, the National Water Resources Strategy, the Master Plan for Risk and Disaster Reduction, the Policy for Disaster Management, the Strategy for Gender, Environment and Climate Change, the Energy Strategy, and the Strategy for REDD+. These instruments recognise that extreme weather events are one of the greatest threats to development and performance in their respective sectors. Additionally, the Socio-Economic Plan already includes a climate change programme (which is reflected in the 2014 Social Plan and District Budget). Mitigation is beginning to be recognised as an opportunity, with references to it in the Energy Strategy (carbon tax and promoting the use of indigenous energy resources for clean and renewable energy) and REDD+.

In its Five-year Government Plan[65] (2015–2019) the government of Mozambique set out the five main priorities in terms of the country's social and economic development, in accordance with the Green Economy concept. Many of Mozambique's climate change actions are integrated in the fifth priority area ('Ensure transparent and sustainable management of mineral and natural resources'). The government also drew up an annual Socio-Economic Plan,[66] which links to the Five-year Government Plan and guides action on the implementation of social and economic activities by setting specific targets for development. In the environmental sector, strategic actions for 2018 included creating Local Committees for Disaster Risk Management; assessing the level of exploitation of marine resources; creating and increasing the capacity of CCPs; and conducting mangrove mapping and inventories in three provinces.

The Strategic Plan for District Development (SPDD) is a guiding instrument that identifies strategic actions to leverage district development. This inclusive plan is prepared with the contribution of the most relevant structures at the district level, which include the SDAE, the SDPI and the health, education, justice and interior sectors. The SPDD is supported by the Local Adaptation Plan (LAP), which delineates strategic areas and priority actions to increase the district's resilience to climate change. The LAP is developed mainly for

65 Republic of Mozambique, 'Proposed Government Five Year Program 2015-2019. Approved at the 4th Ordinary Session of the Council of Ministers' [translated from the Portuguese by author]. Maputo: Government Printers, 2015.

66 Republic Mozambique, 'Proposed Economic and Social Plan for 2018' [translated from the Portuguese by author]. Maputo: Government Printers, 2017.

local use and to support the SPDD, and is drawn up with the participation of local actors, including communities.

Policy and regulatory framework

Mozambique has a number of policies, strategies and other guiding documents that mention or promote EbA (see Table 7). From the local to the national level, some of these instruments are the LAPs, the SPDDs, the Socio-Economic Plan, the Five-Year Government Plan and the National Strategy for Development.[67] However, EbA actions are most visible at the local and district levels, since this is where more specific policies are found. While the NDS essentially focuses on the development of strategies to promote industrial growth (agriculture, fisheries, extractive industry and others), this does not include environmental sustainability or climate adaptation aspects, nor does it exploit the immense possibilities of the Blue Economy, except for a brief mention of eco-tourism. This industrial development will also need to take into consideration the country's commitment to reduce carbon emissions by 76.5 $MgtCO_{2eq}$ between 2020 and 2030.[68] This is meant to be achieved through measures related to energy production, conservation and the sustainable use of biomass energy, solid waste management, REDD+ and others. The Nationally Determined Contributions (NDCs) do not mention coastal habitats, which is a great weakness, considering the extensive mangroves and seagrass beds in Mozambique and their capacity for carbon sequestration and storage. Mozambique is also committed to mangrove restoration and conservation, which means that adding these ecosystems to NDCs would not require significant additional efforts.

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The Sea Policy and Strategy (POLMAR),[69] on the other hand, specifically promotes the Blue Economy (port development, marine transport, naval industry, fisheries, culture, tourism, sports, energy, mineral resources and hydrocarbons). It also complies with legislation on the

67 Mozambique, 'National Development Strategy, 2015–2035' [translated from the Portuguese by the author], http://extwprlegs1.fao.org/docs/pdf/moz147210.pdf, accessed 25 November 2018.

68 MITADER, 'Intended Nationally Determined Contribution (INDC) of Mozambique to the UN Framework –Convention on Climate Change (UNFCCC)', https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Mozambique%20First/MOZ_INDC_Final_Version.pdf, accessed 25 November 2018.

