Investment Prioritization for Climate-Resilient Livelihoods and Ecosystems in the Coastal Zones of Tanzania

Overview

January 2016

Priorities for Tanzania's coastal zone over the next ten years (2016–2025)

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Cover: Storm clouds gathering over mainland Tanzania

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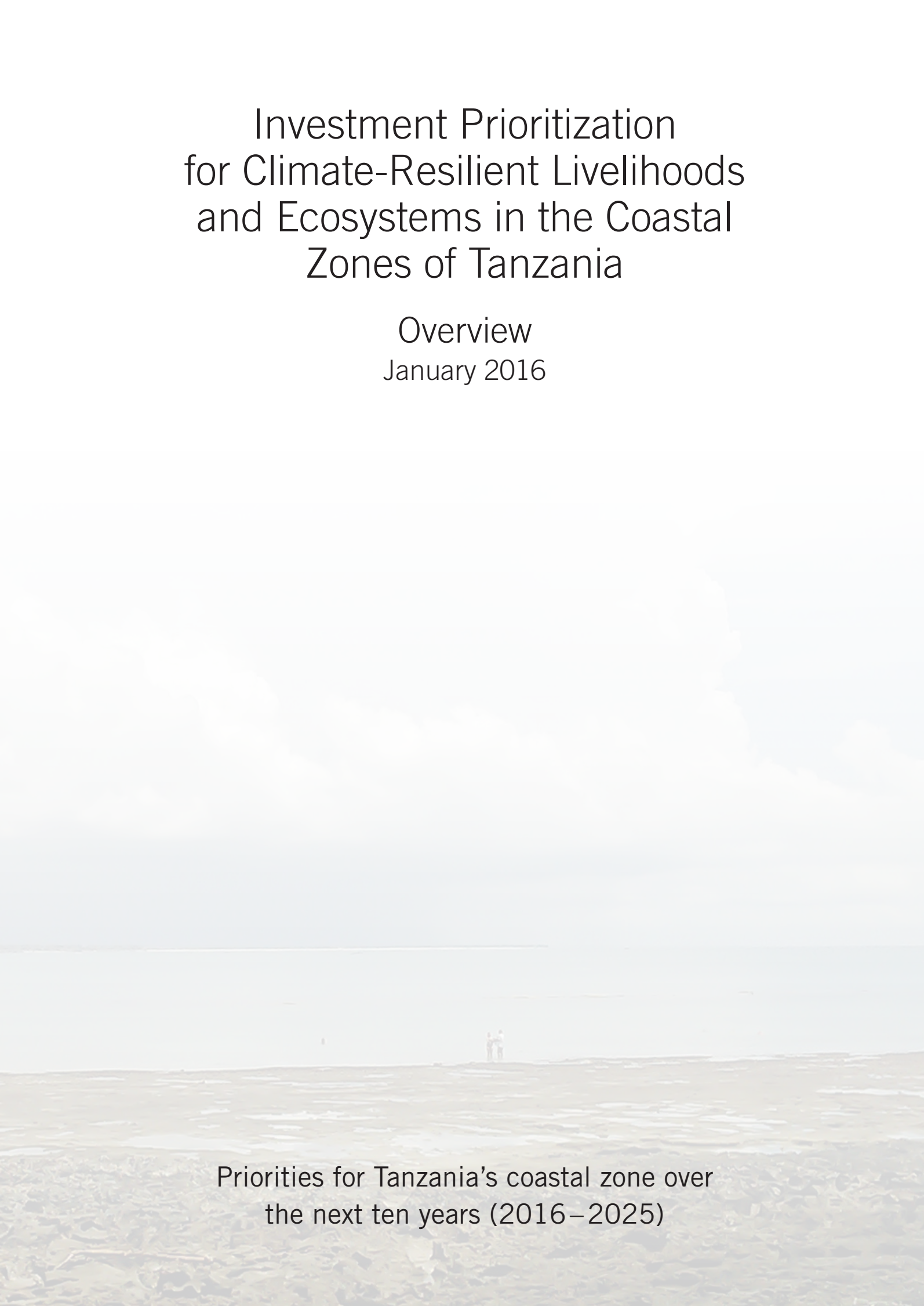
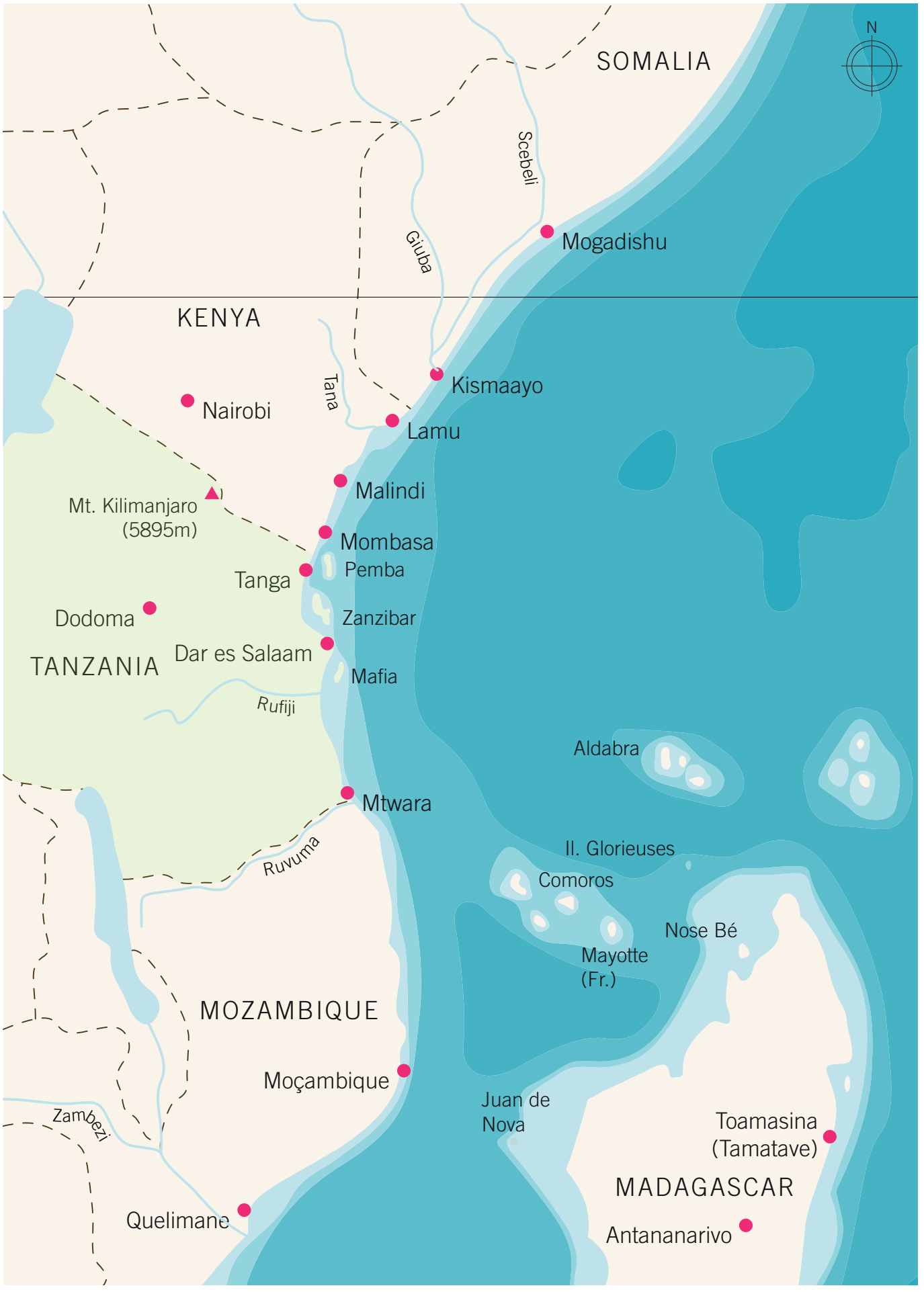


Priorities for Tanzania's coastal zone over the next ten years (2016–2025)

Tanzania and Zanzibar in the Western Indian Ocean



Contents

Acknowledgments

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Statements from Partner Institutions

Climate change is a serious challenge for everyone around the world with its great potential to increase vulnerabilities, destroy economic gains, and hinder social and economic development. Coastal communities are especially vulnerable as they live and work in informal settlements that are exposed to hazards.

Temperature and other variations as a result of climate change will have a strong impact on fisheries and aquaculture, causing a decrease in fish stocks, with significant food security consequences for certain populations. Unlike most terrestrial animals, aquatic animal species used for human consumption are poikilothermic. Changes in habitat temperatures significantly influence their metabolism, growth rate, productivity, seasonal reproduction, and susceptibility to diseases and toxins. For communities who heavily rely on fisheries, decreases in the local availability or quality of fish for food and increased livelihood instability pose serious problems.

Building flexibility and adapting to climate change is increasingly a high priority for all nations. Besides mitigation, on which efforts have largely focused in the past, coastal communities should also play a role in adaptation and that is why the World Bank in collaboration with the Ministry decided to conducted a study to assess vulnerability to climate change impacts and to identify corresponding plans and investment priorities to increase their resilience.

This report on coastal climate change adaptation and investment prioritization offers Ministry officials, and coastal communities (fishers) in developing countries like Tanzania, practical guidance on how to respond to the challenges of climate change adaptation in their areas. It provides a comprehensive overview of key climate adaptation issues that are relevant to fisheries and aquaculture sectors while also offering examples of good practices and successful experiences from elsewhere.

The body of knowledge will be of direct benefit and motivation to various stakeholders in developing climate change action plans. It will help the Ministry, coastal communities and Development Partners make more informed decisions in regard to how climate change is likely to affect community health and well-being and local infrastructures, and how vulnerable communities can harness their own economic strengths.

Dr Yohana Budeba - Permanent Secretary
Ministry of Livestock and Fisheries Development

As Island residents, we are fully dependent on the seas for our survival. Zanzibaris depend on the seas and coastal waters for fisheries, transport and trade. Dried and salted shark and other seafood prepared on Zanzibar, and mangrove poles from mainland forests, have been transported in and out of Malindi Port for centuries. Our Stone Town, now a World Heritage Site, was built from coral rocks that originated, grew and flourished in our seas. The cement used to bind the rocks that form the structure of our oldest buildings was made with lime from baked coral. Wherever we look, we see links to the seas around Zanzibar.

The last 20 years have witnessed two significant changes. Our population has doubled — and now exceeds 1.3 million inhabitants — and the trade in agricultural products, mostly cloves and other spices, has been surpassed in economic significance by the tourism industry. Zanzibar is now a global destination for coastal tourism, with visitors arriving all year round from Europe and other parts of the world to share our beaches, culture and seafood. Again, the seas are the attraction. Another recent change that contributes to the livelihoods of tens of thousands of Zanzibar's women is cultivation and export of seaweed, and to a lesser extent of pearl oysters. These grow in the sea and they constitute only some of the more obvious assets and benefits we reap from the seas that bathe our shores. The coral reefs that fringe the east coast not only provide habitat for the fish we feed on but, less noticeably, also help to protect the beaches and coastal farmland from destructive storm waves and sea level rise. The mangrove forests of Pemba Island and Chwaka, and Menai Bay on Unguja not only provide livelihoods (including sites for fish farming) but also help protect our shores from erosion.

As we benefit from development and modernization, improved education and better standards of living, the growth of our population (including the tourism industry) has challenged local governance agencies like never before. Assistance and guidance is needed in regard to wise use of the land for agriculture, and conservation of coastal forests and freshwater resources and especially with the waste and by-products that accompany progress. Pollution of the coastal waters, from sewage and solid waste, in some instances carried to the seas by our polluted streams, is damaging the marine resources on which we have thrived for so long. There is a need to urgently address these and other problems, including those relating to climate change that affect our islands, to ensure that future generations can continue to develop and benefit from these natural resources that have sustained us for so long.

We are grateful to the World Bank for supporting us with this important study, which has provided a comprehensive set of short-term actions to address the most pertinent problems of today.

Mr Mussa Jumbe - Director
Department of Fisheries Development
Ministry of Livestock and Fisheries

Statement from the World Bank

Sunrise and calm waters off Zanzibar's Stone Town

The coastal areas of mainland Tanzania and Zanzibar encompass about 15 per cent of the country's land area, and are home to approximately 25 per cent of the country's population. Approximately 10 million people depend directly on the integrity of these coastal and marine natural resources for livelihoods. As a result of a rapidly growing population, coupled with intensive economic development, the demands over these resources are growing. Signs of environmental degradation, together with a decline in biodiversity, is evidenced by decreasing yields of fish, deteriorating conditions of coral reefs, and a continuing reduction of mangroves and coastal forests.

Climate change is an additional development challenge that needs immediate attention - the costs of inaction are large. The average annual temperature in the country rose by 1°C in the period from 1960 to 2006, with models indicating future increases in the range of 1°C to 3°C by the 2050s. Precipitation is increasingly unpredictable, with studies showing a shift in the onset of the rainy season(s) and changes in rainfall quantity. Current climate variability already results in major economic costs in mainland Tanzania and in Zanzibar, with individual annual climatic events having an estimated economic cost in excess of 1 percent of GDP. These changes are already affecting the country's natural resources, such as fisheries and seaweed farming, on which many coastal livelihoods depend. Building resilience to short-term climate variability and long-term climate change is a critical development issue for Tanzania, more so within the context of the country's vision of economic transition over the coming decades.

The World Bank has been an active partner with Tanzania addressing these challenges. Through the Marine and Coastal Environment Management Project, the sustainable use of Tanzania's Exclusive Economic Zone was promoted, together with improvements in the management of territorial seas and coastal resources. The project also contributed to a comprehensive system of marine protected areas, strengthening fisheries management in the coastal and deep sea waters, and diversifying coastal livelihoods. The Government of Tanzania, with World Bank funding, launched the South West Indian Ocean Governance and Shared Growth Project (SWIOFish) in March 2015. The SWIOFish Project will further improve the management of priority marine and coastal fisheries, strengthen regional co-management, and increase their economic benefits.

This study on 'Investment Prioritization for Climate-Resilient Livelihoods and Ecosystems in the Coastal Zones of Tanzania' further develops the World Bank's commitment to support the sustainable management of mainland Tanzania's and Zanzibar's coastal and marine resources. The study identifies current and future challenges to coastal areas, and prioritizes specific actions to promote sustainable coastal livelihoods and ecosystems. These actions span a range of interventions, from coastal zone management, awareness raising and education, to specific activities in coastal pollution, protection of natural resources, and solid waste.

We hope that, through this partnership with the Ministry of Livestock and Fisheries Development in mainland Tanzania, and the Ministry of Livestock and Fisheries in Zanzibar, and with the funding support from the Nordic Development Fund, this analytical work will help the Government of Tanzania in future planning processes.

Bella Bird
Country Director for Tanzania, Burundi, Malawi and Somalia
The World Bank

Summary

The coastal areas of mainland Tanzania and Zanzibar are under pressure from population growth and economic activities. A range of problems is of increasing concern to the Government of Tanzania, including ecosystem encroachment, pollution, salinization of soils, estuaries and aquifers, degradation of resources, shoreline erosion and conflicts of interest among stakeholders that depend on the coast for their livelihood.

Climate change will further aggravate this situation, due to sea level rise, air and seawater temperature rise and more frequent extreme weather conditions.

On a request from the Government of Tanzania, the World Bank supported the undertaking of the study "Investment Prioritization for Climate-Resilient Livelihoods and Ecosystems in Coastal Zones of Tanzania". The Nordic Development Fund provided financial support for the study that started in November 2013 and was finalized in early 2015.

