Coastal Profile for Tanzania Mainland 2014
District Volume II
Including Threats Prioritisation

Investment Prioritisation for Resilient Livelihoods and Ecosystems in Coastal Zones of Tanzania

NORDIC DEVELOPMENT FUND

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Acronyms[1]

Addax	International oil and gas exploration and production company
AEWA	African-Eurasian Waterbird Agreement
AGIP	Azienda Generale Italiana Petroli (General Italian Oil Company)
BG	British Gas
BMU	Beach Management Units
BoE	Barrels of oil Equivalent
CAMARTEC	Center for Agricultural Mechanization and Rural Technology
CARE	Cooperative for Assistance and Relief Everywhere
CBNRM	Community Based Natural Resource Management
CC	Carrying Capacity
CFMA	Collaborative Fisheries Management Areas
CFMU	Collaborative Fisheries Management Units
CITES	Convention on International Trade in Endangered Species
CAM	Collaborative Management Areas
CMCA	Community Marine Conservation Areas
CMIP	Coupled Model Intercomparison Project
CNPC	China National Petroleum Corporation
CPTDC	China Petroleum and Technology Development Company
CPUE	Catch per Unit Effort
CPUF	Catch per Unit Fisher
CPUFV	Catch per Unit Fishing Vessel
CRIAM	Coastal Rapid Impact Assessment Matrix
CRIF	Coral Reef Information System
CSAG	Climate Systems Analysis Group (University of Cape Town)
CTI	Confederation of Tanzania Industries
DCCFF	Department of Commercial Crops, Fruits and Forestry
DDT	dichlorodiphenyltrichloroethane
DED	District Executive Director
DEM	Digital Elevation Model
DFMP	Department of Fisheries and Marine Products
DoE	Department of Environment
DSFA	Deep Sea Fishing Authority
DSS	Decision Support System
DWT	Dead Weight Tonnage
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
Engen	Energy company focusing on the downstream refined petroleum products
EPZ	Economic Promotion Zone
EPZA	Export Processing Zones Authority
ERA-Interim	Model for near real time reanalysis used by the European Centre for Medium-Range Weather Forecasts
ESRF	Economic and Social Research Foundation
EV	Evaluation Value calculated in CRIAM
EWURA	Energy and Water Utilities Authority

[1] The list of abbreviations and acronyms covers all volumes, i.e. thematic and district/region for Mainland Tanzania and for Zanzibar

EximBank	China Export-Import Bank
FDD	Fisheries Development Division
FMP	Fisheries Management Plans
FR	Forest Reserve
FYDP	National Fisheries Development Plan
GapCo	Gulf Africa Petroleum Corporation
GapOil	Retailers and marketer of petroleum products (GapCo subsidiary)
GCAP	Global Climate Adaptation Partnership
GCM	General Circulation Model
GDP	Gross Domestic Product
GHG	Green House Gasses
GIS	Geographical Information System
GoT	Government of Tanzania
GOZ	Government of Zanzibar
GPS	Global Positioning System
GSM	Global System for Mobile communication
HAT	Hotel Association of Tanzania
HEP	Hydro Electric Power
HIMA	Hifadhi Misitu ya Asili
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immuno Deficiency Syndrome
IBA	Important Bird Areas
ICM	Integrated Coastal Management
ICT	Information and Communication Technology
ICZM	Integrated Coastal Zone Management
IDD	Iodine Deficiency Disorder
IIDS	Integrated Industrial Development Strategy
IMS	Institute of Marine Sciences
IOD	Indian Ocean Dipole
IPCC	Intergovernmental Panel on Climate Change
ISCP	Innovation Systems and Cluster Programme
IUCN	International Union for Conservation of Nature
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
KNMI	Koninklijk Nederlands Meteorologisch Instituut (Royal Dutch Meteorological Institute)
LEAT	Lawyers' Environmental Action Team
LGA	Local Government Authority
LNG	Liquefied Natural Gas
LUP	Land Use Plans
MACEMP	Marine and Coastal Environmental Management Project
MAFSC	Ministry of Agriculture, Food Security and Cooperatives
MALE	Ministry of Agriculture, Livestock and Environment, Zanzibar
MANREC	Ministry of Agriculture, Natural Resources, Environment and Cooperatives
MARUHUBI	Zanzibar Institute of Tourism
MCS	Marine Control and Surveillance
MCU	Marine Conservation Unit
MIC	Ministry of Infrastructure and Communications
MIMCA	Mnemba Island Marine Conservation Area
MIT	Ministry of Industry and Trade
MKURABITA	Property and Business Formalization Program
MKUZA II	Zanzibar Strategy for Growth and Poverty Reduction

MLFD	Ministry of Livestock and Fisheries Development
MNRT	Ministry of Natural Resources and Tourism
MoT	Ministry of Transport
MOW	Ministry of Water
MoW	Ministry of Works
MPA	Marine Protected Area
MRPU	Marine Reserves and Park Unit
MSME	Micro, Small and Medium Enterprises
MSY	Maximum Sustainable Yield
MUKUTA	National Strategy for Growth and Reduction of Poverty (NSGRP)
MVIWATA	Mtandaowa Vikundivya Wakulimawa Tanzania (farmers network)
NAPA	National Adaptation Programme of Action
NAWAPO	National Water Policy
NAWESCO	National Sustainable Wetlands Management Steering Committee
NBS	National Bureau of Statistics
NDC	National Development Corporation
NEMC	National Environmental Management Council
NFP	National Forest Programme
NGO	Non-Government Organisation
NICEMS	National Integrated Coastal Environment Management Strategy
NSGRP	National Strategy for Growth and Reduction of Poverty
PCB	Polychlorinated Biphenyl
PMO-RALG	Prime Minister's Office for Regional and Local Government
PSA	Production Sharing Agreement
Ramsar	International convention on wetlands management
REDD	Reducing Emissions from Deforestation and forest Degradation
RIAM	Rapid Impact Assessment Matrix
RV	Range Value calculated in CRIAM
SACCOS	Savings and Credit Cooperative Organizations
SAGCOT	Southern Agriculture Corridor of Tanzania
SCUBA	Self-Contained Underwater Breathing Apparatus
SEC	South Equatorial Current
SESIA	Strategic Environmental and Social Impact Assessment
SEZ	Special Economic Zone
SIDO	Small Industries Development Organization
SIDP	Sustainable Industrial Development Policy
SME	Small and Medium sized Enterprises
SMOLE	Sustainable Management of Land and Environment
SPM	Single Point Mooring
SSHS	Saffir-Simpson Hurricane Scale
SST	Sea Surface Temperature
STCDA	Stone Town Conservation and Development Authority
SUMATRA	Surface and Marine Transport Regulatory Authority
SWMP	Sustainable Wetlands Management
TAA	Tanzania Airports Authority
TAFORI	Tanzania Forestry Research Institute
TAMPA	Tanzania Milk Processors Association
TAMPRODA	Tanzania Milk Producers Association
TANESCO	Tanzania Electric Supply Company Limited
TASONABI	Tanzania Specialist Organisation on Community Natural Resources and Biodiversity Conservation

TASPA	Tanzania Salt Producers Association
TATO	Tanzanian Association of Tour Operators
TAWA	Tanzania Wildlife Authority
TAZARA	Tanzania-Zambia Railway
TCAA	Tanzania Civil Aviation Authority
TCCIA	Tanzania Chamber of Commerce, Industries and Agriculture
TCF	Trillion Cubic Feet
TCMP	Tanzania Coastal Management Partnership
TCPL	Trans Canada Pipeline Limited
TD	Tropical Depression
TEMDO	Tanzania Engineering and Manufacturing Design Organization
TEU	Twenty-foot Equivalent Units
TFCG	Tanzania Forest Conservation Group
TFNC	Tanzania Food and Nutrition Centre
TFS	Tanzania Forest Services
TGFA	Tanzania Government Flight Agency
TIPER	Tanzania Italian Petroleum Oil Refinery
TIRDO	Tanzania Industrial Research Development Organization
TLU	Total Livestock Units
TMA	Tanzania Meteorological Agency
TNBC	Tanzanian National Business Council
TNRF	Tanzania Natural Resources Forum
TPA	Tanzania Ports Authority
TPCC	Tanzania Portland Cement Company
TPDC	Tanzania Petroleum Development Corporation
TPSF	Tanzania Private Sector Foundation
TRAFFIC	The Wildlife Trade Monitoring Network
TS	Tropical Storm
TSH	Tanzania Currency Unit
TTB	Tanzania Tourist Board
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFPA	United Nations Population Fund
URT	United Republic of Tanzania
USD	United States Currency Unit
VAT	Value Added Tax
VICOBA	Village Community Banks
VLFR	Village Land Forest Reserves
VPO	Vice President's Office
WB	World Bank
WCST	Wildlife Conservation Society of Tanzania
WRIAM	Water Resources Impact Assessment Matrix
WWF	World Wildlife Fund
ZATI	Zanzibar Association of Tourism Investors
ZATO	Zanzibar Association of Tour Operators
ZAWA	Zanzibar Water Authority
ZCT	Zanzibar Commission for Tourism
ZECO	Zanzibar Electricity Corporation
ZIPA	Zanzibar Investment Promotion Authority
ZNCCIA	Zanzibar National Chamber of Commerce, Industry and Agriculture
ZPC	Zanzibar Port Corporation
ZPRP	Zanzibar Poverty Reduction Plan

Table of Units

BoE	Barrels of oil Equivalent
ft	feet
ha	hectare
km	kilometre
km^2	square kilometre
m	meter
m^2	square meter
m^3	cubic meter
Mm^3	Million cubic metres
mmscf	million standard cubic feet
MV	Mega Volt
MW	Mega Watt
s	second
TCF	Trillion Cubic Feet
TEU	Twenty-foot Equivalent Units

1. INTRODUCTION

Coastal Areas

Vulnerable Areas under Pressure

Coastal areas represent complex and dynamic systems both in terms of human activities and in terms of their biophysical conditions. Today, a significant proportion of the global population lives in coastal areas and the proportion is growing. The effects of the increased pressure are degradation of the environment through pollution and unsustainable exploitation of coastal living and non-living resources. Increasing population density, industrial development, and economic growth have given rise to a variety of additional economic activities, the combined effects of which increase the pressure on coastal areas and their resources. This frequently results in cumulative and complex impacts on the environment, depletion of resources and intensified conflict between competing user groups.

There is a limit to the capacity of coastal environments to sustain human activities without deterioration, and many coastal areas today show signs of severe degradation. One example is exploitation of coastal fish stocks, providing most of worldwide marine fish harvests, which has exceeded sustainable levels in many areas. Another is the loss at an alarming rate of coastal wetlands due to amongst others, interference with hydraulic patterns, conversion to aquaculture and other land uses, pollution, coastal erosion, land reclamation and harbour development. Coastal wetlands such as mangrove swamps, sea grass meadows and lagoons and estuaries are critically important as nursery grounds for a number of coastal fish and shrimp species, they assist in shore protection, and their high biological productivity plays a significant role in impairing or diminishing the effects of organic and nutrient pollution.

Coastal areas are particularly vulnerable to climate variability and climate change, with low-lying areas exposed to inundation through sea level rise and to flooding due to surges during extreme events. Shoreline dynamics is influenced by changes in wave climates and currents and by alterations in catchment hydraulics. Coastal ecosystems will be impacted by changes in temperatures and in seawater acidity.

Tanzania

Tanzania relies on the rich natural resources of its coastal areas. The coastal environments and their valuable resources of water, fisheries, estuaries, mangroves, coral reefs, seagrass beds, recreational areas and arable land are increasingly under pressure as the country develops. Economic growth and industrialisation are exerting pressure on the sensitive coastal ecosystems.

Some of the dominant sectors in Tanzania are the oil and gas sector, the fisheries sector, the agriculture sector, the forestry sector and the tourism sector. Fisheries are predominantly artisan in the near-shore waters where stocks are exploited near or above sustainable yield levels. Coral reefs are suffering from the effects of unsustainable fishing methods such as the use of explosives, whereas offshore fisheries are only carried out to little extent offering some possibilities for further development. Coastal aquaculture offers some potential, particularly within shrimp farming, seaweed farming and cage culture. Whereas coastal tourism is prominent for Zanzibar, coastal areas in the mainland offer significant unexploited potential for tourism development. Land and water resources use activities inland represent potential threats to the coastal areas due to the risk of disturbing hydraulics and siltation patterns on which coastal ecosystems rely. The oil and gas exploration and production activities cause a potential threat to the coastal zone, both in relation to shipping and to offshore activities. Urbanisation and the increasing population pressure in general exert pressure on the environmental quality along the coasts.

The coastlines in some areas suffer from coastal erosion, which may be further worsened by sand mining.

The present coastal zone management is characterised by insufficient integration, co-ordination and co-operation among relevant government agencies at state and local levels and other parties with vested interests in the coastal areas.

There is awareness in Tanzania of the need to strike a balance between competing coastal activities and uses of coastal resources in ways, which recognise commercial and strategic interests, potential coastal hazard, and the need to conserve important natural resources to ensure sustained food yields. Conventional sector planning and management has shortcomings in addressing the many conflicting interests in the coastal zone and in a long term perspective an integrated multi-sector approach is required to ensure sustainable future development of the coastal zone.

In order to address these management challenges the Government of Tanzania with World Bank assistance has through the project "Investment Prioritisation for Resilient Livelihoods and Ecosystems in Coastal Zones of Tanzania" embarked on identifying and prioritising threats with the view of developing fundable adaptation measures to address the most pertinent threats.

The Project

Partners

The World Bank (WB) finances the study with trust funds provided by Nordic Development Fund (NDF).

The client for the project is Fisheries Department at the Ministry for Livestock and Fisheries Development (MLFD) in Dar es Salaam and the Department of Fisheries and Marine Resources at the Ministry of Agriculture, Livestock and Environment (MALE) in Zanzibar.