69 Mozambique, 'Sea Policy and Strategy' [translated from the Portuguese by the author], http://www.mozpesca.gov.mz/polmar/info/doc/POLMAR.pdf, accessed 25 November 2018.

There is also a pressing need to include the effects of climate change in environmental impact assessments for projects in the coastal zone

protection of the marine and coastal environment, and promotes the sustainable use of resources, integrated and participatory management and marine spatial planning (MSP). POLMAR is a relatively new instrument (2017), but it still tackles burning issues such as the need for marine spatial planning, which should also include the expansion of protected areas and spaces for other uses. Many areas proposed for the exploration of hydrocarbons are also biodiversity hotspots, as in the case of the Zambezi Delta, the Rovuma Basin and the Primeiras and Segundas Archipelago.[70] There is also a pressing need to include the effects of climate change in environmental impact assessments for projects in the coastal zone. The cumulative effects of activities such as dune mining can be devastating for coastal communities, as has already been seen in at least one community in northern Mozambique.[71]

TABLE 7 EBA POLICY FRAMEWORK

Instrument	Reference to EbA
National Adaptation Plan (2007)	• Identification of rehabilitation techniques for dunes and mangroves to mitigate the effects of erosion
National Strategy for Climate Change Adaptation Mitigation (2013–2025)	• Increasing the effectiveness of land use and spatial planning (protection of floodplains, coastal and other areas vulnerable to floods) • Mangrove restoration and protection of seagrasses, marine algae, coral reefs and other marine nurseries and juvenile habitats • Protection of biodiversity and forests: coral reef protection; mangrove restoration; creation of a monitoring system with climate change indicators and successful adaptation measures for management reports; creation of buffer areas around national parks and reserves (include marine parks, QNP, BANP and PR) to increase the ecological sustainability of protected areas; expansion of protected areas, creating new areas and expanding current areas • Mitigation and development of low carbon: promote reforestation to ensure carbon sequestration and increase biomass; sustainable exploitation of mangroves given their potential for carbon sequestration
NDC (2020–2030)	• Land use, land use change and forestry (REDD+)

70 Taju A, *op. cit.*

71 DW, 'Mozambique: Chinese company endangers coastal village', https://www.dw.com/pt-002/mo%C3%A7ambique-empresa-chinesa-coloca-aldeia-costeira-em-perigo/a-43173843, accessed 2 November 2018.

Climate Change Strategy for the Nairobi Convention	• Work on scientific programmes to understand determinants of coral reef resilience, mangrove and seagrass sensitivity, and responses to climate change stresses, as well as the connectivity between the systems • Enhance mangrove and seagrass carbon initiatives in the region and establish mangrove buffer zones for migration • Establishment of a seagrass task force
Sea Policy and strategy (POLMAR)	• Addresses marine and coastal pollution and unsustainable use of resources by improving enforcement and training community fiscals • Promotes civil society and community participation in the integrated management of marine and coastal areas • MSP, sustainable management and conservation of biodiversity • Development and strengthening of integrated management (river basin, land-based pollution, sedimentation, etc.) models that promote conservation and rehabilitation of biological diversity, including creating and managing MPAs, and marine spatial planning • Promote research on integrated management • Marine waste management
National REDD+ strategy and action plan	• Strengthen the network of conservation areas • Promote forest management and improve governance • Restore degraded forests