Aims of the Study

The aims of the study were to systematically compile and analyze secondary information to establish a comprehensive and holistic baseline description of the current situation in the coastal areas. Current threats to coastal livelihoods and ecosystems in the coming five to ten years were identified and ranked, and their sensitivity to climate change hazards assessed. Finally, measures to mitigate the most significant threats were considered and translated into actions for the attention of government, private sector and development partners. All the actions identified address major threats to coastal livelihoods and ecosystems, while at the same time offering important entrance points for climate change adaptation.

Stakeholder Participation

Government and non-government stakeholders were involved in large meetings in Zanzibar and Dar es Salaam. Initial workshops validated the baseline descriptions and identified threats, considered the analytical approach to develop and prioritize actions and established working groups to assist the study with local knowledge and expertise. Final workshops in early 2015 validated the portfolio of prioritized actions to address the most significant of these threats.

Portfolio of Actions

The study identified 63 actions to address the most important threats to the coastal livelihoods and ecosystems of mainland Tanzania. These are systemic actions (broad, cross-cutting actions such as coastal zone management, and improvements in awareness and education), plus more specific actions targeting improvements in fisheries, protecting natural resources, addressing freshwater resources and coastal pollution from sewage and solid waste. The overall indicative budget for the proposed actions on the coastal mainland of Tanzania is US$ 657.55 million.

Mainland Tanzania	Number of actions	Indicative budget (US$ million)
Systemic actions	9	18.30
Fisheries and aquaculture	9	25.90
Natural resources, beaches and heritage	5	10.85
Freshwater resources	15	161.00
Coastal pollution from sewage and solid waste	25	441.50

For Zanzibar, the study prioritized 30 actions to address the most important threats to coastal livelihoods and ecosystems. These are divided broadly into systemic actions (including coastal zone management, education and awareness), in addition to actions focusing on natural resources (notably beach erosion and tourism), as well as on issues related to freshwater resources, sewage and waste treatment, and improvements in fisheries and aquaculture. The overall indicative budget for the proposed actions on Zanzibar is US$ 270.15 million.

Zanzibar	Number of actions	Indicative budget (US$ million)
Systemic actions	7	11.05
Fisheries and aquaculture	7	18.50
Natural resources, beaches and heritage	2	10.60
Freshwater resources	4	29.20
Coastal pollution from sewage and solid waste	10	200.80

Background

Context

Adaptation to coastal impacts of climate change in Tanzania has no blueprint solution. The climate change impacts are deeply interlinked with existing anthropogenic influence. Coastal geomorphology will be affected by increased sea level and possibly stronger and more frequent storm surges. Coastal ecosystems will be affected by warmer temperatures, ocean acidification and possibly larger sediment supply from more frequent flood events in rivers feeding the sea. At the same time, coastal forms are being altered by the built environment and by deforestation of essential habitats such as mangrove forests. Coastal ecosystems are heavily influenced by over-fishing, localized high tourism pressure and by deteriorating water quality from anthropogenic diffuse and point sources.

Natural ecosystems provide valuable protection against natural hazards and climate variability, as well as many other useful services. Maintaining and restoring "nature's infrastructure" should be a core principle of good development. For coastal ecosystems, Integrated Coastal Management (ICM) is an approach to pursue such a principle, aiming to increase resilience to environmental threats, from local anthropogenic influence, and from regional and global changes. It involves the entire socio-economic and ecological interaction in coastal areas and is not restricted only to the narrow coastal zone. When climate change considerations are analyzed and main-streamed into the ICM plans, adaptation to increases in weather variability is improved.

The objective of the World Bank-funded Marine and Coastal Environmental Management Project (MACEMP), which closed in early 2013, was to improve the sustainable use of the United Republic of Tanzania's Exclusive Economic Zone, territorial seas and coastal resources. Covering both mainland Tanzania and Zanzibar, among the project's many activities were contributing toward a comprehensive system of marine protected areas, strengthening fisheries management in the coastal and deep sea waters, improving ICM, and diversifying coastal livelihoods, with a focus on encouraging local co-management of coastal resources. Direct support to coastal communities was also given by empowering these communities to request and implement sub-projects that would contribute to improved livelihoods, enhance income diversification and ensure sustainable use of the marine ecosystem. MACEMP did not specifically address climate change, but through its support of community interventions and overall enhanced natural resource management, the resilience of coastal communities was most likely increased.

Building on the results and lessons learned from MACEMP, the Government of Tanzania launched the South West Indian Ocean (SWIO) Governance and Shared Growth Project (SWIOFish) in March 2015, which aims to improve management effectiveness for priority marine and coastal fisheries. Tanzania, together with Mozambique and Comoros, is part of the first phase of SWIOFish implementation, with the opportunity for other SWIO countries to join in future, and with all SWIO countries involved in a regional component of the project. While Phase 1 of SWIOFish Tanzania does not initially include specific measures to build climate resilience in coastal communities, the Government of Tanzania is interested in incorporating priority measures for enhancing coastal adaptation through complementary financing.

In 2007, a National Adaptation Program for Action (NAPA) was developed for mainland Tanzania, while a corresponding plan was initiated in Zanzibar in 2010. Further detailed status reports of coastal resources and recommended actions were given between 2009-2011 by the National Environment Management Council (NEMC) and CARE International, and in March 2013 Tanzania launched its National Climate Change Strategy. Universities and research institutes on both the mainland and Zanzibar have conducted numerous local assessments – for example, of coastal erosion, depletion of mangroves and coral reefs, water resources and water quality, and socio-economic conditions. A significant amount of geo-spatial data exists but is generally outdated and has low resolution.

Despite the many studies that have been conducted, action plans have mostly been general in their recommended adaptation measures. Basic scientific background data – such as detailed topography, biodiversity stocks, land ownership, erosion rates, water quality, etc., as well as research studies and reports – is still scarce and tends to be scattered among many stakeholders. Initiated coastal management and climate change adaptation investments had focused on smaller 'no regret' actions, probably because of limited resources compared to the huge need and widespread stakeholder interest. These had been designed as 'seed money' support, only partially solving the threats, and have been distributed to many different sectors, institutions and geographic locations.

Based on the above, there was a need to focus coastal management and climate change adaptation measures in mainland Tanzania and Zanzibar, aimed at prioritizing interventions for the short term. The Government of Tanzania thus requested support from the World Bank for the study "Investment Prioritization for Climate-Resilient Livelihoods and Ecosystems in Coastal Zones of Tanzania".

Objective

The main objective of the study was to prioritize actions geographically and thematically to promote sustainable coastal livelihoods and ecosystems in mainland Tanzania and Zanzibar. The results comprise proposals for coastal management measures across a range of sectors, which the Government of Tanzania, NGOs, and donors can use to guide their support and investments over a five to ten year period. The proposed actions are for interventions to properly manage resources in a way that is sustainable, and include considerations about climate variability and change. Specific objectives are listed overleaf.

Specific Objectives of the Study

- Conduct a review of current coastal management and climate change adaptation studies and planning activities in mainland Tanzania and Zanzibar, including an inventory of data and information available.
- Identify, analyze and geographically locate the most important livelihood sources of Tanzania's coastal communities, and the ecosystems on which they depend.
- Assess the economic costs of climate change on coastal communities and analyze the adaptive capacity of these communities.
- Identify and geographically locate a gross list of major climate-related threats to sustain these livelihood sources and the ecosystems they depend on.
- Evaluate the gross list of threats in terms of probability of occurrence, prediction confidence, and consequences if a 'business as usual' scenario is applied.
- Identify possible adaptation measures to mitigate the threats and evaluate these measures in terms of cost-benefit efficiency and reasonability to implement.
- Analyze the characteristics of the threats and adaptation measures to prioritize them and identify the most urgent and important investments for sustainable coastal livelihoods and ecosystems.
- Identify ongoing and planned projects supporting coastal management and climate change initiatives in coastal areas, and recognize overlaps with the priorities found above.
- Identify data monitoring and research needs that should be addressed to augment the implementation and sustainability of the recommended investments.
- Establish a GIS database to document the results from the above objectives as far as possible. The database should be used as the basis for undertaking spatial analysis and thus help to prioritize adaptation investments, based mainly on the characteristics and geographic locations of the major threats to sustainable livelihood sources.
- Develop an action plan for priority investments in the short term (next 5 to 10 years) under multiple funding scenarios. The action plan should consider the prioritization results, total estimated costs compared to assumed available funds, and possible overlaps with existing initiatives. It should be specified whether the investments are targeted for mainland Tanzania or Zanzibar.

Partners

The partners for the project were the Fisheries Development Division at the Ministry for Livestock and Fisheries Development (MLFD) in Dar es Salaam and the Department of Fisheries Development at the Ministry of Livestock and Fisheries in Zanzibar.

The consultants carrying out the study were DHI from Denmark and SAMAKI Consultants from Tanzania.

Process

The study started in November 2013 with rapid and systematic efforts to identify, acquire and review recent information on the situation in the coastal areas of mainland Tanzania and Zanzibar. This allowed a preliminary overview of major threats to coastal livelihoods and ecosystems to be developed. The information gathered was organized in a coastal GIS to support further analysis and documentation.

Two inception workshops, in Dar es Salaam and Zanzibar Town in early 2014, allowed government and non-government stakeholders to consider and provide feedback on the overviews. From then, two small working groups with key specialists assisted in preparing a final prioritized list of threats for which adaptation measures and actions were defined. Finally, the analytical phase was completed with two additional stakeholder workshops in January 2015, where actions were considered and feedback provided.

Outputs of the Study

The project results have been presented in a series of reports, which together are a compilation of the information collected and processed, conclusions and recommendations reached. Altogether five volumes have been prepared, some with separate versions for mainland Tanzania and Zanzibar.

A CD-ROM with these documents is provided at the back of the printed version of this overview. Additional material on the CD-ROM includes posters displayed at the inception and completion workshops and various PowerPoint presentations given in the course of the study.

Purpose of this Overview

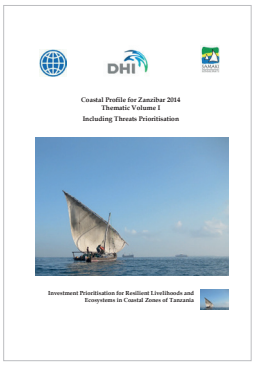
The aim of this overview is to present the background, process and methodology of the study and the findings, in an accessible format for a wider readership.

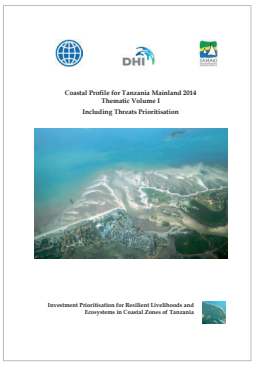
The first section presents the background of the study, an introduction to the mainland and Zanzibar coastal landscapes, describing the economic sectors that contribute towards their respective gross domestic products (GDP) and important livelihood providers to their communities, together with a summary of global warming and climate change issues that affect the coastal zone. The methodology used in the study, and the definition and format of the proposed actions precedes the bulk of the overview, a detailed description of the thematic areas investigated and actions. The latter includes an outline of threats to livelihoods and climate change hazards associated with each thematic area and a description and short list of the proposed actions identified to address the prioritized threats specific to the theme.

Output Volumes from the Study

Volume I: Coastal Themes

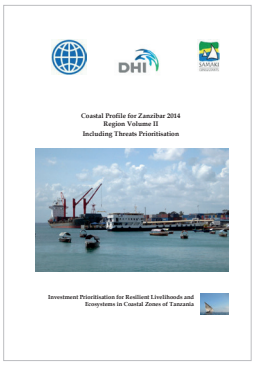
Presents an overview of the situation in the coastal zone from the perspective of various sectors and other country-wide themes, and discussing local communities, climate change and shoreline conditions. A general description of each sector covering resources and their management, discussing economic and socio-economic importance and identifying sector-associated threats to local communities.

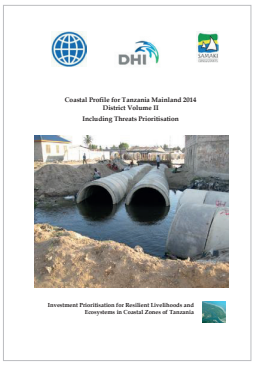




Volume II: Coastal Districts/Regions

Offers a geographical perspective on the coastal situation by district for mainland Tanzania and by region for Zanzibar. For each district or region the overview covers climate, population and the economy basis, followed by a more detailed description of the local coastal environment, encompassing physical, ecological, water, marine species, natural resources, settlements and infrastructure features. Major threats to local communities are identified and vulnerability to climate change assessed in broad terms. Finally, significant local projects and plans are described.



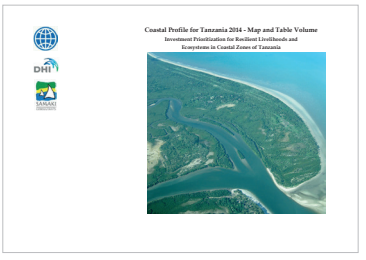


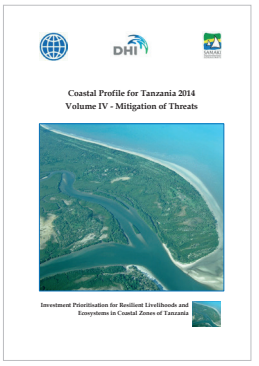
Volume III: Maps and Tables

Presents thematic and district/region maps and offers tabulated information, collected from documents consulted or generated from the GIS. This is a combined volume for mainland Tanzania and Zanzibar, built to support the coastal profiles and analyses under the study.

Volume IV: Overall Threat Mitigation

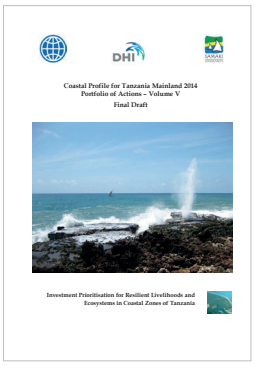
Presents action areas for the threats identified from working groups sessions established after inception stakeholder workshops. This is a combined volume for mainland Tanzania and Zanzibar.





Volume V: Portfolio of Prioritized Actions

This final volume addresses threats to local communities and ecosystems in the coastal areas of mainland Tanzania and Zanzibar. The volume presents the proposed actions for Zanzibar (30 actions, totaling US$ 270 million) and mainland Tanzania (63 actions, totaling US$ 658 million).



Mainland Tanzania

The Coastline

The coast of mainland Tanzania stretches north to south over 800 km. The coastal zone includes a narrow coastal belt varying in width from 20 to 150 km, the coastline, continental shelf islands, and offshore waters. The coastal belt is characterized by low-lying plains that rise towards the hinterland to an elevation of about 200 m at the border with the inland plateau.

The Islands

The major islands of Zanzibar (Pemba and Unguja) and Mafia, are all within 100 km from the mainland. The continental shelf, covering an area estimated to range between 17,500 and 17,900 km^2, is generally narrow with the narrowest point being 2 km and the widest 80 km. Mafia and Unguja are situated on the continental shelf, probably part of a Pleistocene inshore coral reef system which is now separated from the mainland by the relatively shallow Mafia Channel and Zanzibar Channel, respectively.

The coast also contains numerous small islands – some raised fossil coral platforms or sandbanks. The larger and inhabited ones include Songo Songo, Fanjove Kilwa Kisiwani and Songo Mnara (off Kilwa); with smaller and drier islands being Yambe and Karange (off Tanga), and Mbudya and Bongoyo (off Dar es Salaam). All support some terrestrial vegetation and fauna but no freshwater on the latter prevents permanent human settlement. Some islands are critically important for the nesting activities of turtles and birds, such as Latham Island, which is also associated with important fishing grounds.

River estuary and mangroves in Lindi

Main Coastal Habitats

Mangrove forest – Extensive mangrove forests totaling 100 km^2 are found in the tidal inlets, estuaries and creeks along the mainland coast. The largest block, extending over 50 km^2, is the Rufiji Delta. Mangrove forests are critical to fish and crustaceans, which use them as breeding and nursery grounds.