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

Objectives

The objective of the study is to prioritise geographically and thematically the actions to promote sustainable coastal livelihoods and ecosystems in Tanzania (both Mainland and Zanzibar). The results will comprise proposals for measures for coastal management and climate change adaptation in Tanzania, which the Government of Tanzania, NGOs, and donors can use to guide their support and investments over a five-year period.

The specific objectives are to:

1. Conduct a review of current coastal management and climate change adaptation studies and planning activities in Tanzania Mainland and Zanzibar, including an inventory of data and information available;
2. Identify, analyse and geographically locate the most important livelihood sources of Tanzania's coastal communities, and the ecosystems on which they depend;
3. Assess the economic costs of climate change on coastal communities and analyse the adaptive capacity of these communities;
4. Identify and geographically locate a gross list of major climate-related threats to sustain these livelihood sources and the ecosystems they depend on;

5. Evaluate the gross list of threats in terms of probability of occurrence, prediction confidence, and consequences if a 'business as usual' scenario is applied;
6. Identify possible adaptation measures to mitigate the threats and evaluate these measures in terms of cost-benefit efficiency and reasonability to implement;
7. Analyse the characteristics of the threats and adaptation measures to prioritise them and identify the most urgent and important investments for sustainable coastal livelihoods and ecosystems;
8. Identify on-going and planned projects supporting coastal management and climate change initiatives in coastal areas, and recognise overlaps with the above found priorities;
9. Identify data monitoring and research needs that should be addressed to augment the implementation and sustainability of the recommended investments;
10. Establish a GIS database to document the results from the above objectives to the extent possible. The data base should be used as the basis upon which to undertake spatial analysis and thereby assist in prioritizing adaptation investments, based in large part on the characteristics and geographic locations of the major threats to sustainable livelihood sources.;
11. Develop an action plan for priority investment in the short-term (next five years) under multiple funding scenarios. The action plan should consider the prioritisation 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 Tanzania Mainland or Zanzibar.

Phases and Activities

The study has proceeded in three phases:

- **Extended Inception Phase** during which systematic efforts were made to identify, acquire, and review as recent information on the situation in the coastal areas. This phase was completed with two workshops in Dar es Salaam and Stone Town where feedback was given from key stakeholders on the results achieved during the inception period.

  These results were described in an inception report containing a consolidated description of the coastal areas, their resources, socio-economic characteristics and current management, as well as major challenges from both increased anthropogenic pressure and climate change. The report also provided an overview of data and information identified as pertinent for coastal zone management, including a description of the geographical information system (GIS) built as part of the study. The overview is provided as a database of documents and a meta-description of the GIS. The inception report also contained a preliminary list of major threats to coastal areas and a proposed method to analyse these in regard to relevance and adaptation possibilities.

  The inception report was presented in the form of a coastal profile for Tanzania with three volumes as further detailed below.

  The inception report was finalised and distributed in soft copy after the workshops to incorporate feedback from stakeholders on the identified threats. A series of posters was displayed at the workshop presenting selected themes and providing a district level overview.

  Objectives achieved during this phase were 1, 2, 3, 4, 8 and 10.

  Objectives contributed to during this phase were 5, 7 and 9.

- **Prioritisation Study** through which the threats identified in the extended inception phase was examined in more detail in order to prepare a final list of threats for multi-criteria

assessment, which in turn in the process also serves as basis to examine adaptation measures addressing these threats.

The final list of threats and adaptation measures has been reviewed against already existing or planned adaptation projects to avoid overlapping and duplication in the final development of a package of adaptation measures for a 5 year period that can assisting in building resilience of coastal livelihoods and ecosystem.

Objectives achieved during this phase were 5, 6, 7, 9 and 11.

- **Reporting and Dissemination** was the final activity under the study and included a validation among major stakeholders through final workshops in Dar es Salaam and Stone Town. The final report from the study described the list of threats and adaptation measures, the method and results of the multi-criterion analysis, the investment prioritisation and proposed adaptation measures.

Schedule

The duration of the study was from the start estimated to be nine months, allocating three months for the extended inception phase, four months for the prioritisation study and two months reporting and dissemination of the results. The project activities, which started in earnest in November 2013, reached the completion of the extended inception period by mid April 2014 thus experiencing a delay of almost three months reflecting difficulties in acquiring information required for the updated coastal profile and adjusting to schedules of stakeholders.

Although efforts were made to comply with the original scheduled completion of the study by September 2014, the completion was achieved in end January 2015.

Coastal Profile

Presentation of the Coastal Profile

The coastal profile has been based primarily on secondary data, acquired from key stakeholders during the extended inception period. A database has been established listing all relevant documents identified and linkages to soft copies have been included as available.

A Geographical Information Systems (GIS) has been established to contain acquired themes. The GIS has furthermore been used to examine inundation and flooding consequences of various Sea Level Rise scenarios. These analyses use a Digital Elevation Model (DEM) developed for the coastal areas of the country. The GIS has also been used to produce district level statistical information.

The coastal profile has three volumes:

Volume I: Coastal Themes, presenting the situation in the coastal zone thematically, i.e. from the perspective of various sectors and other countrywide themes. Further details are provided in the presentation of the volume below.

Volume II: Coastal Districts, offering an overview of the situation in the coastal zone of each district, localising and adding detail to the information in Volume I.

Volume III: Maps and Tables, presenting thematic and district maps in A3 format and offering tabulated information, collected from documents consulted or generated from the GIS.

A key requirement for all themes and all district presentation has been to identify threats to coastal communities and ecosystems, as has an assessment of vulnerability to climate variability and climate change.

Threats Prioritisation

Process

The coastal profiles were presented in detail for key stakeholders at the Inception Workshops in Dar es Salaam and Zanzibar in April 2014 together with a tool for prioritising the threats to local communities and ecosystems that had been identified in the coastal profiles. The participants in the inception workshops are listed in Annex 6.

Full details on the prioritisation tool, the Coastal Rapid Impact Assessment Matrix (CRIAM), are provided in Annex 3 to this version of the coastal profile. It is particularly useful in developing consensus on management issues among multiple stakeholders in situations where baseline information is scarce and or out of date. It is as the name indicates a rapid tool relying substantially on the knowledge, experience and perception among the group of people using the tool.

The participants at the inception workshops engaged in rapid sessions using the tool to assess the relative importance of the threats identified in the coastal profiles, while also allowing additional threats to be included in the assessment.

To consolidate the CRIAM assessments two smaller working groups were formed in Dar es Salaam and Zanzibar to systematically review and assess all identified threats and to outline broad measures that could be undertaken to address these threats. These measures would then provide guidance for further action oriented detailing towards the development of actions in the form of project sheets.

These working groups of around 10 to 15 members were composed of key actors with particular and recent knowledge about the coastal situation and challenges in mainland Tanzania and Zanzibar. The members of the working groups have been attached this report as Annex 7.

Two full day working sessions took place in June 2014 in each group. The results of their work has since then been further processed and included in the current Version 1 of the Coastal Profile. Details are presented as new subsections in each of the thematic chapters. These are:

- CRIAM Ranking of Threats to Local Communities associated with the theme covered in the chapter
- Outline of Broad Measures to Address Threats to Local Communities associated with the theme covered in the chapter

The working groups were also requested to consider and evaluate the threats identified in the District/Regional Coastal Profiles using the CRIAM methodology and these documents have been updated accordingly.

Threats Prioritisation Methodology Brief

All threats identified in the coastal profiles have been systematically assessed using five criteria:

Criterion A_1 - Importance of condition[2], which is a measure of the importance of the threat, which is assessed against the spatial boundaries or human interests it will affect. Values can be allocated between 4 and 0 as follows:

$A_1 = 0$: No importance

[2] The CRIAM methodology has been used to rank threats both in the thematic and in the district/regional volumes of the coastal profile. The resulting evaluation scores cannot be compared directly between these dimensions as the A_1 values differ. In the thematic volume, the value 3 is allocated for a threat distributed throughout the coast, whereas the value 3 in the district/regional volume is allocated for a threat distributed throughout the district/region.

A_1 = 1: Important only to local condition
A_1 = 2: Important to areas immediately outside local condition
A_1 = 3: Important to regional/national interests
A_1 = 4: Important to national/international interests

Criterion A_2 - Magnitude of change / effect, which is a measure of the scale of the threat. Values can be allocated between 3 and 0 as follows:

A_2 = 0: No change / status quo
A_2 = 1: Negative change to status quo
A_2 = 2: Significant negative dis-benefit or change
A_2 = 3: Major dis-benefit or change

Criterion B_1 – Permanence, which considers whether the threat is temporary or permanent. Values can be allocated between 3 and 1 as follows:

B_1 = 1: No change / not applicable
B_1 = 2: Temporary
B_1 = 3: Permanent

Criterion B_2 – Reversibility, which considers whether the threat can be changed and is a measure of the control over the effect of the condition. Values can be allocated between 3 and 1 as follows:

B_2 = 1: No change / not applicable
B_2 = 2: Reversible
B_2 = 3: Irreversible

Criterion B_3 – Cumulative character, which considers whether the threat has a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other threats. Values can be allocated between 3 and 1 as follows:

B_3 = 1: No change / not applicable
B_3 = 2: Non-cumulative / single
B_3 = 3: Cumulative / synergistic

The overall assessment of each threat is calculated using the following formula:

$$Evaluation\ Score\ (ES) = A_1 \times A_2 \times (B_1 + B_2 + B_3)$$

According to the severity of threats, the evaluation scores can reach values between 0 and 108. For a simpler overview, these scores translates into problem classes as shown in Table 1.

Table 1: Translation of Evaluation Scores into Range Values / Problem Classes

Score (ES)	Range value (RV)	Problem Class
0	0	No importance / Not applicable
1 to 9	1	Slight Problem
10 to 18	2	Problem
19 to 35	3	Important Problem
36 to 71	4	Very Important Problem
72 to 108	5	Major Problem

Full details on the prioritisation methodology are attached in Annex 3: Coastal Rapid Impact Assessment Matrix (CRIAM).

Overall Threats Prioritisation Outcome

Altogether 119 of the threats to coastal communities and ecosystems identified in the ditrict coastal profile for mainland Tanzania have been prioritised. Out of these 4 were considered to constitute

major problems, 38 very important problems, 39 important problems, 25 problems and 13 light problems. The district grouping of the problems are presented in Table 2 below.

Table 2: Overview of threats and their severity in the coastal districts of Mainland Tanzania. Key to threat ranking is 1 = slight problem; 2 = problem; 3 = important problem; 4 = very important problem; and 5 = major problem.

District	Threats as stated in the District Coastal Profile for Mainland Tanzania	1	2	3	4	5	Grand Total
Bagamoyo	Beach erosion		1			1	2
	Beach pollution			1			1
	Fisheries decline				1		1
	Forest habitat destruction			1			1
	Loss of habitat and agricultural area					1	1
	Loss of land and environmental damage		1				1
	Mangrove			1			1
Bagamoyo Total			**2**	**3**	**1**	**2**	**8**
Ilala	Beach and nearshore pollution			1			1
	Beach erosion			1			1
	Diseases outbreaks				1		1
	Fisheries decline				1		1
	Heavy metals pollution			1			1
	Industrial Pollution			1			1
	Oil pollution				1		1
	Sewage pollution			1			1
Ilala Total				**5**	**3**		**8**
Kilwa	Beach erosion		1				1
	Beach pollution		1				1
	Fisheries decline				1		1
	Marine pollution		1				1
Kilwa Total			**3**		**1**		**4**
Kinondoni	Beach erosion				1		1
	Beach pollution				1		1
	Diseases outbreaks			1			1
	Fisheries decline				1		1
	Flooding				1		1
	Heavy metal pollution			1			1
	Land use conflicts				1		1
	Loss of habitat and agricultural area			1			1
Kinondoni Total				**3**	**5**		**8**
Lindi Rural	Beach erosion		1				1
	Beach pollution	1					1
	Fisheries decline				1		1
	Loss of habitat			1			1
	Sea pollution	1					1
	Water source drying				1		1
Lindi Rural Total		**2**	**1**	**1**	**2**		**6**
Lindi Urban	Beach erosion		1				1
	Beach pollution		1				1
	Bush fires			1			1
	Diseases outbreaks	1					1
	Fisheries decline				1		1
	Loss of habitat and agricultural area	1					1
Lindi Urban Total		**2**	**2**	**1**	**1**		**6**
Mafia	Beach erosion		1				1
	Beach pollution			1			1
	Diseases outbreaks			1			1
	Fisheries decline				1		1
	HIV/AIDS increases			1			1
	Land use conflicts		1				1
	Loss of habitat area			1			1