Sources: Mozambique, 'National Adaptation Program of Action', https://www.adaptation-undp.org/sites/default/files/downloads/mozambique_napa.pdf, accessed 10 November 2018; Mozambique, 'National Strategy for Climate Change Adaptation Mitigation', https://www.cgcmc.gov.mz/attachments/article/148/National%20Climate%20Change%20Strategy_lowerres.pdf; accessed 15 November 2018; Mozambique, 'Intended Nationally Determined Contribution (INDC) of Mozambique to the United Nations Framework Convention on Climate Change (UNFCCC)', https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Mozambique/1/MOZ_INDC_Final_Version.pdf, accessed 24 November 2018; Nairobi Convention, 'Climate Change Strategy for the Nairobi Convention', 2016, http://wedocs.unep.org/bitstream/handle/20.500.11822/25676/annex8_climate_strategy.pdf?sequence=1&isAllowed=y, accessed 17 November 2018; Mozambique, 'Sea Policy and Strategy', http://www.mozpesca.gov.mz/polmar/info/doc/POLMAR.pdf, accessed 25 November 2018; Mozambique, 'Sea Policy and Strategy: National REDD+ Strategy', https://www.cgcmc.gov.mz/attachments/article/232/ESTRAT%C3%89GIA%20NACIONAL%20DO%20REDD+.pdf, accessed 14 November 2018

Marine and coastal EbA in practice

During the writing of this report it became clear that there are several ongoing EbA initiatives in the country, conducted by a number of actors, including the government and different NGOs with partners. However, most of these initiatives are not well documented and the information is not easily accessible. This is a problem, for several reasons.[72] Firstly, it allows for the duplication of mistakes, as no one really knows what worked in a certain project, what did not work and why. Secondly, it does not allow project expansion by either the same implementer or another. Thirdly, it makes planning difficult, because no one knows exactly which areas or communities have benefited from what and what the outcomes were. Also, most of these projects do not have partnerships with scientific or research institutions (for ecological or social-economic studies), which is a weakness, since many of them offer valuable opportunities for applied research.

72 Nalau J *et al.*, 'Ecosystem-based adaptation: A review of the constraints', *ScienceDirect*, 89, 2018, pp. 357–364.

EbA initiatives tend to be implemented in response to local interests or impacts without a holistic perspective of the hoped-for results. Many projects are also promoted without taking in consideration the local context, socioeconomic situation, culture, technical capacity and communities' priorities. Another weakness is the fact that these initiatives often do not respond to a common national goal (eg. NBSAP).

Three of these EbA projects are described below.

Coastal Cities Adaptation Project

The USAID Coastal City Adaptation Project (CCAP) was a five-year initiative (November 2013 – November 2018) in five of the country's most vulnerable cities (Pemba, Quelimane, Nacala, Mocimboa da Praia and Ilha de Moçambique). It was aimed at increasing community resilience to climate change. The project included raising awareness, disseminating information about climate change, ensuring preparedness for and responses to natural disasters, and providing assistance in restoring ecosystems to increase resilience and promote adaptation to climate change.

In Quelimane city the CCAP restored more than 59ha of mangroves with the help of local communities, a local NGO, the School of Marine and Coastal Sciences in Quelimane and the Quelimane municipality. The community's involvement was significant, since the first stages of the project included the selection of restoration sites. The project used a combined approach of active planting (22ha in 2015–2016) and hydrological restoration (without planting) in other areas (39ha). Previous mangrove rehabilitation initiatives usually involved planting (at the Limpopo estuary a combination of planting and hydrological rehabilitation was used), but this project mobilised municipalities to take action on climate resilience. The high density of seedlings and saplings is a good indication of the success of restoration efforts in the area, but further monitoring is needed to replicate the results in the long term.

Based on successful designs in Quelimane and Pemba, the project and the country's municipal association are planning to scale up partnerships in three other coastal cities. However, financial and technical resources will have to be mobilised.