Seagrass beds – Over 300 species of seaweed and 12 species of seagrasses are found in Tanzania, playing an important ecological role as habitat for microorganisms and fish.

Coral reefs – More than two-thirds of the coastline supports fringing coral reefs (particularly around Mafia, Mkinga, Tanga, Kilwa and Mtwara) totaling 3,580 km^2 in area, interrupted only near river estuaries. From Mafia, Kilwa and Mtwara reefs, over 200 species of hard corals have been recorded, comparable to the highest for the W Indian Ocean region. Due to the narrowness of the continental shelf, reefs are generally close to shore, within a distance of 1-5 km.

The coastline of Tanzania

Coastal Communities: Mainland Tanzania

Administratively, the mainland Tanzanian coastal area comprises five regions – from north to south, these are Tanga, Dar es Salaam, Pwani, Lindi and Mtwara. The five regions have altogether 16 coastal districts. The important port city of Dar es Salaam, also the nation's commercial hub and center of the administrative and service sector, dominates the coastal zone in terms of population size and economic activities. It comprises three municipalities: Kinondoni, Ilala and Temeke, each of which has a densely populated urban sector and peri-urban and rural sectors. Other urban coastal centers include Tanga, Pangani, Bagamoyo, Kilwa Masoko, Lindi and Mtwara.

The rest of the coastal settlements include a few peri-urban concentrations (Kilwa Kivinje, Kilindoni) and a plethora of rural villages, some of which are relatively isolated, and significantly less endowed in terms of access to quality infrastructure, such as roads, electricity, and other services. Poor infrastructure has affected the socio-economic situation of the local people, constraining their ability to take advantage of many economic opportunities, and to be competitive in the fisheries-related sector.

Population Dynamics

According to the 2012 National Census, the population of mainland Tanzania is approximately 44 million. Slightly over half of the population are female. The average national population density was estimated at 49 persons/km^2. The Dar es Salaam region had about 4.36 million people in 2012, which is 10 per cent of the total mainland population and a population density of 3,133/km^2, the highest for the whole country.

The coastal regions encompass about 15 per cent of the country's land area, and are home to approximately 25 per cent of the country's population (about 8 million people). The population density for mainland coastal Tanzania has been relatively stable for the past 10 years. However, the rapid rate of population growth, especially the coastal urban areas, poses a significant and growing threat to coastal livelihoods and ecosystems.

Urban Centers

The principle urban centers of the coastal districts are the district headquarters, usually the administrative center of the district. With few exceptions, they have witnessed increased immigration from the surrounding rural areas.

Unprecedented urbanization is occurring in Dar es Salaam, at a pace that lacks commensurate urban spatial planning systems and basic service availability. The growth of Dar es Salaam's population density has become characterized by the extensive urban sprawl of the city of Dar es Salaam, largely into unplanned slums and squatter settlements, and partly into planned residential areas and mini-satellite towns (Bunju, Mbagala, Kigamboni). Changes in land-use patterns due to urbanization along the coastal area have also led to the decline in traditional coastal fishing settlements, as has been the case with Kunduchi and Ununio settlements (Kinondoni District, Dar es Salaam region). Similar changes, at smaller scales, are taking place in other coastal urban centers, such as Bagamoyo, Mtwara and Tanga.

Livelihoods

The majority of coastal households along the mainland Tanzania coast depend on a diverse pattern that includes small-scale fisheries, farming, forestry, mining (sand, rock, lime and salt production), small-scale trade, and to some extent, tourist services.

Fisheries – At the community level, small-scale/artisanal fisheries are an important part of the livelihoods of many households. In addition to 36,321 marine fishers, an estimate from 2009 shows that 100,000 coastal habitants at least partly rely on their economic livelihood from the sector. In coastal households, fish accounts for almost 60 per cent of the animal protein consumed. Coastal fisheries are also a source of recreation, tourism and foreign earnings.

Tourism – Beach hotels and the few recreational activities offer a small amount of employment to local people, but in general, coastal tourism is yet to become a reliable source of income or livelihoods for the local populations.

Agriculture – Small-scale subsistence farming is an important source of livelihood for many rural coastal households, in some providing the bulk of household food security. For example, 90 per cent of households in Coast Region and Mtwara Region depend on small-scale agriculture. Major crops include rice, cassava, cashew nuts, legumes and greens. Small-scale animal husbandry is also a livelihood source but to a lesser intensity than arable or fruit farming.

Forestry – Coastal forests, including mangroves, support livelihoods directly and generate revenue for local governments. Forest goods for sale are obtained from forests on public lands and from special district forest reserves. Rufiji District has the highest reported collections compared to other districts, attributed to its proximity to Dar es Salaam where high demand exists for wood products including charcoal.

Coastal mining – Coastal mining includes sand and gravel excavation, salt production and coral mining. Salt production is benign, other than minor mangrove clearance for evaporation ponds in some places. Most of the true mining/excavation activities are unregulated, conducted along beaches, coastal streams or rivers, often leading to localized, accelerated coastal erosion with environmental degradation and threat to coastline stability and properties.

Industry and trade – The industrial activity and the ports constitute a significant sector in the national economy. The coastal ports of Dar es Salaam, Tanga and Mtwara handle the nation's cargo and also transit goods to some land-locked countries of eastern and south-central Africa. Dar es Salaam provides employment for many of its urban residents. Other major centers, like Tanga, Mtwara and Lindi urban area, are dependent on fisheries and related trade, small-scale-farming and businesses.

The islands of Zanzibar

The Coastline

Zanzibar is comprised of the two main islands of Unguja and Pemba occupying a total area of 2,650 km², plus numerous small islands and islets. The combined coast extends over 370 km in length, from latitude 4° 50' S at the northernmost tip of Pemba Island close to the Kenya border to latitude 6° 53' S at Latham Island. Unguja Island (approximately 95 km long), and Pemba Island (about 65 km long), are located within 100 km of the mainland. The deep Pemba Channel (800 m) separates Pemba from the mainland while a relatively shallow Zanzibar Channel (less than 65 km) separates Unguja.

Unguja is a continental shelf island, while Pemba is an oceanic island surrounded by deep waters. There are also twenty small, inshore islands, some of which are uninhabited, plus one tiny oceanic island, Latham Island (or Fungu Mubarak) under the jurisdiction of Zanzibar.

Rivers and Hydrology

The few rivers of Pemba, each less than 10 km in length, to a certain extent influence the coastal environment through creation of productive brackish water environments in estuaries, tidal flats and nourishment of mangroves and seagrass beds. On Unguja there are eight short, mainly seasonal streams that flow to the west and northwest in the northern part of Unguja Urban and West region, between Mahonda and the Stone Town.

The islands of Zanzibar

Main Coastal Habitats

Mangrove forest - Mangrove ecosystems occur mostly in estuaries and protected bays such as in the Makoba and Chwaka, and are found along the entire coast of Pemba and Zanzibar, covering an area of 12,146 and 6,073 ha, respectively. Zanzibar's mangrove forests comprise up to ten tree species, and provide permanent or temporary habitats for many aquatic organisms that move in and out as the tide rises and falls, including for feeding and nursery grounds for many economically valuable species.

Seagrass beds - Over 300 species of seaweed and 12 species of seagrasses exist on Zanzibar, playing an important role as habitat for microorganisms and fish. On Unguja's east coast, Chwaka Bay is fed by three main freshwater creeks, fringed by mangrove forest, extending onto vast areas of seagrass and calcareous *Halimeda* algal beds. Chwaka Bay studies have shown the importance of the area as nursery grounds as well as feeding areas for various marine life forms, particularly fish and crustacean.

Corals reefs - About two thirds of the combined coastline of both major islands support fringing coral reefs, often close to the shoreline. Creek outlets interrupt the fringing reefs, such as at Chwaka Bay and Fumba Bay on Unguja Island, and Chake Chake Bay and Adamson Bay on Pemba Island. All these sites, and numerous smaller islands and sand banks that fringe the coasts of Pemba and Unguja, support coral reefs, contributing to varied and rich assemblage of corals and associated reef communities. Notable examples include Chumbe Island Coral Park (with 200 species of hard corals and 420 species of fish reported), Bawe and Changuu islands, as well as island sites around the north and northwest of Unguja (Kichwani, N Mnemba and Kendawi Reef) and Misali Island off Pemba.

Coastal Communities: Zanzibar

Zanzibar has five administrative regions: two on Pemba and three on Unguja. These are divided into districts, with three on Pemba and six on Unguja. The most important city is Zanzibar's Stone Town, on Unguja, the administrative capital and major trading and historic center on the islands.

Population Dynamics

The rate of population growth in Zanzibar is high and an issue of concern. The average annual population growth rate almost doubled between 1967 and 2002, increasing from 1.8 per cent in 1967 to 3.1 per cent in 2002 (with Unguja's growth rate reaching 3.6 per cent). By 2012, the population of Zanzibar grew to over 1.3 million, with 896,721 people living on Unguja and 406,848 on Pemba.

Zanzibar has seen a rise in population density from around 400 persons/km² in 2002 to around 530 persons/km² in 2012. Population growth and increased densities in the islands' urban centers put pressure on the provision of service facilities, including clean water supply and sewerage disposal, which affect the marine environment.

Urban Centers

Other than Stone Town, the remaining major towns are Chake Chake, Mkoani and Wesha on Pemba, and Mkokotoni, Makunduchi and Nungwi on Unguja. There is fast population growth in some of these urban centers. For example, Stone Town, with its suburbs, is growing at a rate of between 7 and 11 per cent per annum. The non-urban part of the population, about 60 per cent of the total, live in villages and settlements located within the boundaries of the coastal area or very close to it.

Livelihoods

The livelihoods of many of Zanzibar's people are reliant on fisheries, subsistence farming, seaweed farming, mangrove cutting, harvesting of coastal thicket for fuel, livestock keeping and petty trade. Increasingly, salaried (or formal) employment is become important, particularly associated with the tourism sector.

Fisheries – The artisanal and small-scale fishery sector in Zanzibar supported an estimated 34,571 people in 2010. Due to year-to-year variations and seasons, the total number of full-time fishers on the islands is likely to be between 28,000 and 37,000 individuals. The number of those indirectly involved (fish traders and processors, and boat builders and fishing gear makers) could be five to ten times the number of fishers.

Commercial seaweed farming began in 1989 and has now become a significant contributor to the economy of the islands. It is the second most important foreign money earner and contributes about 90 per cent of Zanzibar's marine exports. Seaweed is now farmed in over 56 villages, employing 21,969 people; it is also estimated that the industry renders benefits to about 150,000 individuals. The increasing importance of seaweed farming is reflected in its production figures, starting from barely 500 tonnes per annum of dry seaweed in 1989 to over 10,000 tonnes by 2009.

Other emerging mariculture activities are finfish culture, culture of pearls, oysters and crab fattening.

Tourism – Tourism is now the most significant local employer, particularly for Unguja Island, but also for Pemba. The growth in tourism since the early 1990s has overtaken the traditional, subsistence based livelihood activities such as agriculture and the contribution of the tourism to GDP has been estimated to between 47 to 51 per cent, representing 60 per cent of all foreign investment.

The tourism sector currently employs about 35,000–45,000 people in direct and indirect employment and estimates suggest some 200,000 people on Zanzibar benefit from tourism. Indications are that the contribution from the sector will continue to increase as the industry grows. Tourism is also linked to other sectors such as industry and transportation.

Agriculture – Agriculture occupies about 60 per cent of the population, mostly through informal arrangements and at subsistence level. Nevertheless, it is a dependable and vital source of livelihoods and has traditionally been the largest sector in terms of revenues, but is now second to tourism, contributing 27 to 30 per cent of GDP.

View from Stone Town roof-top

Clove plantation has been a significant economic activity, especially in Pemba, and the islands produced 7 per cent of the world's cloves in 2006. Crop cultivation is predominantly rain-fed and thus dependent on weather. The main crops grown in Zanzibar are cassava and rice (by production and value), though bananas and sweet potatoes are also important, with small amounts of yams, legumes, fruits and vegetables. The livestock sector is not well developed, due to several constraints including shortage of grazing areas.

Forestry – Coastal thickets are harvested for construction poles, fuel-wood, lime making and for charcoal making. Coastal thickets are currently used as a source of energy to provide nearly 90 per cent of the requirement on Zanzibar. Mangrove forests constitute the main source of high-quality construction poles in Unguja, also providing villagers with fuel-wood and other wood products for many purposes, and thus represent a diverse source of local incomes. Bee-keeping, harvesting for traditional medicine, tannin and salt production and non-conventional fishery (crabs, cockles and prawns) are also associated with mangrove forests.

Coastal mining and salt production – Salt-production is more established on Pemba, where it involves clearing of mangroves for construction of evaporation pans. By 1992, more than 15 locations had been cleared for saltpans.

Stone and sand collection is a lucrative income earner, boosted by the growing construction and tourism sectors. However, uncontrolled stone collection and quarrying is threatening the environment. Sand collection along the beaches has also been reported in various areas where there is tourist development, in some locations exacerbating beach erosion.

Industry and trade – The industrial sector remains a minor contributor to employment and GDP on Zanzibar. The production of sugar, textiles and small industries (carvings and paintings) have fluctuated over recent years and are presently minor operations on the islands of Zanzibar.

Climate and Climate Change

Local Climate

Coastal Tanzania, including Zanzibar, is characterized by a tropical hot and humid climate driven by two distinct seasonal monsoon winds. For more than 50 years, air temperature typically has ranged between lows of 22°C and highs of 33°C. The Northeast Monsoon from November to March is the hottest period. This traditionally has been considered the mild season with calmer seas and gentle winds typically between 1 and 8 m/second. In contrast, the Southeast Monsoon from May to October is typically characterized by stronger winds, between 5 and 15 m/second and rougher seas. Tides are semi-diurnal, with spring tides of up to 4 m range and mean spring tides of 3.2 m range.

During the inter-monsoon period, the winds are variable but calm. The rainy seasons coincide with the end of the Southeast Monsoon (March-May), and a shorter rainy season during November-December for northern shorelines. Southern Tanzania has a unimodal rainfall pattern which lacks the short rains. Annual rainfall in coastal Tanzania averages 800-1,000 mm/year with the highest levels recorded in Pemba (1,500 mm/year) and lowest in Mtwara (over 500 mm/year).

Changes to global climate resulting from anthropogenic influences will affect the climate of Tanzania in varying ways, many of which are still being investigated.

Global Warming and Climate Change

Global warming is caused by the increase in emissions of greenhouse gases (GHGs), principally carbon dioxide (CO_2), methane, nitrous oxide and ozone, and water vapor. The concentration of these gases in the atmosphere has increased since 1750, due to human activities, now being higher than in at least the last 800,000 years. The principal effect of this increased GHG emission on the Earth is an overall increase in heat trapped within the atmosphere and oceans (the greenhouse effect), resulting in rising temperatures.

Developments in climate research are regularly reviewed and assessed by the Intergovernmental Panel on Climate Change (IPCC). The most recent is the Fifth Assessment Report (or AR5), finalized in November 2014. A major component of understanding future scenarios of the climate relies on climate modeling of the Earth. As the IPCC explains, climate models are extremely sophisticated computer programs that encapsulate our understanding of the climate system and simulate, with as much fidelity as currently feasible, the complex interactions between the atmosphere, ocean, land surface, snow and ice, the global ecosystem and a variety of chemical and biological processes.

Climate models are based mainly on verifiable physical principles and are able to reproduce many important aspects of past response to external forcing (such as solar or volcanic influences). They thus provide a scientifically sound preview of the climate response to different scenarios, which include anthropogenic forcing (such as increased GHG emissions). The models used range from simple energy balance models to complex Earth System Models (ESMs) requiring sophisticated computing technology. Atmosphere-ocean general circulation models are also used to provide global overviews.