District	Threats as stated in the District Coastal Profile for Mainland Tanzania	1	2	3	4	5	Grand Total
	Marine pollution		1				1
Mafia Total			**3**	**4**	**1**		**8**
Mkinga	Beach pollution			1			1
	Diseases outbreaks			1			1
	Fisheries decline				1		1
	Heavy metal pollution	1					1
	Land use conflicts				1		1
	Marine pollution		1				1
Mkinga Total		**1**	**1**	**2**	**2**		**6**
Mkuranga	Beach erosion		1				1
	Beach pollution			1			1
	Decrease in mangrove and forest habitat and agricultural area			1			1
	Diseases outbreaks			1			1
	Fisheries decline				1		1
	Habitat loss as well as loss of agricultural area			1			1
	Land use conflicts		1				1
	Loss of biodiversity (i.e. disappearance of Dugong)		1				1
Mkuranga Total			**3**	**4**	**1**		**8**
Mtwara Rural	Beach erosion		1				1
	Beach pollution		1				1
	Diseases outbreaks	1					1
	Fisheries decline				1		1
	Habitat destruction			1			1
	Land use conflicts				1		1
	River and estuary pollution	1					1
Mtwara Rural Total		**2**	**2**	**1**	**2**		**7**
Mtwara Urban	Beach erosion				1		1
	Beach pollution				1		1
	Diseases outbreaks		1				1
	Fisheries decline				1		1
	Heavy metal pollution	1					1
	Loss of habitat and agricultural area				1		1
Mtwara Urban Total		**1**	**1**		**4**		**6**
Muheza	Beach erosion				1		1
	Beach pollution			1			1
	Diseases outbreaks			1			1
	Fisheries decline					1	1
	Flooding	1					1
	Land use conflicts				1		1
	Reduced citrus yields	1					1
Muheza Total		**2**		**2**	**2**	**1**	**7**
Pangani	Beach erosion				1		1
	Beach pollution				1		1
	Decline in sea turtle population				1		1
	Fisheries decline				1		1
	Increase of HIV infection		1				1
	Land use conflicts			1			1
	Loss of habitat and agricultural area			1			1
	Marine pollution		1				1
	River erosion		1				1
Pangani Total			**3**	**2**	**4**		**9**
Rufiji	Beach pollution				1		1
	Diseases outbreaks			1			1
	Fisheries decline				1		1
	Flooding of construction areas and vulnerable river valleys			1			1
	Land use conflicts			1			1
	Loss of habitat and agricultural area				1		1

District	Threats as stated in the District Coastal Profile for Mainland Tanzania	1	2	3	4	5	Grand Total
	Marine pollution				1		1
	River and estuary pollution			1			1
Rufiji Total				**4**	**4**		**8**
Tanga	Beach erosion				1		1
	Beach pollution				1		1
	Fisheries decline					1	1
	Freshwater supply reduction		1				1
	Heavy metal pollution	1					1
	Land use conflicts	1					1
	Loss of habitat and agricultural area		1				1
	Loss of land and environmental damage		1				1
	Marine pollution	1			1		2
Tanga Total		**3**	**3**		**3**	**1**	**10**
Temeke	Beach erosion				1		1
	Beach pollution			1			1
	Fisheries decline				1		1
	Flooding			1			1
	Forest decline			1			1
	Heavy metal pollution			1			1
	Industrial Pollution			1			1
	Loss of habitat and agricultural area		1				1
	Oil pollution			1			1
	River condition decline			1			1
Temeke Total			**1**	**7**	**2**		**10**
Grand Total		**13**	**25**	**39**	**38**	**4**	**119**

The details of the ranking of threats within each district are presented in the district chapters under a separate CRIAM heading. A brief overview of threats within each problem class is tabulated in Table 3 to Table 7.

Table 3: Threats assessed to impose major problems to local communities and ecosystems. The assessment has been made using the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

District	Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Bagamoyo	Beach erosion	Kaole, generally along the coast	3	3	3	2	3	72	5					
Muheza	Fisheries decline	At the near shore coastal area	3	3	3	2	3	72	5					
Tanga	Fisheries decline	In the near shore waters including: Kisosora, Chumvini, Msakangoto, Sahare	3	3	3	2	3	72	5					
Bagamoyo	Loss of habitat and agricultural area		3	3	3	2	3	72	5					

Table 4: Threats assessed to impose very important problems to local communities and ecosystems. The assessment has been made using the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

District	Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Muheza	Beach erosion	Kigombe, Msakangoto	3	3	3	2	2	63	4					
Kinondoni	Beach erosion	Entire Coast and particularly at Kunduchi area, Ununio and Mbweni	3	3	3	2	2	63	4					
Mtwara Urban	Beach erosion	Mikindani and Mtwara towns	3	2	3	2	2	42	4					
Tanga	Beach erosion	All along district sea front	3	2	3	2	2	42	4					
Pangani	Beach erosion	Along entire coast and in particular at Pangani Town, Ushongo	3	2	3	2	2	42	4					

District	Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Temeke	Beach erosion	Kimbiji, Kigamboni, and Vijibweni and small islands	3	2	3	2	2	42	4					
Kinondoni	Beach pollution	Entire coast and particularly at Kunduchi, Ununio, and Mbweni	3	2	3	2	2	42	4					
Mtwara Urban	Beach pollution	At the passage to Mtwara Port, Mikindani	2	3	3	2	2	42	4					
Tanga	Beach pollution	All along district sea front	3	3	3	2	2	63	4					
Pangani	Beach pollution	Pangani Town, Pangani River valley	3	2	3	2	2	42	4					
Rufiji	Beach pollution	Populated area such as Kibanjo, Kiasi, Simbaulanga	3	2	3	2	2	42	4					
Pangani	Decline in sea turtle population	Along Ushongo beaches and other sandy beaches and dunes	3	2	3	2	2	42	4					
Ilala	Diseases outbreaks	Throughout urban areas of the district	2	3	2	2	3	42	4					
Ilala	Fisheries decline	Msimbazi Bay, district marine waters.	3	3	3	2	2	63	4					
Kilwa	Fisheries decline	All along the Kilwa coast including Kiswere Harbour, Ruhaha, Mamba, Songo Mnara, Kilwa Masoko, Tikwoiri, Gigwera, Ras Wango, Songo Songo archipelago	3	3	3	2	2	63	4					
Kinondoni	Fisheries decline	Entire district coastal are including Ununio, Mbweni and Kunduchi	3	3	3	2	2	63	4					
Lindi Rural	Fisheries decline	All along the nearshore Lindi	3	3	3	2	2	63	4					
Lindi Urban	Fisheries decline	All along the near shore waters	3	3	3	2	2	63	4					
Mafia	Fisheries decline	All along the near shore areas	3	3	3	2	2	63	4					

District	Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Mkinga	Fisheries decline	Along Mkinga coastal water and habitats (Kwale, Mkinga, Mtibwani, Manza, Moa)	3	2	3	2	2	42	4					
Mkuranga	Fisheries decline	Entire district coastal ares	3	3	3	2	2	63	4					
Mtwara Rural	Fisheries decline	All along the near shores of the district	3	3	3	2	2	63	4					
Mtwara Urban	Fisheries decline	All along the nearshore seas	3	3	3	2	2	63	4					
Pangani	Fisheries decline	All along the coastal shore water and especially Matakani	3	3	3	2	2	63	4					
Rufiji	Fisheries decline	All along the shore	3	3	3	2	2	63	4					
Bagamoyo	Fisheries decline	Bagamoyo Town, Mbegani, Mlingo-tini, Kaole/Kondo, generally along the coastal estuaries	2	3	3	2	2	42	4					
Temeke	Fisheries decline	Mjimwema, Vijib-weni, Kigamboni, Mtoni and Kimbiji	3	3	3	2	2	63	4					
Kinondoni	Flooding	Suna and Makuti B in Magomeni ward, Mkunguni A, Mkunguni B and Hanna-Nassif in Hanna-Nassif ward	2	3	3	2	2	42	4					
Kinondoni	Land use conflicts	Along the coastal front.	3	3	3	2	2	63	4					
Mkinga	Land use conflicts	All along the sandy beach fringed coastal Mkinga	3	3	3	2	1	54	4					
Mtwara Rural	Land use conflicts	All along the coast	3	2	3	2	1	36	4					
Muheza	Land use conflicts	Kigombe and Msakangoto	3	2	2	2	2	36	4					
Mtwara Urban	Loss of habitat/agric ultural area	Mtwara urban suburbs, near shores	3	2	3	2	2	42	4					
Rufiji	Loss of habitat/agric ultural area	Along Rufiji Delta and coastal forests	3	3	3	2	1	54	4					
Rufiji	Marine pollution	Along the near shores	3	2	3	2	3	48	4					

District	Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Tanga	Marine pollution	Shores around Tanga city	2	3	3	2	3	48	4					
Ilala	Oil pollution	Dar es Salaam Harbour and vicinity	2	3	2	2	2	36	4					
Lindi Rural	Water source drying	River valley wells throughout	2	3	3	2	2	42	4					

Table 5: Threats assessed to impose important problems to local communities and ecosystems. The assessment has been made using the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

District	Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Ilala	Beach and nearshore pollution	Selander Bridge beach	1	3	3	2	2	21	3					
Ilala	Beach Erosion	Ocean Road	1	3	3	2	2	21	3					
Bagamoyo	Beach pollution	Beachfront Bagamoyo harbour and vicinity. Coastal villages.	3	1	3	2	2	21	3					
Mafia	Beach pollution	Kilindoni	2	2	3	2	2	28	3					
Mkinga	Beach pollution	All along the coast	3	1	3	2	2	21	3					
Mkuranga	Beach pollution	Koma, Kwale, Kisiju Pwani,	2	2	3	2	2	28	3					
Muheza	Beach pollution	Kigombe, Msakangoto	3	1	3	2	2	21	3					
Temeke	Beach pollution	Mbagala Kuu and Mjimwema	2	2	3	2	2	28	3					
Lindi Urban	Bush fires	Sub-urban wards	2	2	2	2	1	20	3					
Mkuranga	Decrease in mangrove and forest habitat + agricultural area	Koma, Kwale, Kisiju Pwani, Kimanzichana	2	2	3	2	2	28	3					

District	Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Kinondoni	Diseases outbreaks	Throughout the coastal and urban areas of the district	2	2	3	2	3	32	3					
Mafia	Diseases outbreaks	Kilindoni, Bwejuu, Jibondo	2	2	2	2	3	28	3					
Mkinga	Diseases outbreaks	Kwale, Moa, Manza, Mtibwani	3	1	3	2	2	21	3					
Mkuranga	Diseases outbreaks	Throughout the coastal areas of the district	3	1	2	2	3	21	3					
Muheza	Diseases outbreaks	Kigombe and Msakangoto	3	1	2	2	3	21	3					
Rufiji	Diseases outbreaks	In coastal villages such as Kiasi and Kibanjo	2	2	2	2	3	28	3					
Temeke	Flooding	Mtoni River valley	2	2	3	2	2	28	3					
Rufiji	Flooding of construction areas and vulnerable river valleys	Rufiji delta and river basin	2	2	2	2	1	20	3					
Temeke	Forest decline	Kimbiji, Mjimwema, Mtoni	2	2	2	2	2	24	3					
Bagamoyo	Forest habitat destruction	Makurunge Forest Reserve	1	3	3	2	2	21	3					
Mtwara Rural	Habitat destruction	In many villages	2	2	3	2	1	24	3					
Mkuranga	Habitat loss as well as loss of agricultural area	Here and there along the coast	2	2	3	2	1	24	3					
Kinondoni	Heavy metal pollution	Msimbazi river valley, Kundu-chi, Mbweni and Ununio	2	2	3	2	2	28	3					
Temeke	Heavy metal pollution	Mtoni River and Dar es Salaam Port	2	2	3	2	3	32	3					
Ilala	Heavy metals pollution	Msimbazi River valley, Dar es Salaam Harbour + vicinity, Mtoni River area	2	2	3	2	3	32	3					

District	Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Mafia	HIV/AIDS increases	Especially at Kilindoni and dago areas	2	2	2	2	1	20	3					
Ilala	Industrial pollution	Dar es Salaam Harbour and vicinity	1	3	3	2	3	24	3					
Temeke	Industrial Pollution	Mbagala and Mtoni wards	1	3	3	2	2	21	3					
Pangani	Land use conflicts	Saadani and Buyuni border. Ushongo and vicinity. Various district areas	2	2	3	2	2	28	3					
Rufiji	Land use conflicts	Ikwiriri, Kibiti + in many villages and wards	2	3	2	2	1	30	3					
Lindi Rural	Loss of habitat	Forested areas	2	2	3	2	1	24	3					
Kinondoni	Loss of habitat and agricultural area	Mabwe Pande Forest, Mpiji River Valley	2	2	3	2	2	28	3					
Pangani	Loss of habitat + agricultural area	Various district areas	2	2	3	2	1	24	3					
Mafia	Loss of habitat area	All along the coast	2	2	2	2	2	24	3					
Bagamoyo	Mangrove	Uondwe creek, Wami + Ruvu Rrver mouths, Bagamoyo Town to Mpiji River mouth	2	2	3	2	2	28	3					
Temeke	Oil pollution	Kigamboni and vicinity, Inner Makutumba Is., Msimbazi River valley	2	2	3	2	2	28	3					
Rufiji	River and estuary pollution	Rufiji River	3	1	2	2	3	21	3					
Temeke	River condition decline	Mtoni River, Nguva River, seasonal streams	2	2	3	2	2	28	3					
Ilala	Sewage pollution	Ocean Road beach	1	3	3	2	3	24	3					

Table 6: Threats assessed to impose problems to local communities and ecosystems. The assessment has been made using the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

District	Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Bagamoyo	Loss of land and environmental damage	Near shore waters	1	3	3	2	1	18	2					
Bagamoyo	Beach erosion	Coastal stretch towards Mbegani.	1	2	3	2	2	14	2					
Kilwa	Beach pollution	Kilwa Kivinje	1	2	3	2	2	14	2					
Kilwa	Beach erosion	Masoko, Rushungi, Kilwa Kisiwani World Heritage monuments.	2	1	3	2	2	14	2					
Kilwa	Marine pollution	Songo Songo, Kilwa Masoko and Kilwa Kivinje	2	1	3	2	2	14	2					
Lindi Rural	Beach erosion	Sudi, Shuka, Mmumbu, Kikwetu, Mbanja, Mchinga na Kijiweni	2	1	3	2	2	14	2					
Lindi Urban	Beach pollution	Lindi Town	1	2	3	2	2	14	2					
Lindi Urban	Beach erosion	Many spots along the district beach stretch	2	1	3	2	2	14	2					
Mafia	Beach erosion	Utende, Kilindoni, Bwejuu, Juani, Jibondo	2	1	3	2	2	14	2					
Mafia	Marine pollution	Kilindoni	1	2	3	2	2	14	2					
Mafia	Land use conflicts	Mafia Island Marine Park area	2	1	2	2	1	10	2					
Mkinga	Marine pollution	River mouths and vicinity	2	1	3	2	2	14	2					
Mkuranga	Beach erosion	Kisiju	1	2	3	2	2	14	2					
Mkuranga	Land use conflicts	Along the coastal front	1	2	3	2	2	14	2					
Mkuranga	Loss of biodiversity (i.e. disappearance of Dugong)	Kisiju and vicinity	1	2	2	2	2	12	2					