Seagrass restoration in Maputo Bay

The Eduardo Mondlane University is conducting a seagrass restoration experiment in the north-west of Maputo Bay, where 86.3% of the seagrass was lost between 1991 and 2003. The experiment includes different seagrass planting techniques and socio-economic measures to assess community awareness of both the importance of seagrass and the impacts of habitat loss. With encouraging primary results, a proposal to scale up the project to include other areas in the Maputo and Inhambane bays was submitted to UN Environment/GEF. The extended project will include detailed ecological studies (assessment of restoration techniques and intertidal fauna) and value chain analysis

of the main extracted goods. The project also aims to involve the local community in restoration activities (currently the community participates by conducting surveillance of the sites, thereby preventing vandalism). The main stakeholders identified for the project include local communities, municipalities, the IIP, NGOs (Kuwuka and Ocean Revolution), the private sector, and the Department of Biological Sciences and the Faculty of Social Sciences at Eduardo Mondlane University.[73]

Adoption of adaptive measures in the fishing communities of the Quirimbas National Park

This German-financed project was implemented by WWF-Mozambique (January 2016 – December 2018),[74] targeting marine and coastal biodiversity protection through climate-adapted resource use by local fisher communities in the QNP. The project supported the creation of more resilient livelihood sources, allowing local communities to generate higher incomes while protecting and maintaining marine resources. People would thus have greater food security and greater capacity to adapt to climate change impacts. Sustainable practices in terms of resource use should create the preconditions necessary to reduce overfishing, restore fish stocks, and protect marine habitats and coral reefs. The project supported the establishment of no-fishing zones and sustainable fishing practices that are more resilient to climate change. It also experimented with the first octopus closure in Mozambique. The closure periods were introduced in 2017 in four areas within multiple-use zones in the QNP. These areas, as well as the duration (6–7 months) of the closures, were decided by the community, which also patrols the areas in partnership with local authorities (park authorities, police, district government, CCP, CGRN, courts, etc.)

The project supported the use of innovative and selective fishing gear (which exclude small fish with little commercial and nutritional value), training and learning experiences for QNP officers and local communities, ecotourism, local business models (including technical support to the Women Octopus Association) and the creation of a credit and loan association.

The project has been successful in improving the ecological condition of the coral reefs under community management, where increases in fish and octopus size and quantity were reported. This benefited both the fishing community and tourist operators. However, there has also been conflict between the community and tourist operators, who want these areas to be closed permanently. Another source of friction is the involvement of big seafood companies, which are invited to enter the park premises once a year to buy fishing products at competitive prices. Local buyers believe this practice puts them at a disadvantage.

73 Personal Interview, Salomão Bandeira, Senior Lecturer and Researcher Department of Biological Sciences at Eduardo Mondlane University, Maputo, 3 September 2018.

74 A second phase is expected to start in 2019.

MIMAIP is discussing the possibility of legislation to allow co-management and the implementation of a provincial closure period for the octopus industry

The project has triggered several other initiatives, as nearby communities intend to implement similar management models. MIMAIP is also discussing the possibility of legislation to allow co-management and the implementation of a provincial closure period for the octopus industry.[75]

Analysis

Although it has been practiced for a relatively long time (for example, mangrove restoration in Nhangau in Sofala province, the creation of MPAs and community protection areas date back to the 1960s), it is only recently that the term EbA began to be used in adaptation approaches. From the few documented experiences, EbA has proven to be effective, not only as a response to the impacts of climate change but also to create long-term sustainable solutions with multiple benefits. However, there are still some barriers that must be overcome to allow it to expand.

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The NDE, the most important guiding document for the country's development, does not mention the need to integrate climate change into development planning, despite Mozambique's vulnerability to extreme climate events. In a country where development and poverty reduction remain pressing issues, environmental issues tend to be relegated to second place, even when development projects can have considerable ecological and social costs. Some of the development actions set out in the NDS must be aligned with the POLMAR, particularly with Pillar C (on marine and coastal environment). The POLMAR refers to the need to develop and strengthen sustainable management, expand MPAs, increase enforcement in existent MPAs and ensure marine spatial planning. In relation

75 Personal interview, Lara Muaves, WWF Mozambique Country Office, Maputo, 7 September 2018.

to the expansion of MPAs, Mozambique has considerable potential in the marine sector and has the largest marine reserve in Africa (the Ilhas Primeiras and Segundas Partial Environmentally Protected Area), but more needs to be done in terms of enforcement. NDCs also do not fully explore the potential of coastal ecosystems to meet national conservation targets. There is a brief reference to land use change and REDD+, but the contribution of mangroves and seagrass beds in particular should also be taken into account.