Offshore storm approaching Zanzibar's east coast

More important in Tanzania's context are regional climate models, at smaller scales, that can be produced by downscaling global models. Despite shortcomings due to comparison between studies, added value has been demonstrated from the higher resolution of stationary features like coastlines, and from improved representation of small-scale processes like convective precipitation.

Outlook for Coastal Tanzania and Zanzibar

The understanding of likely future changes in climate is based on historic trends, in air and seawater temperature for example, as well as a range of climate models. It should be remembered that little is known about feedbacks, additive, antagonistic and synergistic effects, and the thresholds above which trends may change.

A range of global and regional models have been used to inform climate change scenarios for this assessment. These include: (i) regional models generated by downscaling the Coupled Model Intercomparison Project Phase 5 (CMIP5) global model (based on contributions from 20 modeling groups from around the world); (ii) ocean-wide models from CMIP5 and Atmosphere General Circulation Models (AGCMs); (iii) IPCC AR4 global climate model simulations combined with Coupled Atmosphere–Ocean General Circulation Models (AOGCMs) and ice-sheet models, on global scales; and Dynamic Interactive Vulnerability Assessment (DIVA) modeling for local-scale analysis; and, (iv) ocean general-circulation models.

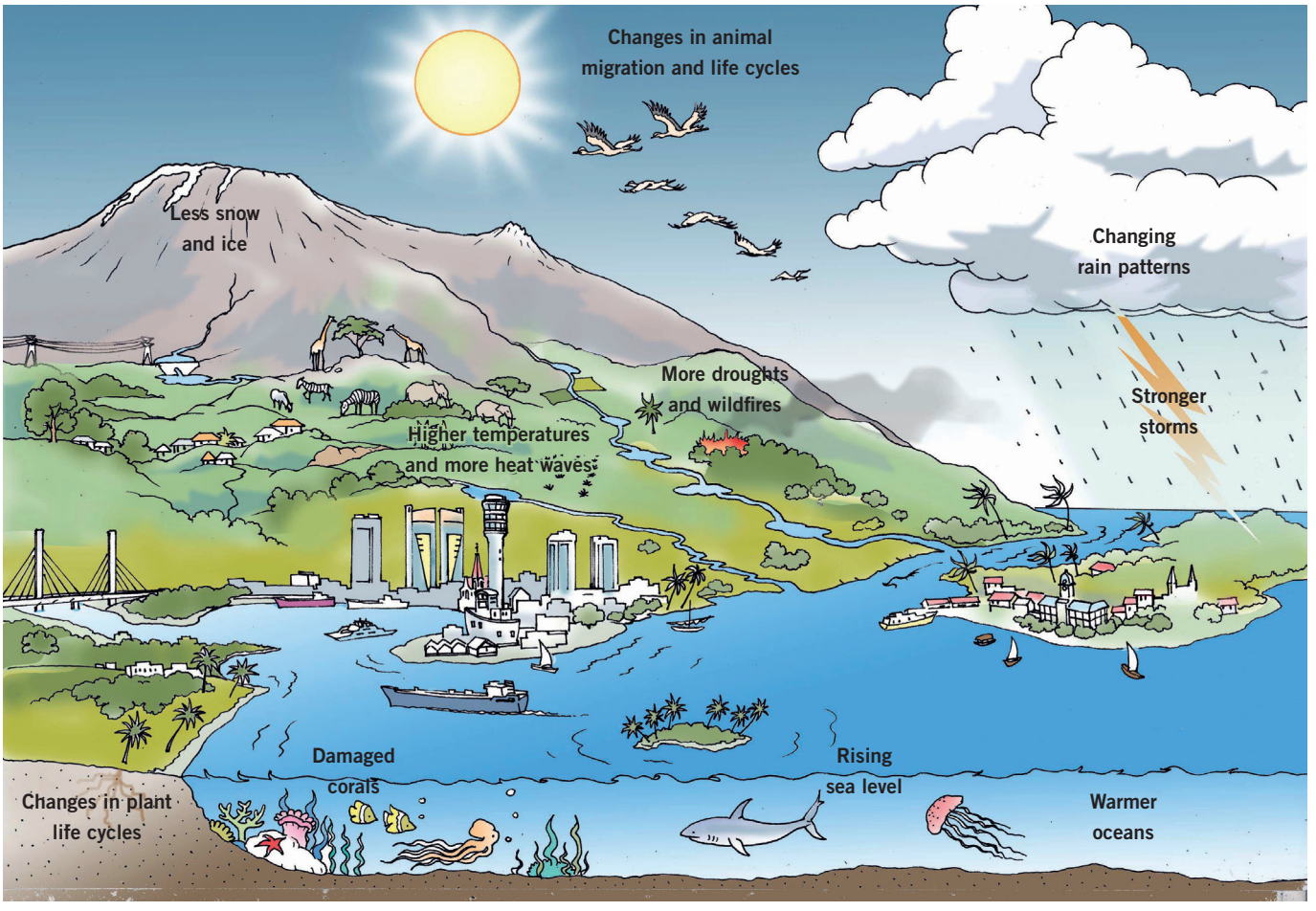
Current knowledge and the finding from the different models described above, allows us to state the following:

- Temperatures are likely to increase in air and water. The average yearly temperatures at the end of the century are likely to be 2 to 2.5°C higher than today. Air temperature in coastal Tanzania is increasing and there are indications the increase is accelerating.
- SST in the western tropical Indian Ocean has been rising for more than a century. In the decade of 1991–2000, the average SST in the Indian Ocean was 0.6°C above the 1900–1960 base and continued to warm thereafter. Temperature increases of such magnitudes will have drastic effects on ecosystems and very likely eliminate certain species (some reef-building corals being especially vulnerable).

- Future precipitation/dry season scenarios and patterns are not conclusive but in the short term might include drier and longer non-rainy seasons and wetter, shorter rainy seasons. Increasing air temperature, sea surface temperature and solar radiation are likely to affect the patterns and intensity of precipitation. However, the relatively short rainfall data series from Tanzania (50 years) precludes detection of any clear trends.
- Global sea level rise due to thermal expansion and melting of glaciers and ice caps will continue for centuries, irrespective of mitigation measures. Additional factors influence sea levels locally. Data on changing sea levels that is available from the region shows both rising and falling trends, though there is widespread agreement for a continued rise.
- Acidification of tropical Indian Ocean waters is not likely to seriously affect the conditions in Tanzania until towards the end of the century. Important and much-needed scientific research on this is potentially highly significant climate change impact is on-going.
- Indication of future wind speeds and intensity and frequency of strong winds/hurricanes suggest increasing trends and problems related to incidences of extreme winds that will affect coastal areas, with significant impacts on coastal infrastructure, agriculture biodiversity and ground water. A slight increase in wind speeds and intensity of storm events is noticed for parts of coastal Tanzania. Increasing air and sea surface temperatures should strengthen winds in the future.

Based on the projections described above and expert judgment, the following five are the most likely hazards considered throughout the study with respect to the thematic and district coastal profiles for mainland Tanzania and Zanzibar, focused primarily on the immediate or short term (5 to 10 years), as well as future possible hazards of major significance:

- Changes in weather patterns influencing the timing and amount of precipitation, and water availability.
- Extreme weather events including excessive precipitation, storms and droughts.
- Sea level rise caused by thermal expansion and melting glaciers and ice caps, but also influenced by other factors regionally and locally.
- Seawater and air temperature rise that can dramatically influence ecosystems and influence weather systems.
- Ocean acidification from increasing levels of dissolved carbon dioxide shifting the pH towards lower values that threaten shell-forming and other calcareous organisms. While it is recognized that this hazard has impacts likely over a longer timeframe (decades), it was included because of the critical value of coral reefs and other calcareous marine resources to Tanzania, mindful that scientific uncertainties may subsequently shorten the projected impact scenario.



Climate change hazards most likely to affect the coasts of mainland Tanzania and Zanzibar

Methodology of the Study

Sequential Approach

A sequential approach was adopted to formulate actions to promote sustainable coastal livelihoods and ecosystems. The portfolio of actions provides a holistic overview of the most important interventions required in the short term to mitigate the current development problems in coastal areas. Each of these interventions requires further appraisals before decisions are made to develop full projects.

Structured Update of Coastal Profile

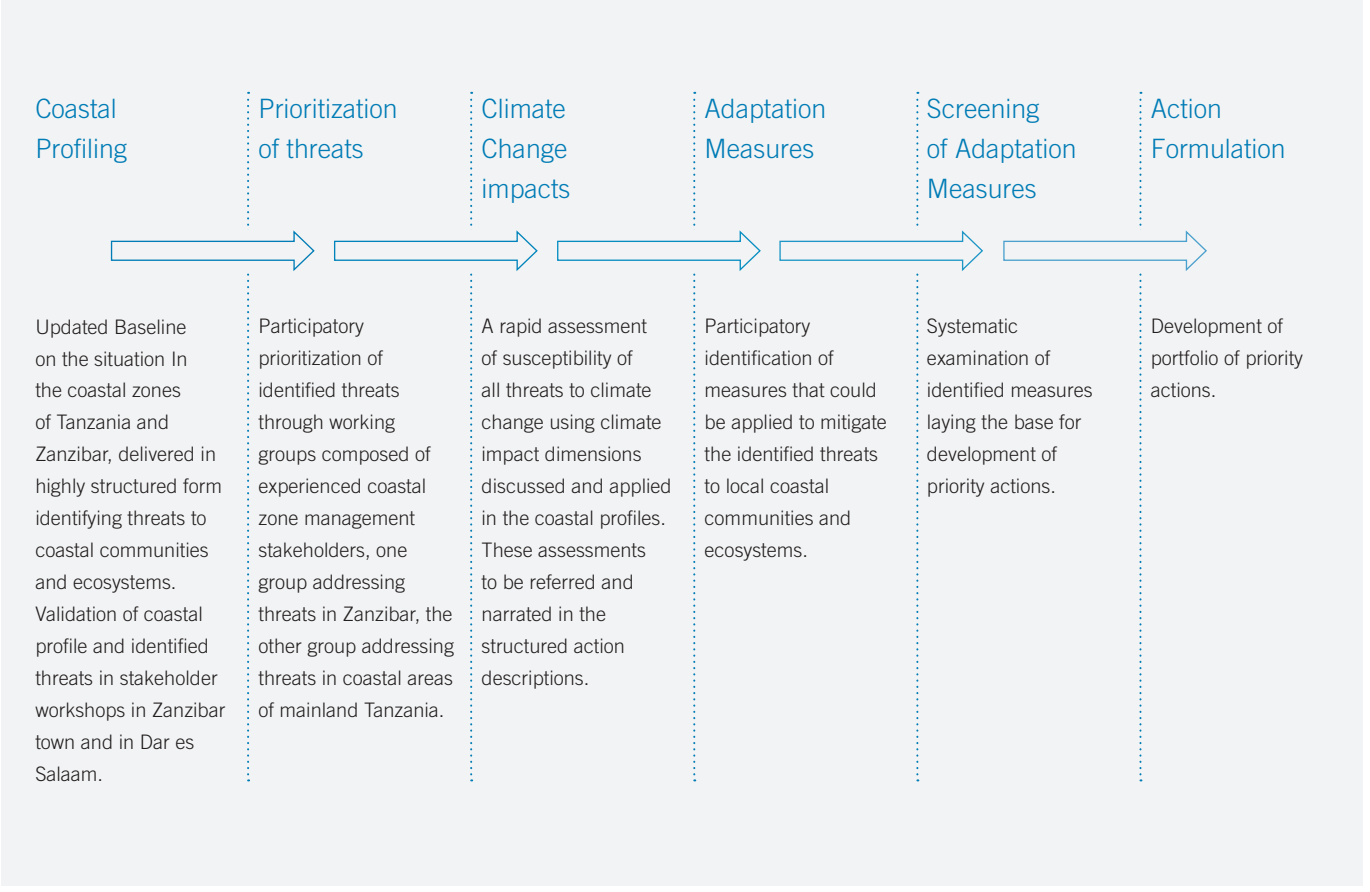
The first step in the study was a rapid assessment to examine current information available in Tanzania and Zanzibar on the situation in the coastal areas. Analyses and assessments relied on local experiences and knowledge, supported by a comprehensive information base. A structured approach was applied to provide a systematic and holistic description, presented in three dimensions: thematic, by geographical administrative area (regional and district), and through tabulated and mapped summaries (see “Output Volumes” page 7).

Participatory Evaluation and Prioritization of Threats

Comprehensive validation of the coastal profiles was carried out through stakeholder workshops held in Zanzibar Town and in Dar es Salaam in April 2014. During the meetings, feedback was provided on the coastal profiles in general, but with a special emphasis on the identified threats to coastal communities and livelihoods. A discussion on prioritization of these threats was then initiated followed by a ranking of threats.

This was done using the “Coastal Rapid Impact Assessment Matrix (CRIAM)” matrix, that uses a set of five criteria (geographical extent, magnitude, permanence, reversibility and cumulativeness) to rank the severity of threats. The CRIAM matrix was applied to all thematic threats in the coastal profiles, looking at the severity from a central management level and to all threats identified in the district and regional volumes, applying a local management angle. Current and foreseen threats were considered.

Working groups in Dar es Salaam and Zanzibar subsequently systematically reviewed, assessed and prioritized all identified threats. The results from the working groups were incorporated into the coastal profiles.



Sequential approach to formulate actions

Threat Susceptibility to Climate Change

An assessment of all identified threats has been carried out on their susceptibility to be further affected by climate change, considering changes in weather patterns, extreme weather events, sea level rise, rise in sea water temperature and ocean acidification.

Threat Mitigation Measures

The two working groups considered what broad measures could be taken to mitigate the prioritized threats. These fell into a series of broad management areas:

- Integrated coastal zone management (ICZM)
- Integrated water resources management (IWRM)
- Land use management
- Shoreline management planning
- Solid and liquid waste management
- Sanitation
- Capacity building
- Technology
- Law enforcement
- Legal review
- Alternative/Improved livelihood
- Awareness raising
- Education

In some cases, measures suggested to address the threats included many of the above management areas, reflecting the complexity of the situation in the coastal areas. The multi-faceted approach also underscores the need for management to adopt a holistic approach and consider integrated solutions in a framework that provides for coordination between many actors.

The measures suggested by the working groups have been further processed and organized in tables by theme and by district/region in Volume IV of the Coastal Profile. A number of action areas have been extracted for final screening before developing more detailed action sheets.

Screening

The action areas have been screened and subjected to an initial evaluation based on general knowledge and site-specific conditions. The screening matrix criteria were:

- Win/win. Does the action have positive impact on other management challenges or opportunities?
- Regret/No Regret. Is the action beneficial without climate change impact?
- Flexibility. Is the action receptive to adjustments according to new knowledge?
- Resilience. Does the action make the management system more robust in responding to the threat and climate change impacts?
- Urgency. How will the implementation of the action be influenced if it is delayed?
- Political acceptability. Does the action require awareness raising and sensitization of the political process or has it already been addressed in policies?
- Costs. Are large investments associated with the action?

Action Formulation

The final step in the study was to develop a portfolio of actions constituting a holistically generated overview of measures to address threats faced by local communities and ecosystems. More details of this process are provided in the introduction to the actions (page 16).

Stakeholder workshop in Zanzibar

Stakeholder workshop in Dar es Salaam

The Proposed Actions

Dense urban development in Dar es Salaam

Sailing a laden cargo dhow into Zanzibar port

Each action is presented in a uniform manner applying a format aligned to the Log Frame Analysis format extensively used as basis for development projects.