District	Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Mtwara Rural	Beach pollution	All along the coastal populated areas such as Msimbati	2	1	3	2	2	14	2					
Mtwara Rural	Beach erosion	Lijombe, Ras Mivinjeni, Sinde Bay, Mnazi Village	2	1	3	2	2	14	2					
Mtwara Urban	Diseases outbreaks	Mtwara Town, Mikindani	2	1	2	2	3	14	2					
Pangani	Increase of HIV infection	All along the district	1	2	3	2	3	16	2					
Pangani	River erosion	along Pangani River Bank	1	2	3	2	2	14	2					
Pangani	Marine pollution	Pangani River valley, Pangani Town	1	2	3	2	2	14	2					
Tanga	Freshwater supply reduction	Zigi River	1	2	3	2	2	14	2					
Tanga	Loss of land and environmental damage	Mwambani port project	1	2	3	3	1	14	2					
Tanga	Loss of habitat and agricultural area	Surrounding suburbs of Tanga city	1	2	3	2	2	14	2					
Temeke	Loss of habitat and agricultural area	Forest reserve and river valley vegetation	2	1	3	2	2	14	2					

Table 7: Threats assessed to impose light problems to local communities and ecosystems. The assessment has been made using the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

District	Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Lindi Rural	Beach pollution	Mchinga	1	1	3	2	2	7	1					

Lindi Urban	Diseases outbreaks	Urban centre and settlements	1	1	2	2	3	7	1					
Mtwara Rural	Diseases outbreaks	In many highly populated areas in the district	1	1	2	2	3	7	1					
Muheza	Flooding	Kigombe	1	1	2	2	1	5	1					
Mkinga	Heavy metal pollution	River mouths and vicinity	1	1	2	2	2	6	1					
Mtwara Urban	Heavy metal pollution	Within Mtwara Port waters, near shore waters	1	1	2	2	1	5	1					
Tanga	Heavy metal pollution	Near shore waters along the coast	1	1	2	2	2	6	1					
Tanga	Land use conflicts	Shores around Tanga city	1	1	2	2	1	5	1					
Lindi Urban	Loss of habitat and agricultural area	Lindi Town	1	1	3	2	2	7	1					
Tanga	Marine pollution	Shores around Tanga city	1	1	2	2	2	6	1					
Muheza	Reduced citrus yields	Across farming sectors of district	1	1	2	2	2	6	1					
Mtwara Rural	River and estuary pollution	Ruvuma River	1	1	3	2	3	8	1					
Lindi Rural	Sea pollution	River mouths	1	1	2	2	2	6	1					

2. Mkinga District

Mkinga District is in the Tanga Region. It has a land area of around 2,718 km^2 and a coastline of 151 km. Mkinga District was formed in 2007, previously the area was part of Muheza District. Mkinga shoreline extends from Mtwara Urban (or Municipality) to the Kenya border. Previously this coast was all part of Muheza, which now has a small coastline of hence there is an absence of census and other historic data specifically for Mkinga.

Climate Profile

Temperature

The climate ranges from hot and humid in the coastal plains to temperate in the mountains. Average monthly temperature data, from nearby Tanga weather station (Tanga Airport, from 1987 to 2012), show ranges from a low of around 20.5 ˚C during the coolest months of July to September when maximum temperatures are 29.4 ˚C and 29.7 ˚C for those months, to the highest monthly means of 32.0 ˚C to 33.2 ˚C during the hot season from December to March, when the temperatures drop to only 23.7 ˚C to 24.5 ˚C. Nights become much cooler inland, especially to the southwest, with increasing elevation towards the Usambara Mountains where both highlands and foothills having variable local conditions dictated by their altitude and exposure to the sun and the prevailing winds. Relative humidity (based on data from nearby Tanga) ranges from 72-75 % for much of the year, increasing to 79 % during the wettest months of April and May.

Precipitation

The average annual rainfall for the nearest weather station, at Tanga Airport, is 1,212 mm (ranging from 644 mm to 1,963 mm), over the period 1987 to 2012, with monthly rainfall peaks in April and May (main wet season) with over 470 mm of rain during those two months, and October to November (short rains) with over 250 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern.

Winds

Based on 26 years of data (1987 to 2012) from the Tanga Airport weather station (in Tanga Rural), in the morning (9 am) winds are generally light (5-9 knots), with strongest morning mean wind speeds during the months of May to July. Slightly stronger wind speeds (9-13 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (12-13 knots) during the months January and Februarys, resulting from typical north-east monsoon variability from light to strong winds within a few days, compared to the typically steady winds of the southeast monsoon period.

Dubi's (2001) study of maximum coastal wind speeds, from 1972 to 1996, recorded the mode of the highest wind speeds reached in Tanga as 20 knots, with peak speeds during July-August. Tanga is considered an area of coastline that is influenced mostly by offshore winds, though over the studied period, the maximum wind speed has shown a decreasing trend (Dubi, 2001).

Population

Population size: 118,065 with 60,305 females and 57,760 males. No previous population data are available since this is a newly established district. The population density in the district is 43.4 persons/km^2.

Based on 2002 census data for Muheza, the percentage of the population living under the poverty line was 33 %, the over 15 years of age literacy coverage was 71 % and under five years of age mortality was 158 (per 1,000 live births).

Economy

The population of Mkinga District depends on small-scale agriculture and animal husbandry, with the coastal population relying on fisheries in addition to agriculture. Other economic activities include retail and wholesale trade.

Agriculture

Arable land in Mkinga constitutes 284 km² which is about 10% of the total district land area. Agricultural activities involve both food and cash crop cultivation that depends, largely, on rain. Food crops grown include rice cassava, sweet potatoes and vegetables. Cash crops cultivated include cashew nuts and coconuts. Food crops production according to Tanga's Regional Commissioner's Office (2006) is 73,400 tonnes harvested from 23,015 ha cultivated, with cash crops grown on 21,067 ha, producing 14,238 tonnes. There was no irrigated land in 2006 and the potential land for irrigation is 230 ha (Tanga Regional Commissioner Office, 2006).

Many households also raise livestock such as cattle, chickens, goats and some sheep. According to 2007/8 household agricultural census in Tanga, Mkinga produces the following livestock: 167,266 cattle of various types (kept by 3,513 households); 112,235 goats (kept by 9,648 households); 27,153 sheep (kept by 1,505 households); 948 pigs, 189,345 chicken (reared by 13,827 households) and about 279 households are involved with beekeeping using 1,394 beehives of various types.

Fisheries

Mkinga coastal zone is rich in marine resources that include a variety of fishes, octopus, sea cucumber, spring lobster, prawns, sea crabs and seaweeds. All these products are obtained from the villages of Zingibari, Kizingani, Moa, Ndumbani, Boma Subutuni, Monga Vyeru, and Kwale. Some of these products are sold in Tanga City, with some exported to Mombasa and elsewhere (MD-ICMAP, 2009). There are 18 BMUs, three FMPs and six bylaws that oversee fisheries activities in the district (MLFD, 2010). Mkinga District has highest number of landing sites (20) in the region, of which 18 are permanent and two are temporary landing site (MLFD, 2010).

According to 2009 frame survey data, there are 1,712 fishers of which 60% are foot fishers; the rest used different types of vessels. Of the 326 vessels recorded, 201 used sail for propulsion, 72 paddles and 53 engines. Mkinga has 210 seaweed farmers (URT, 2010). An average of 63,000 tonnes of various species of fish is caught annually, and of which 25 % is sold outside of Mkinga (MD-ICMAP, 2009). Previously, Muheza (the present day Mkinga) was an important supplier of a variety of species of fish to Dodoma, Arusha and Morogoro fish markets. These include finfish, octopus, prawns, and lobster to mention the few.

The inshore waters off Mkinga are relatively shallow and calm, protected by a line of reefs that create ideal conditions for the fishery for small pelagic fish species (sardines and anchovies). This fishery is the target of many of the 284 ring-nets, mostly operated by 53 motorised vessels noted above (URT, 2010). The small pelagic fish are a significant component of the catch in Mkinga, though data are not available.

Tourism

Mkinga District has a poorly developed tourism sector despite many tourism attraction areas that include marine sites and a small number of sand beaches. One of the reported problems facing this sector is unreliable transport especially during the rainy season. There is also a shortage of tour guides within the district. Some of the Mkinga resorts utilise the offshore and nearshore waters for deep sea fishing and SCUBA diving, respectively.

Minerals

The mining activities undertaken in Mkinga District include excavation of sand, gravel stone or boulders, aggregates and limestone. There are 365 ha of salt works in the district, all located inshore of the mangrove creeks.

Exploration for oil and gas has commenced with only seismic surveys conducted to date. Afren is the major company exploring off the Tanga coast, having taken over the licence from Petrodel. Afren is presently preparing for exploration drilling in the western side of the Pemba Channel, 20-25 km from the coast of Mkinga.

Description of the coast

Physical

Mkinga District borders with Kenya's Msambweni District to the north, Tanga Urban to the south, Korogwe to the west, Muheza to the southwest, and Lushoto to the northwest. This is the second largest of the four Tanga Region districts, and it is penetrated by five coastal river systems, many less than 20 km in length. Most rivers stem from the higher ground to the west, bordering the Korogwe District, including the Umba River which discharges to sea at the border with Kenya and the Zigi River that rises in the Amani Nature Reserve in the Usambara Mountains and flows for 100 km with multiple changes of direction, to discharge into the Indian Ocean 40 km north of Tanga City.

The shore is a mixture of hard substrates giving rise to headlands, interspersed with small sand beach bays and mangrove creeks. There are three small islands, connected to the coast through mangrove forests: Kwale, Mwewe and Kirui. Beach sands on the mainland vary from silicilastic in river-dominated areas to carbonate sand around islands far from river influences**.**

Coastal ecology

The coastline and inshore waters of Mkinga District support coral reefs, intertidal rocky and sand expanses, some with seagrass beds that extend into the subtidal areas, and extensive mangrove forests. There are many bays of shallow water that receive a number of fresh water tributaries forming extensive and patchy mangroves.

Coral reefs – Coral growth off Mkinga is not robust, possibly related to high sedimentation and fresh water input and unsuitable substrate for corals (Muhando, 2011). A deeper barrier reef exists along the boundary of continental shelf where a chain of reef running parallel to the coast from south of the district where it borders to Tanga Urban District with some interruption in some areas. Isolated patch reefs include Mwamba Wamba, Mwamba Shundo and Mwamba Kitugairue. The fringing reef occurs in few spots such as Ulenge Island, north of Kwale Island, east of Boma Kichakamiba east of Kirui Island. Additional patch reefs are concentrated on the northern end of the district close to the Kenyan border within the shallow water east of Kirui Island, and southeast corner of Boma Suutuni, including Mwamba Mwani, Mwamba Mwezi, Mwamba Bunju, Mwamba Minyaani and Mwamba Mwarembo.

Mangroves – Mangroves in Mkinga District cover 4,978 ha. Generally large part of Mkinga coastal line is covered with mangrove stands of various coverage and density, with exception of exposed eastern sides of Kirui and Boma Subutuni. Dense mangrove covers occur around Kwale Island, west of Boma Subutuni and Boma Kichakamiba, north of Boma Ndani northward via Mwewe Island, Moa inner waters to the whole western side of Kirui Island. Other dense stand is in Kizingani southward to Ulenge.

Mangroves on parts that are inaccessible are reported to be in a good condition, not heavily cut e.g. at Kwale Island, Jambe Island, Karange Island and at Manza Bay on the Boma Peninsula (Whitney et al., 2003; Semesi *et al*., 1991).

Mangroves are protected forests with licensed harvesting of poles permitted in prescribed zones. The increase in the overall area of mangroves from 1990 to 2000, recorded by the remote sensing assessment in 2002 (Wang et al., 2003), for both Mkinga and Tanga districts, is probably attributed to increased awareness and conservation efforts by the TCZDP (Whitney, 2003).

Beach and rock shorelines – Most of the shoreline of Mkinga supports mangrove forest and rocky outcrops and headlands, with few and small isolated sand beaches in a few locations, in small bays and rocky inlets. The wide expanses of intertidal sand and mud flats backed by mangrove forests provide important bird feeding areas during low tide, and important fish and shellfish breeding and feeding grounds, in part thanks to the discharges from the many small river systems.

Coastal waters

The peak outflow from the seasonal rivers of Mkinga occurs from March to May and the influence of fresh water from the rivers is restricted to coastal waters and tends to reduce water salinity and increase turbidity due to sediment inputs near the coast.

Marine species of importance

Turtles – Green turtle nesting takes place in some sandy beaches within Mkinga, reportedly at Sungutini, though generally in small numbers due to heavy disturbance of the shoreline from development.

Dugong - A small population of dugong is believed to exist at Mbayae-Kigomeni area, just east of Kirui Island and south of the Kenya border, where dugongs were sighted in 1994 and 2004 (Muhando, 2011).

Cetaceans - Bottlenose dolphins are regularly reported within short distances of the coastline and humpback whales are seen during June to November.

Shorebirds – Mkinga coast is well-known for the migratory shore birds and includes IBA 35, referred to as Tanga North, covering Kibo salt pans to the large inlet at Monga, plus numerous mangrove forests and Kwale Island (Baker & Baker, 2002).