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In general, it is necessary to shift the vision of decision- and policymakers, so that opportunities for conservation development and sustainable resource management can be better identified and exploited. PES and biodiversity offsets are underused opportunities that can be implemented in a wide variety of sectors and, most importantly, can actively engage the private sector and investors. For example, recent reports indicate that, while artisanal fisheries are showing bigger catches, the industrial and semi-industrial shrimp fishery is registering a decrease. Possible causes of this decline are resource overexploitation, habitat degradation and the use of destructive fishing gear.[76] Potential interventions could be to call on fishing companies to compensate communities for preserving the mangroves and to adopt more sustainable practices. A similar opportunity appeared in the conservation project being implemented at the QNP, where the community could also benefit from incentives from tourism companies. Additionally, the country is still not exploring the potential from carbon stored in mangroves and seagrass beds.

Synthesis and closing remarks

Mozambique is a developing country rich in natural capital. Coastal ecosystems provide key goods and services to its population, of which climate change mitigation and adaptation are among the most important. Climate change is real; the country is geographically vulnerable and already suffering the impacts at both the social and environmental level. This will only become more pronounced in the future. Temperature increases,

76 WWF, *Mozambique: Building a Sustainable Shrimp Fishery – How EU Consumers, Corporates and Authorities Can Improve Social, Environmental and Economic Conditions in the Developing World*. Portugal: WWF Mediterranean, 2017.

unpredictable rainfall, more frequent and more intense cyclones, and sea-level rise will have devastating impacts on health, agriculture and the economy in general. Adaptation is key to mitigate these impacts.

Climate action and EbA are contemplated in several Mozambican policy documents, such as the Five-year Government Plan, the Socio-Economic Plan and district and local plans. Many key actions are related to mangrove conservation and restoration, while coral reefs and seagrass beds are usually covered in more general conservation actions. Mangroves, coral reefs and seagrass beds (in this order) are the main ecosystems considered for EbA, but more research is needed to better understand ecosystem dynamics and productivity, and how these are affected by climate change, as well as to identify the best management practices. In general, all systems in the country are threatened (including those within MPAs), even though some are protected by law. The institutional framework for EbA is broad and requires coordination among sectors, but lacks qualified staff, financial resources and inter-institutional coordination and communication. Other key actors for EbA include NGOs (including civil society and local communities), the private sector, researchers and donors. Improvements can also be made at the policy level, where development and environmental policies need to be adjusted. Some other recommendations are:

1 invest in capacity building in institutions working with natural resources, environmental management, climate change, and disaster management;

2 create inter-sectoral communication platforms to improve coordination and communication between EbA-relevant sectors;

3 identify the most climate-vulnerable areas in the country and assess the applicability of EbA approaches;

4 raise awareness of climate change and the role of ecosystems at all levels, including community level;

5 promote capacity building and empowerment at community level on climate change and EbA-related issues;

6 create a database for EbA-relevant information, such as on-going and past initiatives, actors, scientific publications, etc;

7 conduct an assessment of EbA initiatives that were carried out in the country, and document lessons learned;

8 promote applied research to improve understanding of the impact of climate change on ecosystems and their responses;

9 ensure effective and inclusive resource management, based on local knowledge and experiences;

10 invest in natural capital and involve the private sector, creating policies that benefit companies that adopt environmentally sound practices;

11 revise and adjust the EbA institutional framework according to institutional bodies, clarify roles and responsibilities among institutions, assess and build institutional capacity, and secure continued financial resources to accomplish national commitments and regional/international goals;

12 promote EbA as part of an ecosystem-integrated management approach, including ecological, economic, cultural and social dimensions;

13 promote integrative management data tools, as well as the coordination of and communication with different actors working on EbA, including researchers, research institutions, and other relevant stakeholders; and

14 explore potential partnerships and innovative models for long-term EbA financing, including diversification of funding sources.

African perspectives.
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