The portfolio of actions represents the high priority interventions required to mitigate the most pertinent climate change-related threats to local communities and ecosystems. The portfolio also provides the basis for government and development partners to agree on distribution of efforts to further appraise the feasibility of implementing actions contained in the portfolio.

The portfolio of actions distinguishes between two types:

- Systemic actions for both mainland Tanzania and Zanzibar are directed towards improving the enabling environment for sustainable management of development in the coastal zone. In this sense, systemic actions will be supportive for all local actions.
- Local actions are more site-specific, derived from mitigation measures addressing threats emerging at district/region level.

Action Sheet Template

The action sheets do not provide the basis for committing financing for the action - such commitments necessitate further dedicated evaluations.

For the mainland, the study prioritized 63 actions that focus on improvements in fisheries, protection of natural resources, addressing freshwater resource problems and the bulk targeting coastal pollution. The overall indicative budget for the proposed mainland actions is US$ 658 million.

On Zanzibar, the study prioritized 30 actions to address threats to coastal livelihoods and ecosystems, specifically related to natural resources (notably erosion studies and tourism training), on freshwater resources and pollution, and a number of actions targeting improvements in fisheries. The overall indicative budget for the proposed actions in Zanzibar is US$ 270 million.

The sections that follow represent summaries of the main thematic sectors examined during the study. These dominate activities and incomes within the coastal districts of mainland Tanzania and Zanzibar. These thematic areas formed the basis of the threats analysis, including those specifically related to climate changes, which led to the identification of mitigation measures that culminated in defining the prioritized actions.

Each thematic sector is presented with a short background, a description of the most significant impacts and threats resulting from and impacting on coastal community livelihoods ("community impacts and vulnerability") that were identified during the study, followed by a ranking of the most significant of the five hazards from climate variability and climate change (considered over a 5 to 10 year timeframe). A brief outlook for the sector and a description of the prioritized actions to address the threats to this sector in the short term conclude the presentations on each thematic sector.

Coastal and Marine Ecosystems

The coastal features of mainland Tanzania and Zanzibar, namely beaches, coral reefs, seagrass beds, coastal birds and wildlife (sharks, marine mammals, turtles) and related anthropogenic and climate change impacts are considered in this section. Fisheries resources are described separately (page 18) and mangrove forests included under forestry (page 24).

These natural ecosystems are characterized by high marine biodiversity and rich marine and coastal resources. Interacting with each other, they sustain a tremendous diversity of marine life, which supports the livelihood of coastal communities.

A wide range of important and valued species are found along the coast. The main groups include an estimated 200 species of hard corals, some 8,000 species of invertebrates, over 1,000 species of fish, five species of marine turtles, at least 15 species of marine mammals and over forty species of seabirds.

Community Impacts and Vulnerability

- Poor shoreline management (e.g. coral mining) and lack of understanding of coastal erosion leading to loss of shoreline.
- Illegal (destructive) fishing and certain tourist activities damaging seagrass beds and reefs.
- Poor upstream agriculture on Pemba affecting seaweed and seagrass productivity.
- Waste disposal, in solid and liquid form causing harm to seagrass beds and estuaries.
- Excessive nutrient run off and pollution, from sewage disposal and agricultural fertilizers, negatively affecting seagrass meadows and coral reefs from algal growth.
- Overharvest of invertebrate marine life negatively affecting seagrass meadows.
- Sedimentation on coral reefs from river discharges, sewage discharges and dredging.
- Habitat alteration from land use changes.
- Introduction of invasive species often resulting in unexpected ecological, economic, and social impacts.
- Invasive Indian house crow causing loss of bird diversity through ferocious predation on eggs of local bird species thus threatening indigenous populations.
- Gillnetting affecting threatened species, including: turtles (adults and sub-adults) migrating Humpback whales, dugong, dolphins and sharks.
- Seismic surveys by oil and gas companies deterring whales and some dolphin species.

Threats from Climate Variability and Change

Of the five major climate change hazards, three are most likely to affect coastal and marine ecosystems, as follows:

Sea Level Rise – This threat is not especially severe in the short term (5-10 year period), but it is compounded when in combination with extreme weather events (notably storm surges), which increases beach erosion and threatens coastal infrastructure, turtle nesting beaches and mangrove forests.

Seawater Temperature Rise – Increase in sea surface temperature is particularly damaging for coral reefs (resulting in coral bleaching), thus affecting marine biodiversity, possibly leading to local extinctions, potentially affecting coastal fisheries; warmer waters may favor plankton and boost fish growth rates.

Changes in Weather Patterns – Changes in run-off and river flows affecting salinity and siltation and thus inshore fisheries productivity, including breeding; unseasonal precipitation and wind regimes affecting various human activities and fishery yields.

Outlook for Coastal and Marine Ecosystems

The outlook for Zanzibar is that most coastal areas, especially those close to large urban centers (particularly Stone Town, parts of the east coast of Unguja, close to the main ports of Pemba) are experiencing such degradation from various anthropogenic impacts that current pressure is damaging their integrity and productivity.

On the mainland, the situation is similar, with areas close to urban centers witnessing physical and chemical impacts from anthropogenic sources. Coastal areas of Tanga, Dar es Salaam, Kilwa, Lindi and Mtwara are being over-harvested, damaged by destructive fishing, and polluted by urban or agricultural practices.

Additional pressure resulting from the most likely climate change impacts, such as more frequent storm surges and unpredictable weather, shorter but heavier rainfall periods and temperature rise will exacerbate much of the degradation currently witnessed.

Priority Actions for Coastal Ecosystems

There are five systemic management actions that respond to the actual anthropogenic pressures and projected climate change impacts on coastal and marine ecosystems. These actions, proposed as independent undertakings for Zanzibar and mainland Tanzania, valued at US$ 11.1 million in each, are:

- Develop an Integrated Coastal Zone Management Framework (US$ 2 million)
- Develop Integrated Spatial Planning (US$ 3.85 million)
- Formulate a Shoreline Management Policy Framework (US$ 2 million)
- Develop an Information System as Decision Support for Coastal Development Management (US$ 2 million)
- Undertake an Integrated Review of Legal Framework for Coastal Development Management (US$ 1.25 million)

Two further cross-cutting education and awareness actions that are systemic by nature, valued at USD 3.3 million, also address natural resource use and management:

- Primary and Secondary Education (US$ 1.1 million)
- Overall Awareness Raising (US$ 2.2 million)

The focus of two additional actions for the mainland are on supporting the national regulator, the National Environment Management Council (NEMC), and on turtle nesting:

- Support for the NEMC (US$ 1.7 million)
- Turtle and nesting beach protection, Pangani (US$ 0.2 million)

Fisheries

Marine resources (including seaweed farming, especially on Zanzibar) are critical to economic and social development in coastal communities, and underpin the households that rely on the sea for food and income. Some 36,000 individuals on mainland Tanzania and 37,000 fishers on Zanzibar, directly derive their living from fishing. For their households and local communities, fishing is the primary source of protein and a crucial source of revenue in allied industries (such as fish fryers and traders). The fisheries sub-sector contributes between 1-3 per cent to GDP on mainland Tanzania, and around 7 per cent on Zanzibar. It is based on direct fish value generation as well as exports, with the bulk of mainland fish export coming from Lake Victoria's Nile Perch fishery.

The main shallow demersal fishing grounds along the 1,340 km coastline of mainland Tanzania and Zanzibar islands lie within the 20 m contour, an area of around 5,500 km^2 that includes mangroves, rocky tidal zones, coral reefs, sea grass beds and estuaries. Multiple fishing gears are used in the demersal fishery, both traditional and modern, and some deeper waters are also fished. The principal small pelagic fishing grounds are fished at night by semi-industrial purse-seine vessels, involving light attraction. Medium and large pelagic species are fished within 10 km of the coast by a local fleet mostly using large-mesh gill-nets. Prawns are netted in shallow estuarine waters.

Overall fish marine catches have been static around 50,000 tonnes per year, valued around US$ 70 million. Despite an estimated annual potential as high as 100,000 tonnes, increased efforts have not led to increased catches, and there has been a decline in catches per unit effort and changes in catch composition and fish sizes.

Deep-water red snapper catch from Mafia Island

Community Impacts and Vulnerability

- Habitat destruction from illegal fishing methods, and encroachment and over-exploitation, partly due to the open access nature of fishing (especially on the mainland);
- Poverty and poor education among fishers and lack of alternative livelihoods;
- Pollution and sedimentation from poor land use practises in catchments and changes in river flows and river damming, and from domestic and industrial solid and liquid wastes;
- Unsustainable mining of sand, live coral, and limestone;
- Conflicts among local fisher communities over access to resources, from decreased per capita yields and other sector developments
- Increased coastal population and fishing effort accompanied by reduced catch per unit effort.

Threats from Climate Variability and Change

Three of the five major climate change hazards that are likely to affect fisheries in the short term, ranked based on information presently available, are:

Seawater Temperature Rise – Biodiversity changes through extinction, migration, or invasion of species; coral bleaching

Extreme Weather – More frequent and intense extreme weather events impede fishing activities, render low-lying communities, infrastructure and mooring areas susceptible to damages and increase coastal erosion and flooding.

Changes in Weather Patterns – Changes in rain patterns affect run-off flows and estuarine mangrove salinity, fish and crustacean feeding and breeding grounds.

Outlook for Coastal Fisheries

Pressure from over-fishing and use of destructive fishing methods have greatly undermined marine ecology and changed species compositions. There is little room for expanding production from capture fisheries with catches unlikely to increase with more fishing effort. Some potential increase may be gained from deeper water and from improvements in efficiencies in the smaller pelagic fisheries. Aquaculture holds potential for further development.

Shangani fish landing site at Mtwara

Priority Actions for Mainland Fisheries

The overall focus for reducing threats to the livelihoods and the ecosystems that promote coastal fisheries is to improve fisheries management. This requires a thorough review and upgrade of the legislation based on fishery type and fishing areas, from improvement to monitoring, control and surveillance and through elimination of fishing with explosives. Actions also include support for those fisheries that have the potential for expansion or post-harvest improvement, namely of small pelagic species (e.g. sardines), for offshore tuna fishery and the prawn fishery; as well as farming of fish and other marine organisms.

The total indicative expenditure on the nine proposed fisheries actions for mainland Tanzania that help reduce anthropogenic pressures on the resource, and concomitantly mitigate the influences of climate change, is US$ 25.9 million. The specific actions to support mainland fisheries are:

- Fisheries sector review by fishery types and management areas (US$ 3.6 million)
- Small pelagic fisheries support program for mainland Tanzania (US$ 1.7 million)
- Support for mainland fisheries monitoring, control and surveillance program (US$ 5 million)
- Support MCS to end explosive fishing (US$ 3.3 million)
- Strengthening the management of octopus fisheries on mainland Tanzania (US$ 1 million)
- Strengthening the seaweed farming industry on mainland Tanzania (US$ 1 million)
- Tuna fisheries support program for Mtwara and Lindi Regions (US$ 2.6 million)
- Prawn fisheries support program for Rufiji District (US$ 1.7 million)
- Fish farming research and cage trials in Tanga and Kilwa (US$ 6 million)

Priority Actions for Zanzibar Fisheries

Fisheries on Zanzibar have great potential to be sustainably exploited and successfully managed. Experiences from the last fifteen years on community-based fishery management, in areas like Menai Bay (Unguja) and Misali Island (Pemba), confirm that with support and guidance, communities can take responsibility for fishery resources within their traditional fishing grounds. The main focus for reducing threats to livelihoods and the ecosystems from population growth and climate induced changes on coastal fisheries is on improved management and support for those fisheries that have the potential for expansion or where post-harvest improvements can make a contribution. The key areas of support are the fisheries of small pelagic species (e.g. sardines and anchovies), offshore tuna, seaweed farming and fish farming. Improved fishery management will benefit from a thorough review and upgrade of the legislation based on fishery type and fishing areas.

The total indicative expenditure for the seven proposed actions that support fisheries and aquaculture on Zanzibar and respond to projected climate changes impacts is US$ 18.5 million. The proposed actions are:

- Fisheries sector review by fishery types and management areas (US$ 3.2 million)
- Zanzibar small pelagic fisheries support (US$ 1.7 million)
- Support for fisheries monitoring, control and surveillance program (US$ 4.8 million)
- Strengthening octopus fisheries management (US$ 1 million)
- Strengthening seaweed farming (US$ 1 million)
- Semi-industrial offshore tuna fisheries support program, Unguja North (US$ 2.4 million)
- Strengthening fish mariculture (US$ 4.4 million)

Tourism

Sailing dhow at sand bank in Songo Songo Archipelago

Tourism is one of the fastest growing sectors on both Zanzibar and mainland Tanzania. On the mainland, it ranked top in foreign exchange earnings in 2014, overtaking agriculture in GDP terms and providing a range of employment, service and product opportunities for other sectors of the economy. Mainland attractions to international tourists are very strong, based on well-established and exceptional wildlife reserves and parks, landscapes, historical and cultural identity and generally peaceful status.

On Zanzibar, over 70 per cent of the economy is driven by the tourism sector, which includes a diverse array of associated activities. The growth since the early 1990s has been significant, now contributing between 47 to 51 per cent to GDP, representing 77 to 80 per cent of all foreign investment.

While beach (including marine-based) and cultural tourism dominate Zanzibar, on the mainland, coastal tourism is relatively new, but expanding. In 2011, Mafia Island received 4,500 tourists, while Dar es Salaam Marine Reserves catered for 20,000 visitors, and visitors to Tanga, Kilwa and Mtwara region are growing annually.

Community Impacts and Vulnerability

- Weak coastal development management allowing anarchistic tourist development that damages coastal and marine biodiversity, conservation areas and cultural heritage.
- Accelerated beach erosion due to sand mining (e.g. for hotels, roads) and failed engineering structures.
- Tourism sector profits not benefiting the local population.
- Increased cost of living and of land prices, imposing financial, nutritional and security risks for the poor.
- Uncertainty of jobs for local population with lack of steady employment due to seasonal structure of industry.
- Locals losing employment opportunities to better-trained staff from elsewhere.
- Erosion of local traditions and culture due to influences from tourists and outsiders in the industry.
- Worsening security (on Zanzibar and Dar es Salaam) from increased crime.
- Illegal killing of whale sharks, dolphins, turtles and other exotic marine life, damaging Tanzania's eco-friendly image.
- Reduced freshwater supply from a rising population and expanding industries and tourism (especially on Zanzibar).
- Inadequate and illegal sewage infrastructure and waste management resulting in pollution of coastal zone.
- Increase in water-borne disease (e.g. malaria and dengue) from inadequate management of wastewater and drainage.
- Conflicts between local communities and tourist industry developers over resources and between local and outsiders seeking employment.

Threats from Climate Variability and Change

Three of the five major climate change hazards that are likely to affect coastal tourism in the short term, ranked based on information presently available, are:

Sea Level Rise – Degradation of coral reefs with increased erosion; saltwater intrusion in coastal wells; and threats to hotels and infrastructure from erosion, flooding, storm surges, especially at Mafia, Kilwa and Zanzibar Stone Town.

Changes in Weather Patterns – Change in river flows affect beach sedimentation/erosion; fire risk to coastal wildlife-based tourism (mainland) threatening endemic biodiversity; unpredictable recharge of ground water; longer dry spells leading to soil water deficiency and decline in agricultural production; more frequent flooding increasing frequency of diseases; and unpredictability of weather negatively affecting the tourism experience.

Extreme Weather Events – Inundation and flooding of coastal areas; and coastal and marine recreational tourism adversely affected by rougher sea conditions.

Outlook for Coastal Tourism

On the mainland, plans to enhance the coastal part of the sector include diversification away from the dominant so called "Northern Circuit", to promotion of the coast of Tanga and Pangani and development of a strong Southern Circuit, including coastal areas such as Mafia, Bagamoyo, Saadani Game Reserve and Kilwa. Enhancement of Dar es Salaam environs with emphasis on the urban waterfront is also being considered.