Natural resources

Mkinga is endowed with forest richness with about 228 km^2 of natural forests (about 8 % of the district). There are nine forest reserves and four mangrove reserves. Forest reserves are Mtai (3,107 ha), Bamba Ridge FR (24,800 ha), Segoma FR (1,100), Kwangumi FR (580), Mgamo (1,346 ha), Mlungu FR (200 ha), Bombo East I (1,120) and Bamba East II (470 ha) (TRC Office, 2006). Newly established reserves with mangrove forests are Kirui Island Marine Reserves, Mwewe Island Marine Reserves, Kwale Marine Reserve and Ulenge Marine Reserve (Muhando, 2011). There are also 1,422 km^2 of woodland and about 630 km^2 of bush land (representing about 52 % and 30 % respectively of district land).

Settlements

The settlement and built-up portion of Mkinga is concentrated in the eastern portion, following the main arterial route (A14 trunk road) from Tanga town to the Kenya border, including the district headquarters Mkinga, 5 km west of the main road. There are fewer settlements inland to the west of Mkinga with lower densities of inhabitants and land use gives way to more agriculture.

Infrastructure

Mkinga is well connected by road with other districts of Tanga and other regions as well as neighbouring Kenya. It has a total of 425 km long roads in the following categories: trunk road 46 km (A14), regional roads 21 km, and district roads 290 km. All major mobile operators in the country has network in Mkinga. These are Tigo, Airtel, Zantel and Vodacom. TTCL landline services are also available.

Major Threats

Table 8: Overview of threats to coastal communities in Mkinga district.

Threat	Location	Cause
Beach pollution	Kwale, Mtibwani, Manza, Moa	Uncontrolled solid and liquid waste disposal, often in creeks; lack of toilets for public as well as residential houses. For instance in Kwale 2002 there was only 48 latrines among 808 households.
Fisheries decline	Along Mkinga coastal water and habitats (Kwale, Mkinga, Mtibwani, Manza, Moa)	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods as well as coral mining for lime production
Marine pollution	River mouths and vicinity	Use of fertilizers and chemicals for agricultural purposes from upstream river flow.
Heavy metal pollution	River mouths and vicinity	Wastes from tourist hotels, construction sites, workshops, garages and industries located upstream.
Diseases outbreaks	Kwale, Moa, Manza, Mtibwani	Lack of latrines, poor solid waste management, uncontrolled food vending.
Land use conflicts	All along the sandy beach fringed coastal Mkinga	Unplanned selling of beach plots to investors may create big conflict between the community land use interests with investors. Conflict between seaweed farmers and fisher due to destruction of seaweed farms by fishing vessels. Conflict between bordering villages of Kenya and Mkinga on marine resources use

CRIAM Ranking of Threats to Local Communities in Mkinga District

Table 9: Prioritisation of threats to local communities in Mkingi District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Land use conflicts	All along the sandy beach fringed coastal Mkinga	3	3	3	2	1	54	4					
Fisheries decline	Along Mkinga coastal water and habitats (Kwale, Mkinga, Mtibwani, Manza, Moa)	3	2	3	2	2	42	4					
Beach pollution	All along the coast	3	1	3	2	2	21	3					
Diseases outbreaks	Kwale, Moa, Manza, Mtibwani	3	1	3	2	2	21	3					
Marine pollution	River mouths and vicinity	2	1	3	2	2	14	2					
Heavy metal pollution	River mouths and vicinity	1	1	2	2	2	6	1					

Major Opportunities

Opportunities available for coastal communities:

The following livelihood opportunities are mentioned in MD-ICAMP (2009):

- Aquaculture – well-planned and controlled aquaculture especially in the abandoned saltpans and other coastal low land, accompanied by the establishment of suitable hatchery to supply seed crustaceans (e.g. crabs) or fish.
- Tourism – Mkinga has many tourist attractions for eco-tourism as well as mainstream tourism. In the words used in Mkinga District Investment Profile "the district is blessed with sun drenched beaches on its coast, plains studded with coconut palms and cashew trees, and cooler foothills and temperate mountains of the Eastern Usambaras. Tourists can arrange "Safaris" and view elephants in the Mkomazi National Park, hike in mountainous landscape to marvel at numerous endemic plants in the Nilo Reserve, glimpse on a distant Mount Kilimanjaro, and dive in the coral rich warm water of the Indian Ocean."
- Fisheries – Tanga coast has very high potential for open waters and oceanic fisheries.
- Beekeeping – the district is endowed with many forest reserves both inland and mangrove forests which are very suitable for beekeeping.
- Land - Land in Mkinga district is underutilized. Over 250,000 ha are arable but only little over 75,000 ha has been utilized to 2008, thus about 70 % of arable land is yet to be utilized.

- Fish processing – The large amounts of fish such as sardines has the potential for value adding, for example in the form of preservation such as through canning, adding value to the fishing industry and improving food security and export potential.

Climate Change Impacts

Table 10: Estimated area losses of sea level rise scenarios on overall area in Mkinga district.

Mkinga	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation	165	0.06	402	0.15	870	0.32	2,293	0.84	4,233	0.64	22,512	8.28

Significant impacts from sea level rise are felt over the general land area for rise levels only above 10 m, affecting over 8% of the land, since much of the district is sufficiently raised to avoid inundation from lower sea level rise scenarios. However, even a 1 m rise will significantly impact the seafront properties and infrastructure. The mangrove creeks at Kwale and Moa and other smaller inlets, are vulnerable to storm surges especially when coinciding with spring high tides. Such events are likely to have significant impacts further inland, along much of the length of the creeks with potential seawater penetration into agricultural land and shallow wells.

Projects and Plans

The entire coastline of Mkinga is part of the internationally-recognised "Msambweni-Tanga" area of eco-regional importance (WWF, 2004). The 100 scattered reefs and islands that extend from Pangani north beyond Shimoni into Kenyan waters cover an area that is referred to as "Msambweni-Tanga". No legislated conservation or formal protection measures are associated with the status of eco-regional importance however the recognition has drawn attention to the coastal habitats of northern Tanzania, which in some locations have resulted in improved management and increase conservation awareness. Two main environmental and coastal management initiatives in the Tanga Region including the Mkinga coastline are:

- Tanga Coastal Zone Conservation and Development Programme (TCZCDP) – This initiative has been working with local communities since 1994, through IUCN-EARO with funding from Irish Aid in response to the Tanga Regional government's concern for an increasing decline in marine resources and reef degradation. TCZCDP has been a central force in coastal zone management in Tanga Region, addressing mainly fisheries management, and to some extent fisheries development. This district-based activity aims at "improved coastal resource management by district administrations, resource users and other stakeholders". The aim was for over 90 % of the Tanga coastline to be included in six collaborative fishery management areas. These management plans involve over 40 village communities and are recognised at District level. Some aspects, for example freedom to cut mangrove trees, have national recognition.

  The TCZCDP was one of the first coastal management programmes in the WIO to make livelihoods improvement a central objective, and one of the first to start with a community-based approach (Samoilys & Kanyange, 2008). Since the Programme started, according to IUCN (Horrill *et al* 2001), there has been a marked improvement in the health of the reefs and the size of fish populations, and catches have improved. The resulting collaborative fishery management areas (CMAs), set up as joint initiatives between local communities and district authorities in Mkinga District are Boma-Mahandakini collaborative management area, with closed reefs Mwamba wa Bunju; and Deep-Sea Boma Collaborative Management Area, with closed reef Chundo-Kiroba in the southern sector or Mkinga's waters.

Since the lead technical agency, IUCN, handed over the programme to government in 2005 and funding from the donor, Irish Aid, ceased in 2007, the programme has been integrated within District government work plans and budgets as the Tanga Coastal Zone Resources Center, though with a significantly reduced budget and range of activities. Nevertheless, e.g. the status of the reefs and fisheries continue to be assessed by District officers in collaboration with Village Monitoring Teams (Samoilys, 2004). The Fisheries Division, though poorly equipped technically and financially, has continued to support fisheries development in the region while the Forest Department facilitates some programmes at the village level.

- Sustainable Environmental Management through Mariculture Activities (SEMMA) - In 2003 the US-based NGO Agricultural Cooperative Development International and Volunteers in Overseas Cooperative Assistance (ACDI/VOCA, 2007), established the SEEGAD project, to be called SEMMA from 2005 (with USAID funding). The project has played a pivotal role in mariculture training in Tanga (Savoie, 2005; ACDI/VOCA, 2007), focusing mainly on seaweed farming and conducting successful mangrove crab (*Scylla serrata*) fattening trials (ACDI/VOCA, 2008). SEMMA suspended its support for culturing penaeid prawns (shrimp) and milkfish (*Chanos chanos*) due to low or unreliable seed availability, as well as technical and market constraints, although some community groups are still practising milkfish farming. SEMMA's main conclusion regarding culture of these animals is that hatcheries are essential if mariculture is to be sustainably conducted and scaled up. Currently there is no hatchery in East Africa though there are plans to construct one for prawns in Bagamoyo. SEMMA are applying for funds for a mangrove crab hatchery in Tanga.

3. Tanga Urban District

Tanga Urban District (or Municipality) is in the Tanga Region. It has a land area of around 624 km^2 and a coastline of 67 km.

Climate Profile

Temperature

The climate is hot and humid, with average monthly temperatures at Tanga Airport weather station (from 1987 to 2012) ranging from a low of around 20.5 ˚C during the coolest months of July to September when maximum temperatures are 29.4 ˚C and 29.7 ˚C for those months, to the highest monthly means of 32.0 ˚C to 33.2 ˚C during the hot season from December to March, when the temperatures drop to only 23.7 ^{o}˚C to 24.5 ˚C. Relative humidity ranges from 72-75 % for much of the year, increasing to 79 % during the wettest months of April and May.

Precipitation

The average rainfall for Tanga weather station (at Tanga Airport) is 1,212 mm (ranging from 644 mm to 1,963 mm), over the period 1987 to 2012, with monthly rainfall peaks in April and May (main wet season) with over 470 mm of rain during those two months, and October to November (short rains) with over 250 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern.

Winds

Based on 26 years of data (1987 to 2012) from the Tanga Airport weather station (in Tanga Rural), in the morning (9 am) winds are generally light (5-9 knots), with strongest morning mean wind speeds during the months of May to July. Slightly stronger wind speeds (9-13 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (12-13 knots) during the months of January and February, resulting from typical northeast monsoon variability from light to strong winds within a few days, compared to the typically steady winds of the southeast monsoon period.

The maximum coastal wind speeds study by Dubi (2001), from 1972 to 1996, revealed the mode of the highest wind speeds reached in Tanga as 20 knots, with peak speeds during July-August. Tanga is considered an area of coastline that is influenced mostly by offshore winds, though over the studied period, the maximum wind speed has shown a decreasing trend (Dubi, 2001).

Population

Population: 273,332 with 142,412 females and 130,920 males. The district has experienced a moderate annual growth rate between 2002 and 2012 of 1.19 % leading to about 11.3 % increase of the population over the ten-year period, and documenting a low level of growth, probably natural growth rather than in-migration. The population density in the district has grown very slightly to 477 persons/km^2 in 2012 from 424 persons/km^2 of 2002.

Economy

Economy of Tanga Urban District depends on agriculture, industries, trade and commerce, communication and transport as well as livestock husbandry and fisheries. In the Integrated Coastal Management Area in Tanga, fisheries engage 50 % of the population (directly and indirectly). The district accounts for almost 60 % of all industrial establishments in the Tanga Region (URT 1997).

Based on 2002 census data, the percentage of the population living below the poverty line was 17 %,

the over 15 years of age literacy coverage was 87 % and under five years of age mortality was 118 per 1,000 live births.

Agriculture

Arable land in Tanga Urban district constitutes of 110 km^2 and covers 18 % of the total Tanga Urban District land area, with agriculture one of the leading economic activities in Tanga Urban District, second, in terms of the labour force, to trade and commerce (TR-SEP, 2008). Food crop production is 50,662 tonnes, harvested from 15,741 ha cultivated, with cash crops grown on 7,758 ha, producing 12,691 tonnes (TR-SEP, 2008). Main cash crops produced are sisal and coconut while main food crops produced are maize and rice. Potential land for irrigation is estimated at 2,000 ha with irrigation presently covering 180 ha (TR-SEP, 2008).

The main livestock husbandry for Tanga Urban is about 16,000 cattle, 10,500 goats, 6,100 sheep, 3,500 pigs and 75,000 poultry.

Fisheries

Tanga Urban supports 25 landing sites, of which 15 are permanent and five are temporary (MLFD, 2010), the most active being Sahare south of Tanga city. According to the 2009 frame survey data, there are 2,503 fishers of which 202 are foot fishers; the rest used different types of vessels. Of the 504 vessels recorded, 337 used sail for propulsion, 99 paddles and 68 engines. Tanga Urban has 191 seaweed farmers (URT, 2010). The district has eight BMUs, though without any FMPs or bylaws (MLFD, 2010). In 2011, about 845,334 kg of fish were harvested in Tanga Urban district.

The inshore waters off Tanga Urban are relatively shallow and calm, protected by a line of reefs and islands that create ideal conditions for the fishery for small pelagic fish species (sardines and anchovies). This fishery is the target of many of the 70 ring-nets, mostly operated by 68 motorised vessels noted above (URT, 2010). The small pelagic fish are a significant component of the catch in Tanga Urban, though data are not available.

The shallow inshore waters around the islands and coast provide habitat suitable for seaweed farming, an activity that engages 191 people in Tanga Urban District.

Tourism

Tourism has not contributed much to the economy of Tanga Urban, though the sector has seen recent expansion in numbers and quality of hotels and tourism facilities. There are about 31 hotels and guesthouses in Tanga Urban District, some of them used as tourist hotels. Among the tourist attractions are Amboni Caves, Galanos hot sulphur springs, Toten Island, URITHI Tanga Museum, Tanga War Graves and Memorials, Tongoni Ruins, Ndumi Village defence works, Mwarongo sand beaches, coastal mangroves and coral reefs for diving and snorkelling.

Minerals

The mining activities undertaken in Tanga Urban district include excavation of sand, gravel stone or boulders, aggregates and limestone for cement production. There are 286 ha of salt works in the district, all located inshore of the mangrove creeks.

Exploration for oil and gas commenced with only seismic surveys conducted to date. Afren is the major company exploring off the Tanga coast, having taken over the licence from Petrodel and Afren is presently preparing for exploration drilling in the western side of the Pemba Channel, 20-25 km from the coast of Tanga Urban.

Description of the coast

Physical

This is the smallest of the four Tanga Region districts, and it is penetrated by five small coastal river systems, including Mkulumuzi River that begins in the East Usambara Mountains and terminates in the mangrove delta at Tanga Bay. Other rivers are all less than 30 km in length. The Zigi River provides Tanga City with freshwater, though it discharges to the Indian Ocean in neighbouring Mkinga District.

The shore is a mixture of hard substrates giving rise to headlands, interspersed with sand beach bays, the largest being Tanga Bay and numerous mangrove creeks. Tanga urban waters include two islands, Yambe East and Yambe West, within 3-4 km from the shore. Sediments types vary greatly, from clay bound sands in bays to gravel to more unconsolidated sands around the reefs. Beach sands vary from silicilastic in river-dominated areas to carbonate sand around islands far from river influences**.**

Coastal ecology

The coastline and inshore waters of Tanga Urban District support coral reefs, intertidal rocky and sand expanses. The inner bays and passages south of Tanga to Pangani are typically no more than 20 m deep while the passages to the north are 30-40 m deep. Sand and sediment cover much of the seabed of these sheltered areas, in places supporting productive seagrass beds.

Coral reefs – Tanga Urban reefs are divided into three main groups. Deeper barrier reefs, fringing reef and patch reefs. Deeper barrier reefs are found in the southern end of the district waters, which include Tongoni Reef and part of Yambe Reef. Fringing reef is found just south of Tongoni from north of Kiungani southward. Coral expanses are present in patches on the western margins of the barrier reefs while the east fringes typically support coral reefs slopes.

Mangroves – Mangrove in Tanga Urban District cover an area of 1,198 ha in three major stands. A north mangrove stand from the northern border of the district southward to Kisosora, a mangrove stand from Ras Kisosora south ward to north of Mwambani area, and the long stretch which runs from south of Mwambani area southward to Kiungani.

Mangroves are protected forests with licensed harvesting of poles permitted in prescribed zones. The increase in the overall area of mangroves 1990 – 2000, recorded by the remote sensing assessment in 2002 (Wang et al., 2003), for both Mkinga and Tanga districts, is probably attributed to increased awareness and conservation efforts by the TCZDP (Whitney, 2003). Despite this trend, more accessible areas especially those near Tanga town and large villages along Mwambani Bay, at Kasera, Mandusi, Machuwi, and Shari - are over-utilised and are much degraded (Whitney et al., 2003; Semesi et al., 1991).

Beach and rock shorelines – Most of the southern shoreline of Tanga Urban supports rock intertidal with the northern part a mixture of mangrove shoreline with mud and some sandy beaches.

Coastal waters

The peak outflow from the mainly seasonal rivers of Tanga Urban occurs from March to May and the influence of freshwater from the rivers is restricted to coastal waters and tends to reduce water salinity and increase turbidity due to sediment inputs near the coast.

Coastal pollution in Tanga is attributed to discharge of effluents from sisal decorticating plants in the area, as well as from municipal wastes or wastes from the local industrial facilities including (in

the past) a fertiliser factory (Munisi, 1998). Up to twenty plants discharge their wastes onto the coast via the Pangani, Sigi, Mruazi/Mnyuzi and Mkurumzi Rivers (Shilungushela, 1993) some of which are heavily polluted.

Marine species of importance

Cetaceans - Humpback whales are regularly reported within short distances of the coastline especially during months of June to November. Dolphins are also present sporadically throughout the inshore and offshore waters.

Coelacanth – *Latimeria chalumnae* are found and often caught from deep waters in and around Tanga Coelacanth Marine Park (URT, 2011), most of which is located in waters of Tanga Urban.

Turtles – Green turtle nesting takes place in some sandy beaches within the district

Shorebirds – Tanga Urban coast is well known for the migratory shore birds and with Mkinga District includes IBA Tanga North (IBA 35) as well Tanga South (IBA 36) from Mwarongo salt works to sandy spit on the mouth of Koreni River.

Natural resources

Natural forest in Tanga Urban District covers an area of 2 km^2 with only one reserve in the district, the Kolekole FR (309 ha) and 133 km^2 of woodland (21% of the land coverage) and 316 km^2 of bush land (representing approximately 51 % of the district).

Settlements

The settlement and built-up portion of Tanga Urban covers approximately 12 km^2 (about 2 % of the land cover) and is concentrated in the central eastern shoreline area around the Tanga Bay that comprises Tanga Port. Other built-up areas are along the main transport route west, to Muheza town and beyond to north-west Tanzania towns of Moshi and Arusha, and beyond into Kenya; north to Kenya's south coast and Mombasa; and south along the coast to Pangani. These areas also include industrial and manufacturing sectors, sited at Majengo, located about 1.5 km from the City centre. Beyond 5 km from the city centre to the north, west and south, Tanga Urban have lower densities of inhabitants and the land use gives way to more agricultural land with smaller settlements.

Infrastructure

Tanga city is well served with transport communication, with the main trunk road (A14) leading north to Kenya and west to Muheza and on to northern Tanzania (also to Dar es Salaam), with secondary road south as far as Pangani. The Tanga Port is the second largest seaport in Tanzania, capable of handling a capacity of 500,000 tonnes of cargo a year. The port handles mostly cargo (copper concentrates from the Kahama mines, bulk wheat, cement, fish fillets/octopus and hide and skins). Sisal and coffee are also exported to European and Asian markets. Tanga Port is located near the city centre, and is well connected by roads, railways and communications with large markets in East and Central Africa. However, it does not have enough space for expansion and a new site, at Mwambani to the south, is being considered for future port development. Tanga airport can serve small and medium sized aircrafts and presently benefits from daily scheduled flights to Pemba, Zanzibar and Dar es Salaam and Arusha. A sewerage system serves 16 % of the city population. The railway line from Tanga west to Muheza, Korogwe and on to Moshi, and the line south through Saadani to Dar es Salaam, are both non-operational and in need of major rehabilitation.

Major Threats

Table 11: Overview of threats to coastal communities in Tanga Urban district.

Threat	Location	Cause
Beach pollution	All along district sea front	Uncontrolled solid waste disposal.
Beach erosion	All along district sea front	Mangrove cutting, dynamite fishing, beach sand mining, unplanned construction along the coast.
Fisheries decline	In near shore waters incl. Kisosora, Chumvini, Msakangoto, Sahare	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods as well as coral mining for lime production and constructions
Heavy metal pollution	Near shore waters along the coast	Wastes from tourist hotels, construction sites, workshops, garages and industries located upstream.
Marine pollution	Shores around Tanga city	Inadequate sewerage control and direct disposal to the sea of untreated municipal sewerage, poor quality of sewerage construction, poor solid waste management. 84 % of the population use on site sanitation. The sewerage system is located at central business district only where the effluent is ultimately discharged into Indian ocean.
Marine pollution	Shores around Tanga city	Large plantations in the highlands drain into Tanga Urban basin and hence fertilizers, pesticides, herbicides and fungicides may pose as threat to marine environment.
Freshwater supply reduction	Zigi River	Muheza town needing more freshwater than presently supplied by the Mkulumuzi River.
Loss of land and environmental damage	Mwambani port project	Mwambani port project developed without due procedures on impact assessment and local livelihood analysis
Land use conflicts	Shores around Tanga city	Conflict between seaweed farmers and fishers on marine land use, Conflict between grazers and farmers
Loss of habitat and agricultural area	Surrounding suburbs of Tanga city	Rapid urbanization, high increase of immigration into the city.

CRIAM Ranking of Threats to Local Communities in Tanga Urban District

Table 12: Prioritisation of threats to local communities in Tanga Urban District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	In near shore waters incl. Kisosora, Chumvini, Msakangoto, Sahare	3	3	3	2	3	72	5					
Beach pollution	All along district sea front	3	3	3	2	2	63	4					
Marine pollution	Shores around Tanga city	2	3	3	2	3	48	4					
Beach erosion	All along district sea front	3	2	3	2	2	42	4					
Freshwater supply reduction	Zigi River	1	2	3	2	2	14	2					
Loss of land + envir-onmental damage	Mwambani port project	1	2	3	3	1	14	2					
Loss of habitat and agricultural area	Surrounding suburbs of Tanga city	1	2	3	2	2	14	2					
Heavy metal pollution	Near shore waters along the coast	1	1	2	2	2	6	1					
Marine pollution	Shores around Tanga city	1	1	2	2	2	6	1					
Land use conflicts	Shores around Tanga city	1	1	2	2	1	5	1					

Major Opportunities

Opportunities available for coastal communities:

- Aquaculture – well planned and controlled aquaculture especially in the abandoned saltpans and other coastal low land, accompanied by the establishment of suitable hatchery to supply seed crustaceans (e.g. crabs) or fish.
- Tourism – Tanga has many tourist attractions as mentioned above, relevant to ecotourism as well as mainstream tourism. Beautiful beaches, historical position and pre-historic caves can attract more tourists foreign as well as locals.
- Fisheries – Tanga's relatively simple access to open waters provides opportunities to develop the fishery for large pelagic species.
- Fish processing – The large amounts of fish such as sardines has the potential for value adding, for example in the form of preservation such as through canning, adding value to the fishing industry and improving food security and export potential.

Climate Change Impacts

Table 13: Estimated area losses of sea level rise scenarios on overall area and on land uses in Tanga Urban district.

Tanga Urban	Total (km^2)	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
		ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation		151	0.26	491	0.86	1,306	2.28	2,786	4.87	4,218	7.37	8,625	15.07
Built-up area	12	0.00	0.00	1.67	0.13	2.50	0.20	3.28	0.26	3.28	0.26	11.76	0.95

For sea level rises levels above 4 m, approximately 5 % of the district land will be flooded, and 15% of the district will be inundated with a 10 m rise (or surge). Built-up areas will generally not suffer, even with a 10 m rise (or surge) though when coinciding with spring high tides, creeks and smaller inlets are likely to be significantly impacted along much of the length of the creeks with potential seawater penetration into agricultural land and shallow wells.

Projects and Plans

The entire coastline of Tanga urban is part of the internationally-recognised "Msambweni-Tanga" area of eco-regional importance (WWF, 2004) as described above (Chapter 2). There are three principle environmental and coastal management initiatives that have been implemented in the Tanga Region that include the Tanga Urban coastline.

Tanga Coelacanth Marine Park (TCMP) – The TCMP was gazetted in August 2009, with park boundaries that include Tanga Bay and extend southward to Kigombe Village on the Muheza coast and beyond into the northern end of Pangani District's shore. The TCMP covers an area of 552 km^2 of which 85 km^2 are terrestrial; it encompasses nine villages and a population of 45,000 residents (URT, 2011).

Tanga Coastal Zone Conservation and Development Programme (TCZCDP) – Though the project ceased to operate many years back, of relevance to Tanga Urban is the Mwarongo-Sahare Collaborative Management Area (CMA), that includes two islands directly east of Tanga city, and the Deep Sea-Boma CMA that includes a small section of Tanga Urban's northern waters (see fuller description of TCZCDP in Mkinga chapter 2, above).

Sustainable Environmental Management through Mariculture Activities (SEMMA) – Again, a project no longer operational, but one with a legacy (see description in Mkinga chapter 2, above).

Mwambani (Tanga) port - The Tanga-Arusha-Musoma Railway (3 billion USD) is a joint project between Uganda and Tanzania expected to start during the 2014 financial year and which would also develop the ports of Tanga (Mwambani) and other ports and lines. The planned location of this new 'deep-sea' port would be at the center of the Tanga Coelacanth Marine Park and is thus unlikely to materialize should an ESIA be conducted, unless TACMP is de-gazetted.

Tanga-Arusha-Musoma railway – This a 3 billion USD joint project between Uganda and Tanzania, expected to start during the 2014 financial year and includes a 12 km section from Kange to the proposed port at Mwambani in Tanga. This line will be constructed in line with the Tanzania Port Authority (TPA) implementation schedule as port rail connections from the proposed new port of Mwambani – Tanga. Feasibility studies and engineering design will be commissioned once the exact location and design of the proposed port are determined by TPA. The port is expected to assist in decongesting the port of Dar es Salaam and providing alternative routes for non-coastal countries. However, environmental concerns remain, as the railway would cut across the Serengeti National Park, while a port in Mwambani Bay would probably require de-gazetting of the Tanga Coelacanth Marine Park.

Natural gas pipeline from Dar es Salaam to Tanga (Tanzania) and Mombasa (Kenya) – The six routes presently being considered for the 527-550 km pipeline include four that traverse the coastal districts of Dar es Salaam Region (Ilala and Kinondoni), Bagamoyo, Pangani, Tanga Urban, Muheza and Mkinga, one that heads first to the west from Dar es Salaam to Chalinze and then follows the main trunk road (A14) northwards to Korogwe traversing the central portion of Bagamoyo and avoiding Pangani District, and one marine route that follows the coastline at a depth of maximum 50 m, about 10 km offshore, with a feeder branch into Tanga Urban (EAC, 2011).

4. Muheza District

Muheza District is in the Tanga Region. The large district was reduced in 2007 from an original area of 4,204 km^2 to the present day coverage of around 1,537 km^2. Similarly, the coastline was reduced from 197 km to the present day, relatively short coastline of 46 km.