The Government of Zanzibar aims at sustainable, environmentally and culturally friendly tourism, which benefits hoteliers, villagers and wider stakeholders. Tourism policy reform, adoption and encouragement of more eco-friendly tourism practices, coastal zoning, enforcement of relevant laws, and inclusion of climate change adaptation and mitigation are called for.

Priority Actions for Mainland Tourism

In addition to the five systemic actions (see page 17), four specific actions are prioritized to lessen the threats from climate change impacts on coastal tourism-related livelihoods and ecosystems. Coastal erosion is manifest in many locations along mainland Tanzania, with diverse approaches to combat the threat currently undertaken by local governments and the tourism and private sectors. What is needed is an over-arching, holistic study of the entire coast. At the Kilwa Kisiwani World Heritage Site, erosion has long been an issue, with minor ad hoc initiatives undertaken to mitigate damage to structures. Here, a specific action is proposed to examine in detail the erosion issues at the site. The important cultural center of Bagamoyo is the focus of a specific town planning study as local authorities grapple with the pressures of uncontrolled development brought about by the proximity to the rapidly expanding city of Dar es Salaam and associated coastal issues related to climate change. Finally, an over-arching action is included that provides support for tourism management planning at the sector level, which includes components focused on climate change threats and mitigation.

The total indicative expenditure on the four proposed actions addressing tourism-related threat is US$ 11.35 million as detailed below:

- Beach erosion study for mainland coast (US$ 6.6 million)
- Erosion study for Kilwa Kisiwani World Heritage Site (US$ 3.1 million)
- Bagamoyo town planning (US$ 0.4 million)
- Support for Tourism Management Planning (US$ 1.25 million)

Coastal tourism facility in Temeke, Dar es Salaam

Priority Actions for Zanzibar Tourism

The shores of Zanzibar, especially Unguja Island, provide evidence of coastal erosion in many locations, with diverse approaches by local governments and the private sector, especially hotel owners, to combat the threat. In most cases, the mitigation measures constructed by hotels serve only to worsen the situation. Safeguarding the sand beaches is important of tourism and for the health of the lagoons that fringe these shores, where seagrass beds need sandy substrate to secure their roots. To correctly address the issue, an over-arching, holistic study of the entire coast is needed, budgeted at US$ 4.4 million.

The importance of the tourism sector is well-recognized, yet the greatest threat affecting local livelihoods associated with the sector is the loss of employment opportunities due to inadequate levels of training among local job-seekers and competition from more qualified personnel from mainland Tanzania and Kenya. In light of climate impacts on other sectors like fisheries and agriculture, maximizing local content within the tourism sector of Zanzibar is a priority.

Two specific actions are proposed, to address the lack of skills in the industry and to investigate coastal erosion – a major climate change impact. The total indicative expenditure on these two proposed actions is US$ 10.6 million, as shown below:

- Professional Tourism Training Center (US$ 6.2 million)
- Beach erosion study on Pemba and Unguja (US$ 4.4 million)

The five systemic management actions are especially relevant to coastal tourism, both for mainland Tanzania and Zanzibar. In particular, the ICZM and shoreline management actions which accommodate projected climate change impacts. The combined total cost for these five actions is US$ 11.1 million.

Agriculture

Cattle on Zanzibar passing through the beach between grazing areas and overnight pens

Agriculture is the mainstay of livelihoods for most Tanzanians. Including livestock keeping, agriculture is practised at small and large scales, in urban and rural settings. Most coastal land is of low agricultural potential, with over-reliance on rain. Investment in these coastal districts has remained low. However, presently, 80-90 per cent of coastal people's livelihood depends largely on subsistence agriculture, but with some cash crops. In recent years, several large bio-fuel projects have targeted the coast where there is available land and agro-climatic conditions and soils suitable for these crops.

On Zanzibar, agriculture is one of the key sectors, contributing around 30 per cent of GDP. Out of this, crops contribute to just over 20 per cent and livestock just under 5 per cent. Agriculture dominates exports, at 95 per cent in foreign exchange value, with cloves and seaweed making up three quarters of the total. There is a high proportion of mixed agriculture and livestock farming, which includes a rapidly expanding sub-sector of cattle, goat and chicken keeping. The sector is very climate-sensitive, mostly dependent on rain, with production vulnerable to drought or intermittent dry spells during the rainy season.

Unlike the mainland, Zanzibar relies on food imports, particularly rice and wheat, but also maize flour, fruit and vegetables. Most staple foods, such as rice, wheat flour and sugar are imported from overseas, yet maize, flour and pulses come mainly from the mainland.

Community Impacts and Vulnerability

- Poor land management and poor land tenure, leading to social conflicts over land between arable farming and livestock grazing.
- Inadequate support for continued or expanded production.
- Weak marketing resulting in post-harvest losses.
- Reduction in soil fertility and structure and reduced yields.
- Invasion of catchments by farmers leading to drying up and contamination of ground and surfaces waters.
- Dependence on rain, insufficient water for irrigation, poor water resources management hampering supply.
- Poor farming practices due to shortage of land, access to products and farming techniques.
- Lack of business/financial management training among producers and suppliers, limiting success of product distribution.
- Reduced land for agriculture on Unguja due to intense competition and loss of public land (coral rag).
- Inadequate agricultural product supply leading to tourism operators seeking suppliers elsewhere.
- Unpredictable demand by tourism sector due to uncertain occupancy rates precluding long-term orders.
- Local production costs of agriculture produce uncompetitive.
- Insufficient climate forecasting and early warning systems.

Cashew fruit harvest from coastal areas of Lindi

Threats from Climate Variability and Change

Of the five climate change hazards likely to affect coastal agriculture, the two most significant are:

Changes in Weather Patterns – Increased unpredictability in the timing of rains, potentially shifting agro-zones and favoring invasive species and new or more severe crop diseases; more intense rain increasing surface runoff and soil erosion; annual flow reductions of coastal rivers threatening irrigation; changes in plant species composition affecting quality of pasture; and unseasonal precipitation affecting livestock water supply.

Extreme Weather Events – Damaged crops through strong winds, inundation of coastal lands or prolonged dry spells.

Outlook for Coastal Agriculture

It is widely expected that agriculture output in much of Tanzania and Zanzibar will continue to grow, despite being partially undermined by the above climate stresses. The need to improve production, processing, including post-harvest and marketing are ever-present. Production will likely increase faster with better fertilizer use, improved irrigation, and crop selection. To that end, there are a large number of initiatives (e.g. SAGCOT on the mainland), some led by NGOs and donors, that support agriculture development at local levels. Unfortunately, many such initiatives in the past have failed to boost production as hoped. A strong involvement of the private sector is needed to ensure development in this sector. There are recent investments at industrial scales, mainly for biofuel or rice and sugar projects, that may contribute towards growth in the sector.

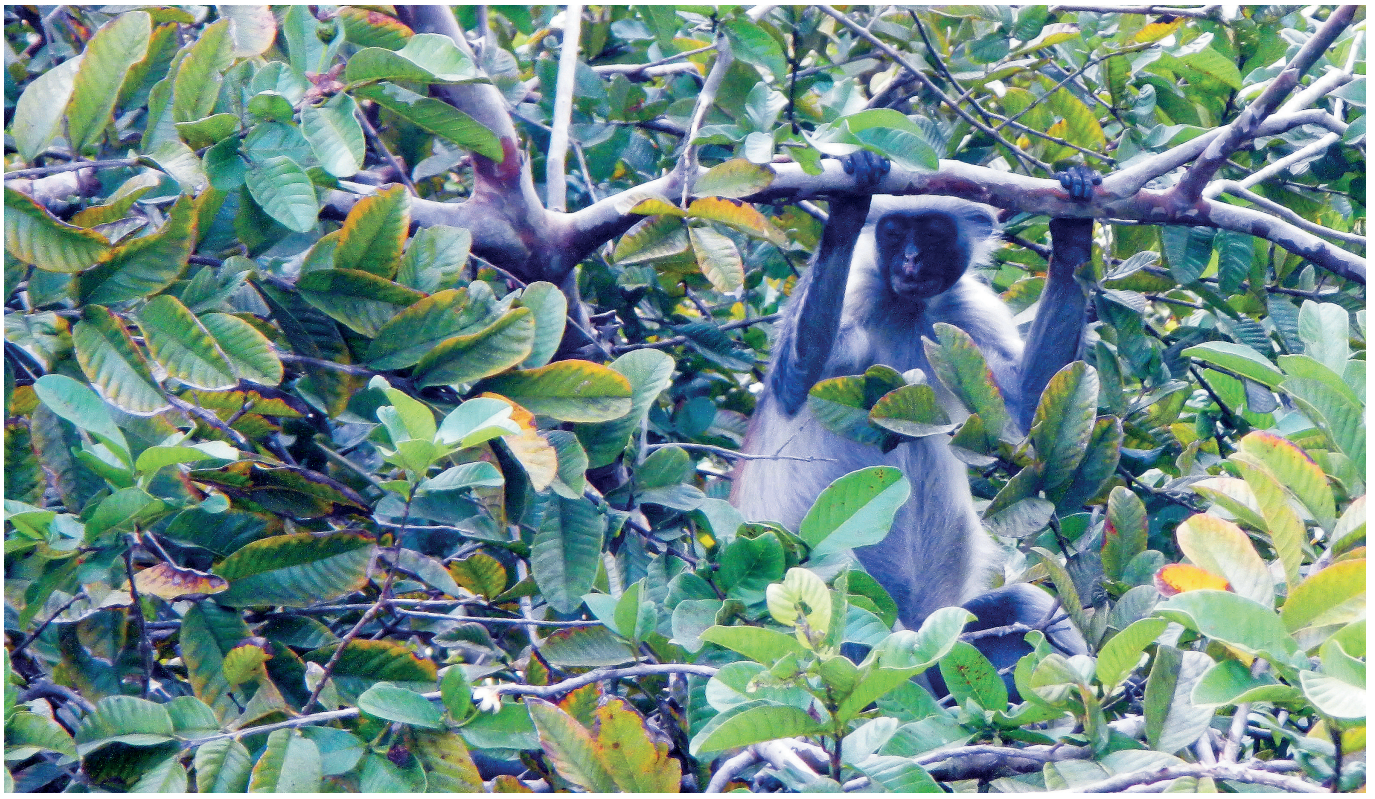
Priority Actions for Agriculture

While agriculture in coastal districts contributes significantly to local coastal livelihoods, in general, outputs are marginal compared to agriculture further inland. Exceptions include cashew, coconut and fruit cultivation. All coastal agriculture is vulnerable to climate change impacts as it is across the country. However, because there are a number of nationwide initiatives to address improvements in the agriculture sector, the study did not prioritized any specific actions relevant to the sector. Only one cross-sectoral action is proposed that affects large-scale agriculture and all development projects on mainland Tanzania. This is aimed at strengthening the mainland environmental regulator, the NEMC, as detailed below.

- Support for the NEMC (US$ 1.7 million)

The five systemic management actions are relevant to coastal agriculture for both mainland and Zanzibar and accommodate projected climate change impacts, in particular the actions related to integrated spatial planning and review of legal framework. These are valued at US$ 11.1 million.

Forestry



Zanzibar red colobus monkey in Jozani Forest

Forests and woodlands are key elements in the livelihoods of hundreds of thousands of households across Tanzania. On Zanzibar, forests and woodlands cover an estimated 60 per cent, with only two small remnants of the original forests left, at Jozani and Ngezi Forest Reserves.

Features of coastal forests and mangroves include high biodiversity (some as protected sites), and extractive resources such as timber, charcoal, and poles. Forest fuel wood and charcoal provide 80-95 per cent of energy supply in Tanzania and Zanzibar. Other uses are traditional medicines, gums and resins, plus indirect ecosystem functions including regulating water-catchment, erosion control, nutrient cycling, maintaining local climates, and supporting biodiversity.

Mangrove forests on the mainland are protected as forest reserves, though management is often lacking in remote areas. The largest mangrove areas are found on the coasts of Tanga district, in the delta of the Rufiji River (40 per cent of the national total), in Kilwa and Lindi districts, and parts of Muheza, Bagamoyo, Kisarawe and Mtwara. On Zanzibar, mangrove forests mainly occur on the western shores on the two main islands, occupying 18,000 ha.

Community Impacts and Vulnerability

- Invasion of catchments and upstream changes in river courses by farmers, decreasing flows to coastal and mangrove areas e.g. Pangani estuary.
- Inadequate enforcement of forest management regulations and ineffective land use planning resulting in illegal clearing, over-harvesting of mangrove and coastal forests or clearance for salt works (particularly on Pemba).
- Poor harvest methods (e.g. slash and burn) and fires escaping from plot clearing causing forest loss.
- Pollution from fertilizers, pesticides, other toxic chemicals and solid wastes.
- Inadequate enforcement of hunting regulations resulting in loss of wildlife from many coastal forests.
- Encroachment of expanding agriculture and settlements into coastal forest reserves.
- Land tenure uncertainty discouraging local long-term investment in village land and protection of sensitive areas that are important as water catchment areas.
- Inefficient fuel production (e.g. charcoal) and consumption, exacerbating demand for fuelwood.
- Unreserved status of more than 60 per cent of mainland forest and woodlands leaving areas with insufficient management instruments.
- Pests and grazing damage to arable farms.
- Conflict between villages over mangrove cutting.

Fringing mangrove forest on Zanzibar

Threats from Climate Variability and Change

Three of the five major climate change hazards that are most likely to affect forests are ranked below:

Extreme Weather Events – Damage to forests from strong winds or inundation and excessive flooding of mangroves, especially during high tides; and damage to coastal forests from severe drought.

Sea Level Rise – Contribution to erosion of mangroves during storm events is the most significant in the short term.

Changes in Weather Patterns – Unseasonal rain affecting various forest and related livelihood activities; more intense rain leading to more aggressive surface runoff and increased soil erosion; new or more severe forest diseases; and increased risk of forest fires.

Outlook for Coastal Forests

The annual deforestation rate on Zanzibar and mainland coastal forest areas is likely to increase as demand for forest products grows in the absence of alternatives, especially of energy for cooking. Meanwhile, the ability of governing institutions to contain or reduce the degradation is challenged, despite the large number of initiatives, NGOs and donors that support forest conservation programs.

The REDD Strategy 2012 addresses the current uses of forest resources and proposes strategies to halt forest deforestation and degradation, by raising carbon financing through the 'Reducing Emissions from Deforestation and forest Degradation' (REDD+) scheme. The potential exists for REDD initiatives to contribute towards conservation/restoration of coastal and mangrove forests in Tanzania.

Priority Actions for Forestry

All coastal forests, including mangroves, are vulnerable to climate change. However, because the impacts are not considered likely in the short term (5 to 10 years) and there are a number of nationwide initiatives to address improvements in the forestry sector, the study prioritized only one specific action relevant to this sector, as detailed below.

- Mangrove rehabilitation around Bagamoyo Town (US$ 0.55 million)

As with coastal agriculture and tourism, the five systemic management actions described in the Coastal and Marine Ecosystems section (page 17) are also particularly relevant to coastal forestry.

Freshwater Resources

Mbemburu River and Msungu Bay, Kilwa coast

Nine water basins cover mainland Tanzania, though some central areas (particularly the internal drainage basin) are extremely dry with little surface water. Nevertheless, overall, Tanzania is challenged by a high degree of water resource variability both spatially and temporally – a situation likely to worsen with population growth. On Pemba Island, small surface streams exist but major aquifers are absent, while Unguja Island houses large underground aquifers - the main sources for drinking water.