Climate Profile

Temperature

The climate ranges from hot and humid in the narrow coastal plains of Muheza, to temperate in the mountains to the west. Average monthly temperature data from nearby Tanga weather station (Tanga Airport, from 1987 to 2012) indicates ranges from a low of around 20.5 ˚C during the coolest months of July to September when maximum temperatures are 29.4 ˚C and 29.7 ˚C for those months, to the highest monthly means of 32.0 ˚C to 33.2 ˚C during the hot season from December to March, when the temperatures drop to only 23.7 ˚C to 24.5 ˚C. Nights become much cooler inland, especially with increasing elevation towards the Usambara Mountains where both highlands and foothills having variable local conditions dictated by their altitude and exposure to the sun and the prevailing winds. Relative humidity (based on data from nearby Tanga) ranges from 72-75 % for much of the year, increasing to 79 % during the wettest months of April and May.

Precipitation

The average annual rainfall for Muheza weather station (at Muheza weather station) is 1,619 mm (ranging from 690 mm to 3,607 mm), over the period 1981 to 1996. From 1981 to 2010 (with some months lacking data) the monthly rainfall peaks are March to May (main wet season) with over 600 mm of rain during those three months, and October to December (short rains) with 450 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern.

Winds

Based on 26 years of data (1987 to 2012) from the Tanga Airport weather station (in Tanga Rural), in the morning (9 am) winds are generally light (5-9 knots), with strongest morning mean wind speeds during the months of May to July. Slightly stronger wind speeds (9-13 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (12-13 knots) during the months January and Februarys, resulting from typical northeast monsoon variability from light to strong winds within a few days, compared to the typically steady winds of the southeast monsoon period.

In a study by Dubi (2001) of maximum coastal wind speeds, from 1972 to 1996, the mode of the highest wind speeds reached in Tanga was 20 knots, with peak speeds during July-August. Tanga is considered an area of coastline that is influenced mostly by offshore winds, though over the studied period, the maximum wind speed has shown a decreasing trend (Dubi, 2001).

Population

Population size: 204,461 with 100,843 males and 103,843 females. Since Muheza District has been recently divided into two districts, there is discontinuity of data. The present day population density in the district is 49 persons/km^2.

Based on 2002 census data for the original Muheza, the percentage of the population living under the poverty line was 33 %, the over 15 years of age literacy coverage was 71 % and under five years of age mortality was 158 (per 1,000 live births).

Economy

Muheza District depends on large-scale and small-scale trade, small-scale livestock keeping, horticulture, tourism as well as milk production, small-scale industry and processing. A small number of coastal villages engage in fisheries. The main source of cash income activity for smallholder households in Muheza District is business followed by sales of food crops. It is estimated that about 95 % of Muheza residents are self-employed, in the informal sector and the remaining 5 % are employed in various public institutions.

Agriculture

Land suitable for agricultural in Muheza District is estimated at 643 km^2, representing 42 % of the entire district area. Muheza coastal area falls in zone C1 of agro-zoning, which is in east and south of the district, below 200 m elevation, this zone, receives rains 1,000 – 1,200 mm. It has two growing seasons, from March to June and September to December. There is low soil fertility and low water holding capacity below 200 m altitude (coastal plains). The main crops grown are cassava, jatropha, sweet potatoes, cashew nuts, pineapples, citrus, passion fruits, sisal and coconuts, the latter two crops on commercial scales. In 2005/6, the district cultivated 31,300 ha of cash crops and harvested 16,269 tonnes while food crops were cultivated in 33,182 ha and 126,900 tonnes harvested (TR-SEP, 2008). Potential area for irrigation in this district is 970 ha of which only 20 ha are under irrigation, with 150 ha under irrigation development (TR-SEP, 2008).

Livestock husbandry also takes place in Muheza with numbers of cattle steadily increasing from 2002 to 2008, as in other Tanga districts. According to data form the agricultural census of 2007/2008, the numbers of the major livestock reared in the district are as follows: cattle 30,947 (which include those reared by 390 farmers for milk production sold to Tanga Fresh Ltd. in 2011), chickens 471,123, goats 69,735, pigs 6,086, ducks 35,383, and sheep 9,078 (URT, 2012).

Fisheries

The short present-day coastline of Muheza supports only a single landing site, with no FBMs or special bylaws that govern fisheries (MLFD, 2010). According to the 2009 frame survey, there are 265 fishers of which 32 are foot fishers; the rest used 91 different types of vessels, of which 75 used sail, two use paddles and 14 use engines. Muheza has 265 seaweed farmers (URT, 2010).

Tourism

Tourism is not a significant sector in Muheza due to a number of shortcomings, such as poor access of coastal Muheza caused by poor infrastructure, especially roads. There is an initiative to promote tourism in Muheza District – the Muheza Cultural Tourism Initiative (see Projects and Plans).

Minerals

The mining activities undertaken in Muheza district include excavation of sand, gravel stone or boulders, aggregates and limestone. There are no salt works in the district.

Description of the coast

Physical

This is the second largest of the four Tanga region districts, which borders Mkinga to the north, Pangani to the south, Handeni to the southwest and Tanga Urban to the northeast. The drainage systems of Muheza consists of the Pangani, Zigi and Mkulumuzi rivers that flow through the district, dissecting the lowlands and emptying into the Indian Ocean in neighbouring districts. The Mkulumzi River supplies water to Muheza town. Koreni River discharges about half way along the

shoreline. The short shoreline is mostly sand beach giving way to a rocky reef platform extending to the subtidal, with small sections of limestone outcrop.

Coastal ecology

The coastline and inshore waters of Muheza District support a narrow fringing mangrove forest, intertidal rocky and sand expanses, with large areas of seagrass beds that extend sub tidally and patches and isolated coral reefs.

Coral reefs – Two small patch reefs front the shores of Muheza District and a shallow inshore fringing reef that extends along much of the shore. The widespread use of destructive fishing practices such as dynamite fishing, dragging nets, and anchoring, and natural causes including storms, the 1998 El Nino and the occurrence of sea urchins (secondary effect of over-fishing) have impacted on these reefs over the years.

Mangroves – Mangrove forests in Muheza cover 50 ha, mostly as a narrow fringe, with the largest and most dense stands concentrated along the southern coast. The main mangrove stands include Dahali on the Southern tip of Kigombe (22.1 ha) (MD-ICMAP, 2009).

Beach and rock shorelines – Most of the shoreline of Muheza supports a rock intertidal band 200-400 m wide, with the northern part and large portion of the southern section fringed by mangrove forest. At least half of the 46 km shore is backed by sand beach.

Coastal waters

The peak outflow from the mainly seasonal rivers of Muheza occurs from March to May and the influence of freshwater from the main river at the border with Tanga Urban District and two small seasonal rivers is restricted to coastal waters and tends to reduce water salinity and increase turbidity due to sediment inputs near the coast.

Marine species of importance

Turtles – Green turtle nesting takes place in some sandy beaches within the district.

Cetaceans - Humpback whales are regularly reported within short distances of the coastline especially during July to November.

Shorebirds – Muheza coast includes the southern portion of the Tanga South IBA 36, extending from Mwarongo salt works in Tanga Urban to sandy spit on the mouth of Koreni River in Pangani District (Baker & Baker, 2002).

Natural resources

Muheza is well known for exotic forests with rich biodiversity and endemism, with 300 km^2, covering over 19 % of the district. There are nine forest reserves in Muheza District which cover an area of approximately 16,169 ha. These include dense and open forests, shrub bushes and thickets at the following sites: Manga (1,635 ha), Kwamarimba (1,032 ha), Mlinga (840 ha), Kambai (1,050 ha), Semdoe (880 ha), Kwani (2,545 ha), Tongoe (1,202), Nilo (6,025), and Derema (960 ha). The reserves face various degradation problems, for instance 175.5 ha of Semdoe FR and 287.6 ha of Mlinga FR were encroached (Munyuku, 1995). There are also 168 km^2 of woodland, representing about 11 % of the district and 396 km^2 of bush land, representing approximately 26 % of the district.

Settlements

The settlement and built-up portion of Muheza covers approximately 2 km^2 and is concentrated in the central area of the district, some 30 km from the coast and along the main trunk road to Tanga City. Along the coastal district road, linking Tanga City with Pangani, the main village of Kigombe

represents the major settlement on the coast. Inland, sparse settlements and wide expanses of commercial sisal plantations occupy the landscape.

Infrastructure

Total road length in the district is 687 km of which trunk road is 43 km (the A14 north to Tanga City and west into Handeni District), regional roads 127.5 km and district roads 302.6 km (TR-SEP, 2008). Mobile communication from all four major mobile networks in Tanzania, Airtel, Zantel, Tigo and Vodacom is available in some areas of the district. TTCL a national landline telecommunication network is also available in some parts of the district. The railway line from Tanga to Muheza, Korogwe and west to Moshi, and the line south through Pangani to Dar es Salaam are both non-operational and in need of major rehabilitation.

Major Threats

Table 14: Overview of threats to coastal communities in Muheza district.

Threat	Location	Cause
Beach pollution	Kigombe, Msakangoto	Uncontrolled solid and liquid waste disposal, lack of latrines in many households and public areas. Discharge from industrial wastes
Beach erosion	Kigombe, Msakangoto	Beach sand and gravel excavation, mangrove cutting, dynamite fishing, unplanned construction along the coast.
Fisheries decline	At the near shore coastal area	Destruction of fish nurseries by mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods as well as coral mining for lime production
Diseases outbreaks		Inadequate sewerage control, flooding, poor solid waste management, uncontrolled food vending.
Flooding	Kigombe	Poor drainage in the settlement area
Land use conflicts	Kigombe and Msakangoto	Between sisal plantation and community (large land area owned by sisal plantation the fact that deprive community of for their various needs), construction of hotels vs beach access by local community. Conflict on the use of marine resources which emanates to misunderstanding between Immigrants fishers and resident fishing areas without following regulation
Reduced citrus yields	Across farming sectors	Lack of technical support to farmers

CRIAM Ranking of Threats to Local Communities in Muheza District

Table 15: Prioritisation of threats to local communities in Muheza District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	Nearshore coastal areas	3	3	3	2	3	72	5					
Beach erosion	Kigombe, Msakangoto	3	3	3	2	2	63	4					
Land use conflicts	Kigombe /Msakangoto	3	2	2	2	2	36	4					
Diseases outbreaks	Kigombe / Msakangoto	3	1	2	2	3	21	3					
Beach pollution	Kigombe / Msakangoto	3	1	3	2	2	21	3					
Reduced citrus yields	Across farming sectors of district	1	1	2	2	2	6	1					
Flooding	Kigombe	1	1	2	2	1	5	1					

Major Opportunities

Opportunities available for coastal communities:

- Agro-processing industries - Establishment of spice processing plants and fruit processing units.
- Tourism – Ecotourism.

Climate Change Impacts

Table 16: Estimated area losses of sea level rise scenarios on overall area and on land uses in Muheza district.

Muheza	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation	26	0.01	75	0.02	159	0.04	268	0.06	422	0.10	704	0.17

The raised shore and short length of coastline (46 km) preclude any significant impacts from sea level rise, even for the 10 m rise scenario. However, a storm surge coinciding with spring high tides are likely to have significant impacts further inland, along much of the length of the main river creek at the border of the district with Tanga Urban, with potential seawater penetration into agricultural land and shallow wells.

Projects and Plans

The entire coastline of Tanga urban is part of the internationally-recognised "Msambweni-Tanga" area of eco-regional importance (WWF, 2004) as described above (Chapter 2). There are three principal environmental and coastal management initiatives that have been implemented in the Tanga Region that include the Muheza coastline, a tourism initiative and medical research centre in the district.

Tanga Coelacanth Marine Park (TCMP) – The TCMP was gazetted in August 2009, with park boundaries that include Tanga Bay and extend southward to Kigombe Village on the Muheza coast and beyond into the northern end of Pangani District's shore. The TCMP covers an area of 552 km^2 of which 85 km^2 are terrestrial; it encompasses nine villages and a population of 45,000 residents (URT, 2011).

Tanga Coastal Zone Conservation and Development Programme (TCZCDP) – Of relevance to Muheza is the Mtang'ata CMA that includes a number of reefs directly east of Muheza shores (see full description of TCZCDP in Mkinga chapter 2, above).

Sustainable Environmental Management through Mariculture Activities (SEMMA) - (see description in Mkinga chapter 2, above).

Amani Research Centre of the National Institute for Medical Research (NIMR) – The Amani research Centre is located at Ubwari in Muheza, north-eastern Tanzania at about 40 km west of Tanga City. Amani Research Centre has a vision of developing itself into a centre of excellence in vector biology and disease control research. Based on the NIMR strategic plan (2003 – 2013) Amani Research Centre focuses on a broader agenda that includes research on malaria, plague, lymphatic filariasis, tick-borne relapsing fever, onchocerciasis, health systems and policy. The Centre also undertakes bio-informatics, diagnostics and laboratory sciences as well as demographic surveillance systems, basic and applied research (genetics and molecular biology) and indigenous knowledge and traditional medicine. Amani Centre has been the WHO reference centre for conducting trials on the efficacy of

various insecticide treated fabrics under various settings, and has put up facilities for Phase II trials of insecticides and insecticide treated fabrics.

Natural gas pipeline from Dar es Salaam to Tanga (Tanzania) and Mombasa (Kenya) – The six routes presently being considered for the 527-550 km pipeline include five that traverse all or some of the coastal districts between Ilala, Bagamoyo, Pangani, Tanga Urban, Muheza and Mkinga and one offshore marine route (see full description in Mkinga chapter 2, above).

5. Pangani District

Pangani District is in the Tanga Region. It has a land area of around 1,800 km² and a coastline of 182 km.