The national mainland coastal districts receive around 1,000 mm per year whereas Zanzibar receives a significantly higher annual rainfall (1,916 mm on Pemba and 1,565 mm on Unguja). Rainfall recharges Tanzania and Zanzibar's aquifers, with overflow discharges to the sea that generally prevent saltwater intrusion.

The quality of rainfall data is improving thanks to Tanzania's Meteorological Agency, though there is scant data on most rivers other than the Rufiji and Pangani. Similarly, detailed information on the shape and size of Zanzibar's aquifers is lacking, though studies carried out in the early 1990's estimated the total annual acceptable yield of the Unguja aquifer to be about 50 per cent of the total recharge.

About one third of the Tanzania's grid electricity comes from hydropower installations. Water flows provide numerous provisioning services while also supporting the tourism sector. Yet demand for irrigation and livestock, and the consequence of land use changes and hydropower developments have degraded many river basins and significantly reduced discharges. In some, such as the Rufiji, Pangani, Wami and Ruvu, the situation is critical with multiple socio-economic conflicts and potential ecological and environmental impacts resulting at the coast.

Community Impacts and Vulnerability

- Inefficient management of piped water supply leading to leaks and loss of valuable water resources.
- Increased demand from tourism sector exceeding supply at times, resulting in water shortages.
- Corruption within management wasting water or revenues from water usage.
- Poor integrated river basin management leading to degradation of water bodies with riverbank damage, pollution from municipal waste and sewage, poor agricultural practices or mining (including sand), over-abstraction for agriculture and hydropower.
- Deterioration of river flows leading to reduced estuarine and marine productivity, especially of delta prawn and small pelagic species (e.g. sardines).
- General lack of information on patterns of climate change and impacts on hydrology of coastal mainland and Zanzibar's rivers.
- Lack of updated data on river discharges leading to insufficient monitoring of river discharges.

Threats from Climate Variability and Change

Three of the five major climate change hazards likely to affect freshwater resources are:

Changes in Weather Patterns – Unpredictability of rainfall affecting water flows (notably surface water and estuarine discharges, ecological and sediment processes, and groundwater recharge); potential increased demand on water when rainfall decreases during dry season when demand often highest.

Extreme Weather Events – A higher frequency of intense rainfall events affecting surface water (e.g. on Pemba) and estuarine discharges, ecological and sediment processes, potentially exacerbating erosion of catchments, riverbanks, estuaries and nearby shorelines.

Air Temperature Rise – Household/tourism and agricultural water demands increases, the latter due to combination of evaporation and plant transpiration rates.

Outlook for Freshwater Resources

The outlook at present is insufficient water to meet the needs of the growing population, particularly of the large urban centers on the coast (parts of Dar es Salaam, Zanzibar Stone Town and Chake Chake). The problem also affects the drier rural areas where local water supplies are least abundant, in some cases where tourism resorts are denser than elsewhere.

In 2007, Tanzania's renewable water resources per capita was 2,291 m³. With the rapid population growth witnessed over the last 50 years, reaching 45 million in 2012, the projected population for 2050 is 52 million, at which point the country's per capita water resources will fall below 1,700 m³ per person, the definition of water scarcity. The expected increase in tourist numbers on Zanzibar will increase the pressure on freshwater resources and more sustainable supplies need to be established to tap this important development opportunity.

Priority Actions for Mainland Freshwater

River and coastal pollution were deemed priority focus areas. Sources of pollution include the drains, sewers, illegal dumping and rivers. Nutrient and chemical pollution discharged through these rivers into the coastal environment along shoreline extends from Mkinga District, to Dar es Salaam and south to the Rufiji delta. Evidence of river degradation, from water abstraction, destruction of riverine vegetation and pollution is well-documented and very visible.

The total indicative expenditure on the eleven proposed actions addressing rehabilitation of east-flowing rivers is US$ 134.4 million. The following river system on the mainland are the focus of the actions:

- Four east-flowing rivers, Mkinga (US$ 13.5 million)
- Sigi and Mkulumzi rivers, Tanga/Muheza (US$ 13.5 million)
- Lower Pangani River, Pangani/Muheza (US$ 13.5 million)
- Wami River, Bagamoyo (US$ 7.5 million)
- Ruvu River Basin, Bagamoyo (US$ 13.5 million)
- Mkuza and Mpiji rivers, Bagamoyo/Kinondoni (US$ 13.5 million)
- Seven east-flowing rivers, Kinondoni (US$ 13.5 million)
- Msimbazi River Basin, Ilala/Kinondoni (US$ 17.7 million)
- Kizinga and Mzinga river basins, Ilala/Temeke (US$ 13.5 million)
- Nguva River and other rivers in Temeke (US$ 5.5 million)
- Lower Rufiji and Mohoro rivers, Rufiji (US$ 9.2 million)

Sources of freshwater for coastal populations have similarly become degraded and polluted, especially in the more arid parts of the coast. Areas affected where there are no known projects addressing the shortage include Tanga City, Lindi Town, isolated smaller islands of the Mafia Archipelago and villages within the Mnazi Bay area close to Mtwara. The total indicative expenditure on improvements to municipal and village freshwater supplies is US$ 26.6 million, as follows:

- Tanga City (US$ 5.5 million)
- Lindi Town, Lindi Rural (US$ 6.7 million)
- Outlying small islands of MIMP, Mafia (US$ 7.7 million)
- Outlying villages in MBREMP, Mtwara (US$ 6.7 million)

One of hundreds of delta tributaries of the Rufiji River

Priority Actions for Zanzibar Freshwater

Pollution of beaches and the marine environment have reached unprecedented levels. Sources include the drains, sewers, illegal dumping and rivers. Nutrient and chemical pollution discharged through these rivers into the coastal environment along shoreline is present on the west coast of Unguja. Evidence of degradation of the small rivers of Unguja and Pemba, from water abstraction, destruction of riverine vegetation and pollution is very visible.

The total indicative expenditure on four proposed actions addressing rehabilitation of west and northwest-flowing rivers is US$ 17 million. These are:

- Five W-flowing streams, Unguja Urban and West (N of Stone Town) (US$ 8.5 million)
- Three NW-flowing streams near Mahonda, Unguja Urban and West Region (US$ 8.5 million)

Sources of freshwater for coastal populations have similarly become degraded and polluted. Areas affected where there are no known projects addressing the shortage include Unguja North, especially around Nungwi where there is now a large village and tourism sector, as well as parts of Pemba. Two action are proposed that entail a study, review and design of freshwater supply options for Pemba and Unguja North, with an estimated total of US$ 12.2 million as shown:

- Pemba (US$ 5.5 million)
- Unguja North (US$ 6.7 million)

Industry

On Zanzibar, the industry and manufacturing sector is characterized by small businesses that contribute relatively little to GDP. This is partly because activities are small scale and secondly because most of what is produced is in the informal sector. Industry on the isles of Zanzibar was dominated by processed clove oil and other natural oils, with textiles only becoming important recently. In contrast, mainland coastal districts house major industrial and manufacturing businesses, associated with limestone, cement, textiles, chemicals and agro-processing.

Dar es Salaam has over 500 major industrial establishments registered, including pharmaceutical, chemical, plastics and rubber, glass, metal works, soaps and detergents businesses. Outside Dar es Salaam, Tanga has the fastest growth in regional GDP (18 per cent), with impressive accumulation of factories such as textile mills, food processing, leather goods, handcrafts, cosmetics and construction materials. Southern coastal regions have historically contributed far less industrial output, a situation that is gradually changing with local gas-powered electricity being utilized by new cement plants in Mtwara.

Community Impacts and Vulnerability

- Inadequate infrastructure management in both mainland coastal areas and Zanzibar unable to maintain supply of services (electricity, transport, water), resulting in a disincentive for industry to be attracted to the coast and develop.
- Lack of coordination of locations of new industries undermines integrated planning.
- Failure to monitor industry liquid and solid wastes, leading to pollution of waterways, ground water, and open grounds.
- Failure to monitor industry air emission leading to air pollution.

Threats from Climate Variability and Change

Two of the five major climate change hazards likely to affect coastal industry, at least indirectly, are ranked below:

Changes in Weather Patterns – Greater volumes of standing water increases risk of flood damage to transport, communication and electricity supply infrastructure affecting industry.

Extreme Weather Events – Damage to power infrastructure from fallen trees, or from direct impacts of weather affecting industry power supply; damage to communication infrastructure (including roads) from direct weather impacts such as more extreme rainfall.

Part of the industrial area of Dar es Salaam

Outlook for Industry

The mainland coastal zone will witness considerable industrial development in the coming 5 to 10 years. Natural gas development is underway in Mtwara, Lindi and Kilwa, and has the potential to benefit livelihoods by creating business opportunities (e.g. for fertilizer, cement factories, processing plants) that require large amounts of power and labor force. Industries in these traditionally poor regions have a chance of greater development if profits from the activities are retained locally.

A major coastal development instrument promoted by the National Development Corporation includes stimulation of industrial firms through cluster development supported by Special Economic Zones (SEZ). Three coastal SEZs are planned: for Dar es Salaam linked with the Central Railway Line to constitute the “Logistics Corridor” and TAZARA to constitute the “Agricultural Corridor”; Mtwara SEZ developed as the “Minerals Corridor” and the Tanga corridor to serve the areas of northern and north-western Tanzania up to and including Rwanda.

On Zanzibar, given the importance of exports of raw spices, increased value addition could present a starting point for diversification. Active promotion of its manufacturing sector will be needed over a substantial period of time to tap into the potentials that do exist.

Priority Actions for Industry

While industry in coastal cities is significant to local livelihoods and national GDP, in most cases poor management has led to negative impacts on the environment. Fortunately a number of nationwide initiatives exist to address improvements in the industry sector and in its management, thus the study did not prioritize any specific actions relevant to the sector.

Only one cross-sectoral action is proposed that affects the industrial sector, and all development projects on mainland Tanzania. This is strengthening the mainland environmental regulator, the NEMC, as (as stated earlier):

- Support for the NEMC (US$ 1.7 million)

Ports and Harbors

The Tanzanian mainland ports system comprises of one large international port, Dar es Salaam, with a throughput of 13.5 million tonnes for the period 2012-13; two medium-sized coastal ports, Tanga and Mtwara, with throughputs of 380,000 and 295,000 tonnes respectively for the same period; and the secondary coastal ports with recent throughputs of less than 50,000 tonnes per annum (2007 estimates), namely Pangani, Kilindoni (Mafia), Kilwa Masoko and Kilwa Kivinje, Lindi and Mikindani (Mtwara). There are also two large port projects in the government's development plans: the Mwambani Port (at Tanga) and Bagamoyo Port.

Between 2001 and 2007 the average annual growth in coastal port exports exceeded 9 per cent, with container traffic growing even faster, at around 13.5 per cent annually. Transit traffic to land-locked countries (Rwanda, Malawi, Zambia and others) makes up a growing proportion of Dar es Salaam's traffic, increasing from 10 to 41 per cent of liquid bulks, and from 25 to 39 per cent of containers over the same period.

Zanzibar and Pemba Islands are served by five ports, including Malindi Port plus minor ports at Mkokotoni (Unguja) and Mkoani and Wete (Pemba). Given the island's strategic location, the Malindi Port is still one of the principal ports in East Africa and handles around 90 per cent of Zanzibar's trade. A refurbishment was completed in 2009 but there is a need for a new port and there are plans for a container port at Maruhubi area (north of the existing port) which will facilitate Zanzibar's economic development, trade growth and the movement of cargo along Africa's east coast. Malindi Port also services passenger ferries commuting between Dar es Salaam, Pemba and at times Tanga, handling over 1,000 ferry passengers daily, including large numbers of tourists.

All Tanzania's coastal ports are located close to city centers, where their operation contributes to traffic congestion and other adverse environmental effects, especially in the largest port of Dar es Salaam. Difficulties in acquiring land have led to cramped and inefficient port layouts, and imposed serious constraints on port expansion plans.

Community Impacts and Vulnerability

- Inefficient operation at Dar es Salaam and Malindi (Zanzibar) ports leading to loss of economic competitiveness (compared to other ports e.g. Mombasa) by increasing the costs of import and export to and from global markets.
- Possible inadequate compensation for land for port expansion at Dar es Salaam, Mtwara, Mwambani (Tanga) and Bagamoyo, and at Maruhubi (Zanzibar).
- Possible inadequate environmental impact mitigation during port expansion at Mtwara, Mwambani (Tanga) and Bagamoyo, leading to environmental degradation, particularly through sediment deposition on coral reefs.
- Erosion of shorelines adjacent to some secondary ports such as Kilindoni (Mafia), Lindi, Kilwa Kivinje and Kilwa Masoko, and Mkoani and Wete (Pemba), and Mkokotoni (Unguja).
- Marine and solid waste pollution arising from port activities and traffic.

Aerial view of Zanzibar's Malindi Port, Stone Town and Bwawani areas

Threats from Climate Variability and Change

By their very design, ports are not expected to be significantly impacted in the short term by any of the five major climate change hazards.

Outlook for Ports and Harbors

Since approximately 90 per cent of Tanzania's international transactions transit through the port of Dar es Salaam, improvements to this facility, especially efficiency should be prioritized. Similarly for Zanzibar's Malindi Port where the planned construction of a new port at Maruhubi should improve the efficiency and lower the cost of trade, so important for these small islands.

Priority Actions for Ports and Harbors

The impacts of climate change are not considered likely to affect port operations in the short term (5 to 10 years). Consequently, the study prioritized only one specific action relevant to this sector, as detailed below.

- Waste oil treatment facility for mainland ports: Dar es Salaam, Tanga, Kilindoni (Mafia) and Mtwara (US$ 24.3 million)

In addition, many of the systemic actions are also relevant to this sector as is the strengthening of the national environmental regulator on the mainland, seen as being very important to support the development of ports and harbors sector.

- Support for the NEMC (US$ 1.7 million)

Infrastructure

The speed of population growth, accompanied by urbanization, requires matching infrastructure in many parts of the mainland coast and Zanzibar. This places enormous pressure on the local authorities to match the provision of basic services (sewage systems, clean water supply, power and energy, transportation, health, education, solid waste management, etc.). Some of the infrastructure sub-sectors fare better than others, for example developments in communications over recent years are far more impressive than the development in provision of safe drinking water, mindful of the respective roles of private sector and local governments.

Enterprise development surveys suggest that infrastructure constraints are responsible for about 34 per cent of the productivity handicap faced by the private sector in Tanzania over the period 2002-2006, with the remainder being due to governance, red tape, and financing constraints. Transportation is reportedly the infrastructure constraint that weighs most heavily on businesses followed closely by water supply.

Community Impacts and Vulnerability

- Poor land use and infrastructure management leading to poor or biased choices for development.
- Inadequate infrastructure management failing to supply services (electricity, transport, water supply, health and education and communication) to coastal regions, resulting in a deterioration of living standards, business development and prosperity.

Threats from Climate Variability and Change

Three of the five major climate change hazard areas likely to affect coastal infrastructure, at least indirectly, are:

Extreme Weather Events – Increased rainfall volumes leading to faster deterioration of roads and drains; damage to communication and power infrastructure from direct impacts of weather; low-lying tourism infrastructure in Zanzibar vulnerable to increased frequency of storm events coinciding with high tides and sea level rise.

Sea Level Rise – Possible elevated salinization of coastal aquifers affecting safe water supplies.

Changes in Weather Patterns – Accumulation of standing water boosting water borne diseases and risk for drinking water supplies.

Outlook for Infrastructure

On Zanzibar and the mainland coast, considerable development in business and tourism is likely in the coming 5 to 10 years. Agricultural output, development and general trade are likely to witness accelerated growth in the near future, especially in the urban industrial zones. Improved roads and upgraded electricity will support the trend.

A daladala stop

On the mainland, coastal zone oil and gas development is already accelerating development in Mtwara, Lindi and Kilwa and has the potential to benefit livelihoods through employment, while companies in the sector are likely to further engage in the community and support local development.

Agricultural output, tourism development and general trade are likely to accompany the development growth, especially in the southern coastal regions, but also to the north. Tanga and Pangani are already witnessing growth in the tourism sector, largely due to better roads and infrastructure, and the trend is likely to continue.

As described in the industry sector theme (page 28), Tanzania has embarked on the concept of “development corridors”, whereby large public investments in energy and transport will support and boost private sector investment in mining and agriculture along four corridors, thus ensuring balanced regional growth, running from the coast inland. All extend from the coast, hence if these developments do materialize, the outlook for infrastructure that supports industry and development in coastal districts is positive. The challenge will be for the responsible ministries and local authorities to implement and maintain the infrastructure sub-sectors that are being developed.

Aerial view of the new Kigamboni Bridge (under construction) connecting Dar es Salaam with Temeke District's southern areas

Priority Actions for Mainland Infrastructure

The impacts of climate change on infrastructure are two-fold: that of direct impact on existing systems, many of which are already inadequate and inefficient; and second, and more serious, impacts on the increasing need for infrastructure where this is lacking in the face of rapid population growth. For example, pollution from the inadequate municipal sewage system of Dar es Salaam will only become more severe with climate change impacts described above. The design and construction of sewage systems was prioritized for the following 13 sites, with a total indicative cost of US$ 338.4 million:

- Tanga City (US$ 24.3 million)
- Pangani Town (US$ 24.3 million)
- Bagamoyo Town (US$ 34.3 million)
- Kinondoni Municipality (US$ 34.3 million)
- Ilala Municipality (US$ 34.3 million)
- Temeke Municipality (US$ 34.3 million)
- Kilindoni Town, Mafia (US$ 24.3 million)
- Kilwa Kivinje Town, Kilwa (US$ 24.3 million)
- Kilwa Masoko Town, Kilwa (US$ 24.3 million)
- Lindi Town, Lindi Urban (US$ 24.3 million)
- Mikindani Town, Mtwara Urban (US$ 24.3 million)
- Mtwara Town, Mtwara Urban (US$ 24.3 million)
- Safe toilet facilities for Bwejuu and Jibondo islands, Mafia District (US$ 6.8 million)

Priority Actions for Zanzibar Infrastructure

The constant discharge of sewage, mainly from large urban areas like the Stone Town and other large coastal settlements threatens the status of the seas surrounding Zanzibar. Facilities to contain and treat sewage are lacking throughout the isles. Health and pollution problems are widespread and strongly associated with waste management and are likely to worsen in light of the climate change impacts described on the previous page.

The construction or rehabilitation of these essential urban infrastructure facilities require immediate attention. The total indicative expenditure on the five proposed actions addressing sewage collection and treatment facilities on Zanzibar is US$ 161.5 million, focused on the following sites:

- Stone Town (US$ 24.3 million)
- Stone Town periphery (US$ 34.3 million)
- Nungwi Village and hotel areas (US$ 34.3 million)
- Mkoani, Pemba South (US$ 34.3 million)
- Chake Chake, Pemba South (US$ 34.3 million)

Urbanization

One of Temeke District's new residential complexes

According to official statistics, the proportion of people living in urban areas has increased on the mainland from about 6 per cent in 1967 to about 30 per cent in 2012, with Zanzibar's urban population for the same period increasing from about 29 per cent to 46 per cent of the total. The annual urban growth rate is about 2.8 per cent, indicating that Tanzania is one of the most rapidly urbanizing countries in the region. This growth rate is typical of most of the main coastal urban centers.

Among the 16 coastal districts are seven centers considered urban: Tanga city, Muheza, Bagamoyo, Dar es Salaam, Utete (Rufiji), Lindi and Mtwara. Of these, Dar es Salaam is by far the largest, with a population of about 151,000 in 1963, 2.5 million by 2001 and 4.4 million by 2012. Much of urban growth of Dar es Salaam has been unguided, characterized by informal settlements and unserviced housing areas. In Bagamoyo, 65 per cent of the urban population now live in unplanned and unserviced settlements, while the suburbs of Zanzibar's Stone Town have one of the highest proportions of urban residents living in unplanned settlements in all of sub-Saharan Africa.

In Zanzibar, 40 per cent of the population now lives in urban areas, which are growing at an annual rate of between 7 and 11 per cent. The five areas classified as urban are the towns of Wete, Chake Chake and Mkoani on Pemba and Zanzibar Stown Town and Makunduchi on Unguja.

Rapid urbanization is a major factor in the increased challenge of developing adequate infrastructure, as described earlier. The speed at which urbanization is taking place in most major coastal cities, places enormous pressure on the authorities to match the provision of basic services, yet, the advantages to citizens of urban life compared to rural existence are many, the most obvious being access to facilities, services and amenities, with more options for jobs and education.

Community Impacts and Vulnerability

- Poor urban management leading to informal settlements that lack clean water and adequate sanitation and unsanitary environments.
- Inadequate solid waste management and sanitation causing pollution of the landscape, watersheds and coastal areas.
- Failure of housing for the youth and children exposing them to human predators, violence, abuse and sexual assault that increase their risk of HIV infection.
- Poor capacity to manage the rapidly increasing volume of vehicles, leading to increasing congestion, conflicts and air pollution, which also impacts on the working hours and fatigue among the workforce.
- Encroachment into coastal habitats from urban expansion and poor urban management leading to environmental degradation.

Threats from Climate Variability and Change

Two of the five major climate change hazards likely to affect coastal urbanization, are as follows:

Changes in Weather Patterns – Increased population vulnerability due to high densities within unplanned urban areas leads to reduced drainage in certain areas and the increased risk of water-borne diseases (e.g. malaria, dengue), plus contamination of drinking water supplies. All will be worsened by changes in weather. Increased rainfall likely to impact on poor quality housing of urban informal settlements and exceed capacity of storm water and drainage systems.

Unregulated urban settlement on Zanzibar in lowland areas

Extreme Weather Events – Severe flooding is likely to impact more significantly on the urban poor settlements where the majority of urban dwellers live and are less informed and able to mobilize finances to adapt. Similarly, the unplanned/ illegal settlement in low-lying flood zones, especially in Dar es Salaam and around Zanzibar Stone Town are particularly vulnerable to flooding; coastal pollution following heavy rainfall due to discharge of solid and liquid wastes via rivers and drains directly into the marine environment.

Outlook for Urbanization

Urban growth in Tanzania's coastal urban centers and those of Zanzibar is projected to continue in the coming decades. However, if the current predicaments faced by urban centers are not addressed soon, conditions will deteriorate. As density increases and unplanned settlements become more congested, investments in facilities, services and infrastructure will become more expensive, both financially and socially.

Priority Actions for Mainland Urbanization

The impacts of climate change on urbanization are two-fold: direct impact on existing urban structures; and more serious, impacts of climate change on the lack of amenities faced by rapid population growth. For example, pollution from the inadequate municipal solid waste system of Dar es Salaam will only become more severe with climate change impacts described above. To address these short-comings, eleven solid waste collection and processing facilities are proposed, for the following cities and towns, budgeted at US$ 39.3 million:

- Tanga City (US$ 6.8 million)
- Pangani town (US$ 6.8 million)
- Bagamoyo Town (US$ 6.8 million)
- Kinondoni (US$ 7.8 million)
- Ilala (US$ 7.8 million)
- Temeke (US$ 7.8 million)
- Kilindoni, Mafia (US$ 7.8 million)
- Kilwa Kivinje, Kilwa (US$ 6.8 million)
- Kilwa Masoko, Kilwa (US$ 6.8 million)
- Lindi Town, Lindi Urban (US$ 6.8 million)
- Mikindani/Mtwara, Mtwara Urban (US$ 6.8 million)

Two further actions specifically address the need for urban planning at Bagamoyo, close to Dar es Salaam, and to support the national mainland environmental regulator as being directly relevant to urban planning and development:

- Bagamoyo town planning (US$ 0.4 million)
- Support for the NEMC (US$ 1.7 million)

Priority Actions for Zanzibar Urbanization

The status of the seas surrounding Zanzibar is threatened by the constant discharge of solid and liquid wastes, via rivers and from mangrove dump sites. Facilities to contain, treat and re-cycle waste are lacking throughout the isles. Health and pollution problems are widespread and strongly associated with waste management and are likely to worsen in light of the climate change impacts described above.

The construction or rehabilitation of these essential urban infrastructure facilities require immediate attention. The total indicative expenditure on the five regional solid waste collection and processing facilities on Zanzibar is US$ 39.3 million, focused on the following sites:

- Pemba North (US$ 6.8 million)
- Pemba South (US$ 6.8 million)
- Unguja North (US$ 6.8 million)
- Unguja West and Urban (US$ 12.1 million)
- Unguja South (US$ 6.8 million)

Sand and Rock Mining and Sea Salt

Tanzania has an extensive and diverse mining sector, mostly in the interior and west of the county. The coastal zone has mining operations focused on limestone for production of cement, and of live coral for manufacture of lime. Most salt in Tanzania is produced through evaporation of seawater.

Sand and Rock Mining
From Zanzibar and mainland coastal districts, sand, rock and coral (as rock or lime) are mined for the building industry, in a trade mostly unregulated, with few royalties accrued to the government. Illegal sand mining along beaches, in coastal streams/rivers (on the mainland), and at other restricted areas causes localized coastal erosion and environmental degradation and threatens coastal properties. At diverse mainland locations, live coral is used for manufacture of lime.

Salt Production
Along Tanzania's mainland coast, exist an estimated 3,697 hectares (ca. 37 km^2) of saltpans (mainly in Bagamoyo, Mtwara and Kilwa districts) while on Zanzibar saltpans cover some 105 hectares (ca. 1 km^2). Volumes of salt produced are relative to areas of saltpans, thus Zanzibar production is minor. As with rock and sand mining most of operations are unregulated. Several hundred operators exist, with most mainland operations consisting of evaporation ponds from seawater intake points to the crystallizing ponds. The industry continues to suffer from inconsistent iodization, with southern regions of Mtwara and Lindi (and Pemba, Zanzibar) with the lowest levels of iodized salt consumption.

Community Impacts and Vulnerability

Sand and Rock Mining

- Poor management or shores and river basins and poor understanding of coastal processes leading to shore erosion.
- Destruction of coral reef protection services by removal of live coral threatens coastal infrastructure and fisheries resources.
- Reduced coastal sand recharge from rivers due to over-extraction of river sand.
- Weak or dysfunctional institutional enforcement of mining policy to protect rivers and coastline.
- Anarchistic sand and rock extraction from coastal zone resulting in increased erosion.
- Loss of river basin habitat and beach habitats for turtle nesting from un-regulated beach and river sand extraction.
- Economic losses through loss of coastal aesthetics, depleting Tanzania's value for tourists.
- Increased water borne diseases from rain-filled quarries.
- Shallow water table contamination from poorly cited quarries.
- Sea Salt Production
- Lack of support with infrastructure (e.g. roads) and land tenure, disincentive for investors in the industry.
- Unplanned urbanization reduces land for expansion.
- Unsustainable practices degrading mangroves and causing losses with respect to shelter from wave action and fisheries.
- Local population prone to iodine deficiency disorders (IDD) from low iodization of salt.

Aerial view of new coastal salt evaporation ponds in Mkuranga District

Threats from Climate Variability and Change

Two of the five major climate change hazards are likely to affect coastal mining and salt production, as follows:

Changes in Weather Patterns – Unseasonal rain affecting evaporation and production in saltpans, as well as access to river sand.

Extreme Weather Events – Extreme rainfall and storm events significantly damaging salt pan structures (dykes).

Outlook for Coastal Mining and Sea Salt

Sand/Rock Mining – With the GDP growth rates of Tanzania and Zanzibar reaching 6-7 per cent and expected to continue in the construction industry, demand for materials such as bricks, limestone, sand and gravel are likely to remain. Hence, the coastal mining sub-sectors will probably continue to boom, with increased volumes traded, and increased impacts if left unregulated.

Sea Salt Production – On Zanzibar, the salt industry has very little room for expansion. Meanwhile on the mainland, Value Added Tax on salt sold makes it more expensive to the consumer and the tax burden is a disincentive to development of the sector. Though mainland sea salt industry has room for expansion, to the benefit of the wider economy, population and livelihoods of those involved, the industry needs to be supported and managed within a holistic shoreline management plan.

Priority Actions for Coastal Mining and Sea Salt

As impacts of climate change are not considered likely to significantly affect coastal mining operations in the short term (5 to 10 years), the study did not prioritize any actions specific to this sector, other that the systemic actions that are also relevant. However, the strengthening of the national environmental regulator NEMC on the mainland was seen as being directly relevant to guiding the coastal mining and solar salt production industries.

- Support for the NEMC (US$ 1.7 million)

Oil and Gas

Deep sea exploration drilling off Lindi District

Part of buried gas pipeline in Mtwara, extending to Dar es Salaam

Since 2004, the gas from Songo Songo gas field has been piped 232 km to generate electricity in Dar es Salaam, at the Ubungo Power Station. By 2007, the gas from the Mnazi Bay gas field was used to produce electricity in Mtwara and in Lindi by 2009. These are significant milestones in the development of self-sufficiency in the oil and gas sector.

In southern Tanzania, offshore exploration drilling has continued, with now enough proven reserves of methane discovered by the BG Group (UK) and Statoil (Norway) to justify investment in the construction of a Liquefied Natural Gas (LNG) plant at Lindi. Pending final investment decisions by the exploration companies, construction is expected to begin by 2016 and last 10 to 15 years before the liquefied gas can be sold on the international market, with significant revenues and abundant gas realized by Tanzania. Meanwhile, a 500 km gas pipeline is presently nearing completion to supply surplus gas from the Mnazi Bay gas field near Mtwara and the Songo Songo gas field to Dar es Salaam, providing feed gas to significantly boost electricity generation in 2016.

Unlike the southern mainland coast of Tanzania, there has been very little exploration on Zanzibar, mainly due to definitions over "Union resources", something that is likely to change when the new Constitution is finally agreed. The island of Pemba contains hydrocarbons, evidenced through a natural oil "seep" on the west coast, though this is no guarantee of commercial volumes.

Community Impacts and Vulnerability

- Vagaries of the international demand, and hence world market prices for oil and gas (the driving force for exploration), beyond Tanzania's control, may threaten local development of the sector, local jobs and livelihoods.
- Degradation of the natural marine and coastal environment (from accidental and operational spills of oil compounds and other chemicals) which potentially can impact livelihoods, may occur from failure of companies to adhere to environmental and socio-economic safeguards, partly due to weakness in the oversight provided by national regulators responsible for environmental and social impact assessments (ESIAs) and project monitoring.
- Social and/or political unrest related to behavior of the Government and other stakeholders, compounded by the perceived inequality partly due to lack of information and poor awareness of the project cycle.
- Piracy attacks against offshore operations (reduced significantly from 2014).
- Damage to infrastructure and environment from engineering design failure.

Threats from Climate Variability and Change

By their very design, oil and gas infrastructure and vessels are not expected to be significantly impacted in the short term by any of the five major climate change hazards.

Outlook for Oil and Gas

For mainland Tanzania (and potentially also for Zanzibar in the future), exploration and development operations are likely to witness significant increase in volumes extracted and traded, income generated and employment created.

Priority Actions for Oil and Gas

Climate change impacts are not considered likely to affect oil and gas operations in the short term (5 to 10 years), consequently the study did not prioritize any actions specific to this sector, though some of systemic actions are particularly relevant (see page 17). AS for some of the latter thematic sector, strengthening of the national environmental regulator NEMC on the mainland was seen as being directly relevant to supporting oil and gas development.

- Support for the NEMC (US$ 1.7 million)

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