Climate Profile

Temperature

The climate is predominantly hot and humid over the wide coastal plains, with average monthly temperature data, from nearby Tanga weather station (Tanga Airport, from 1987 to 2012), revealing ranges from a low of around 20.5 ˚C during the coolest months of July to September when maximum temperatures are 29.4 ˚C and 29.7 ˚C for those months, to the highest monthly means of 32.0 ˚C to 33.2 ˚C during the hot season from December to March, when the temperatures drop to only 23.7 ˚C to 24.5 ˚C.

Relative humidity at Tanga ranges from 72-75 % for much of the year, increasing to 79 % during the wettest months of April and May, while for Dar es Salaam, relative humidity ranges from 67-70 % from August to October, increasing to 82 % during the wettest months of April. Pangani is likely to experience relative humidity within those of the neighbouring districts.

Precipitation

The average annual rainfall for Pangani (from Pangani weather station) is 1,206 mm (ranging from 661 mm to 1,991 mm), over the period 1980 to 2008. From 1980 to 2011 (with data lacking for some months) the monthly rainfall peaks are March to May (main wet season) with over 530 mm of rain during those three months, and October to November (short rains) with 290 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern.

Winds

Based on 26 years of data (1987 to 2012) from the Tanga Airport weather station (in Tanga Rural), in the morning (9 am) winds are generally light (5-9 knots), with strongest morning mean wind speeds during the months of May to July. Slightly stronger wind speeds (9-13 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (12-13 knots) during the months of January and February, resulting from typical north-east monsoon variability from light to strong winds within a few days, compared to the typically steady winds of the southeast monsoon period.

In a study by Dubi (2001) of maximum coastal wind speeds, from 1972 to 1996, the highest wind speeds reached in Tanga was 20 knots, with peak speeds during July-August. Tanga is considered an area of coastline that is influenced mostly by offshore winds, though over the studied period, the maximum wind speed has shown a decreasing trend (Dubi, 2001).

Population

Population size: 54,025 with 27,155 females and 26,870 males. The district has experienced an average annual growth rate between 2002 and 2012 of 2.07 % leading to more than 24 % increase of the population over the ten-year period, with a low level of net in-migration. The population density in the district has grown to 31 persons/km² in 2012 from 25 persons/km² in 2002.

Based on 2002 census data, the percentage of the population living below the poverty line was 22 %, the over 15 years of age literacy coverage was 73 % and under five years of age mortality was 173 per 1,000 live births.

Economy

The economy of Pangani District largely depends on small-scale agriculture and animal husbandry, with the coastal population highly dependent on fisheries. Other economic activities are including retail and wholesale trade and tourism.

Agriculture

Suitable land for agriculture in Pangani estimated to cover 157 km^2 (about 9 % of the total Pangani District area) of which only 35 % is used (TRC Office, 2006). Agriculture engages the largest percentage of the labour force in the district followed by street vending and fisheries (TR-SEP, 2008). Agricultural activities involve both food and cash crops cultivation that depends largely on rain. The main food crops include maize, simsim, paddy, cowpeas, green gram and vegetables. Cash crops cultivated include sisal, cashew nuts and coconuts. Household crop production according to TR-SE Profile (2008) is 6,826 ha planted with food crops and 13,207 tonnes harvested, while cash crops produced 88 tonnes from 86 ha in 2005/6. Potential irrigated land covers 22,500 ha, while only 300 ha are irrigated (TRC Office, 2006).

Livestock husbandry takes place in Pangani with main animal kept including cattle (28,285), goats, (34,262), sheep (7,071), poultry (142,006) and ducks (7,180) (TR-SEP, 2008). Land suitable for grazing covers 23,790 ha (TRO's website).

Fisheries

Fisheries contribute to the economic activities in Pangani District with 13 landing sites, of which four are permanent and nine are temporary, with fisheries regulated through 11 BMUs and three FMPs, though there are no fisheries bylaws in the district (MLFD, 2010). According to the 2009 frame survey data, there are 930 fishers of which 190 are foot fishers; the rest used different types of vessels. Of the 271 vessels recorded, 176 used sail for propulsion, 88 used paddles and seven used engines. Pangani has 210 seaweed farmers (URT, 2010). Over 39 tonnes of fish were harvested in the year 2005/6 (TR-SEP, 2008).

Tourism

There are a number of tourist hotels, especially in Ushongo village and vicinity. In Pangani town and nearby villages there are about 20 accommodation facilities, including beach lodges and guesthouses. In Saadani NP area there are about five accommodation facilities including tented camps. A number of tourist attractions are available in Pangani District including several historical sites in and around the town remind the strong Arabian, German and English pasts, example being the District boma which has been used by all major foreign powers in the country. Other attractions are historical sisal plantations, cultural tourism (the old Pangani town), Pangani River cruises and Saadani National Park. Of particular interest is Maziwe Island Marine Reserve (the oldest marine reserve in the country, established in 1981) with rich biodiversity of corals and associated flora and fauna. In addition, the district has many kilometers of sand beaches such as along Ushongo village from where a number of tourist activities can be conducted such as water sports, wind surfing, boat trips, sailing, kayaking, and biking.

Minerals

The mining activities undertaken in Pangani district include excavation of sand, gravel stone or boulders, aggregates and limestone, mainly from coastal riverbed sources. There are a few minor salt works in the district.

Description of the coast

Physical

The second largest of the four Tanga Region, the Pangani District boarders Handeni district to the west, Muheza to the North and Bagamoyo District (Coast Region) to the south. The district is penetrated by several main rivers, Pangani River that drains a basin of 43,000 km^2, extending from the slopes of Kilimanjaro, and emptying at the coast at Pangani town, plus five smaller coastal rivers (Msangasi, Ushongo Mabanoni, Madete and Kipumbwi rivers) in addition to numerous seasonal streams. The shore is mostly soft substratum extending to the subtidal, and sediments dominated by sand inshore, mainly of silicilastic river-dominated origin extending to 50 m depth, except for 7-8 km of raised reef platform north and south of Pangani estuary (Shagude, 2004).

Offshore there is the single small island of Maziwe (a Marine Reserve) and two clusters of coral patch reef clusters, the largest Ushongo, Datcha, and Kipumbwe and adjacent reefs.

Coastal ecology

The coastline and inshore waters of Pangani District support coral reefs, intertidal rocky and sand expanses, some with seagrass beds that extend into the subtidal areas, and extensive mangrove forests. A prominent feature of the district is the Pangani River, from which the district takes its name. It has a large floodplain and delta and vast mangrove forests that flank the tributaries of the delta.

Coral reefs – Pangani reefs can be divided into two major types according to reef formation in relation to the main coast, the inshore fringing reef and a series of sand banks few kilometres from the shore. The inshore fringing reefs extends from Ras Kikobwe past Kigombe, Mkwaja to Sunge, while the reef off the coast around the sand banks include Mwamba Mawe, Maziwe, Fungu Ushongo, Kibumbwe reefs, Fungu Datcha, Mwamba Alek, Mkwaja and Mwamba Buiuni. Coral cover and condition of these reefs vary with some areas such as Maziwe, Dambwe, Upangu and Zinga having 40 – 50 % cover.

Mangroves – Mangrove forest cover in Pangani District is estimated to 2,260 ha. In Pangani, the main mangrove stands are at Pangani river mouth (753 ha, extensive, stretches for about 10 km inland); areas near Ushongo Mabaoni (153 ha), areas along Msangasi River (422 ha), at Kama River (170 ha), and near Ras Machusi (184 ha).

Beach and rock shorelines – Part of Pangani shoreline, especially within the river mouth and few kilometres north and south is characterised by long continuous stands of mangrove forest with muddy substratum. The area is also characterised by long sandy beaches, for example at Ushongo village the beach stretches for more than 3 km.

Coastal waters

The peak outflow from the many rivers of Pangani occurs from March to May and the influence of freshwater from this river and the five additional small rivers, contributing large amounts of freshwater and sediment to coastal waters resulting in reduced water salinity near the coast.

Marine species of importance

Cetaceans - Humpback whales are reported within short distances of the coastline especially from July to November.

Turtles – Maziwe Island was known for green, hawksbill and Olive Ridley turtle nesting in the 1970s. Although it is covered by water during high tide it is still a natural nesting site and turtles still

frequent the area. Madete beach, within Saadani NP, is a second very important turtle nesting site in Pangani (Wells et al., 2007). Tagging of a female green turtle from a Pangani beach revealed, during the first 78 days, important data on inter-nesting movement patterns and the home range of a gravid female who remained within 15 km of her nesting beach (Figure 1) suggesting it is likely that she went on to lay several more nests around the Panagani area after she was tagged (Seas Sense, 2014).

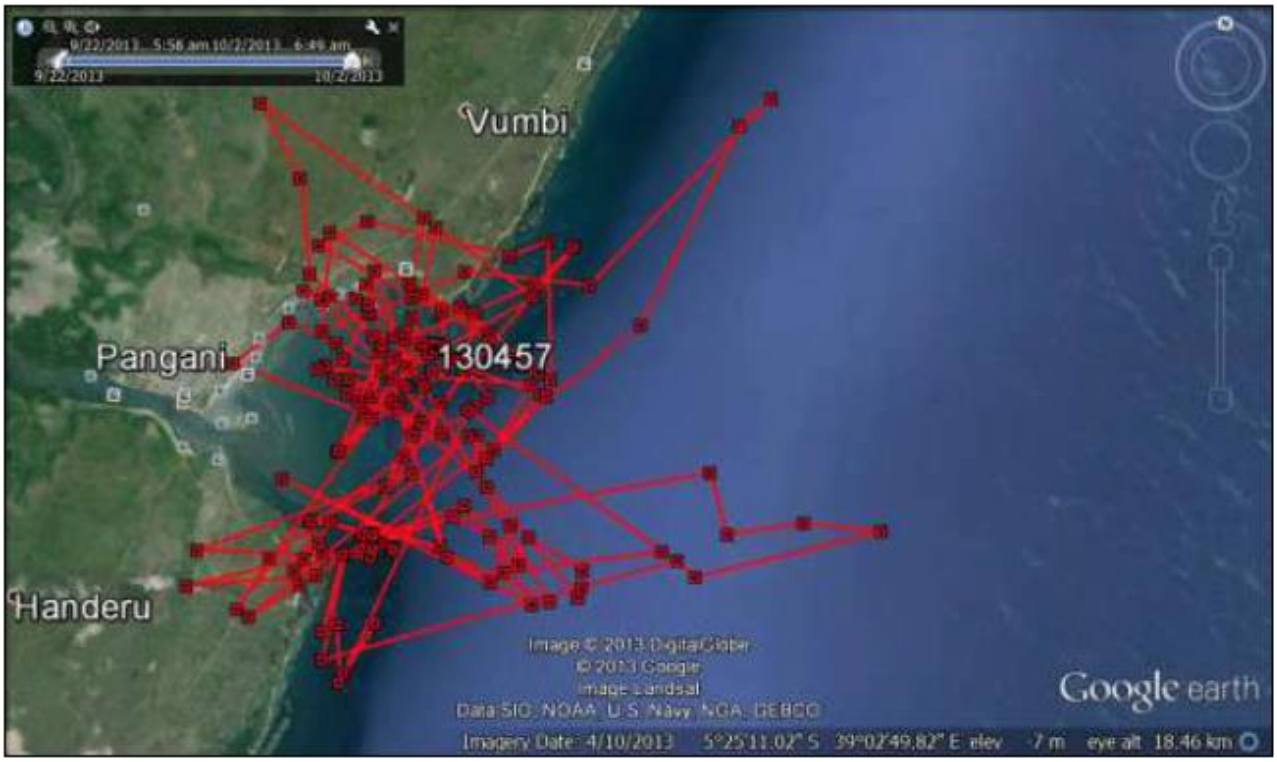

Figure 1: Inter-nesting movement of green turtle "Olive", September-December 2013 (Sea Sense, 2014). Note: records over land due to weak satellite coverage increasing error.

Shorebirds – Recently about 38,000 shorebirds were counted in Maziwe Island MR one of which is black tern, very rare in the region. Water birds are a feature of Saadani NP and contribute to the diversity of birds in the park, with approximately 300 species recorded.

Natural resources

There are no natural forests remaining in Pangani, though woodlands cover 536 km^2 (about 30 % of the district) and only two forest reserves exist, Garafuno FR (195 ha) and Msubugwe FR (4,407 ha). Garafuno has no defined management while Msubugwa is a central government protected reserve and there is a proposal to join the latter to Saadani NP. Major threats in these reserves include logging, hunting, fires and fuel wood collection (NEMC, 2009). There are also 722 km^2 of bush land (about 40 % of the district) and 270 km^2 of grassland (about 15 % of the district).

Settlements

The settlement and built-up portion of Pangani (about 1 km^2) represents less than 1 % of the district and is concentrated in the north-eastern corner, at Pangani town, and in six main villages along the north-south coastal road, that mostly runs parallel to and within 7-8 km from the shore, linking Tanga City to Bagamoyo. There are few settlements in the interior of the district and no trunk roads.

Infrastructure

Pangani has one airstrip which needs attention. Total road length in the district is 345 km of which 193 km are regional roads, district roads are 109 km, feeder roads are 128.4 km and urban roads extend for 14 km. Only 120 km (35 %) of Pangani roads are passable year round (TR-SEP, 2008). All major mobile phone operators have network in Pangani. The railway line from Dar es Salaam to Tanga passes through the district and north into Muheza but are non-operational and in need of major rehabilitation.

Major Threats

Table 17: Overview of threats to coastal communities in Pangani district.

Threat	Location	Cause
Beach pollution	Pangani Town, Pangani River valley	Uncontrolled solid and liquid waste disposal, human excreta due to lack of latrines, coconut husk disposal on the beach. Large plantations in the highland drain into Pangani basin and hence fertilizers, pesticides, herbicides and fungicides from up land far to Kilimanjaro highlands may pose as threat.
Beach erosion	Pangani Town, Ushongo,	Mangrove cutting, dynamite fishing, beach sand mining, climate changes, Pangani beach wall degradation
River erosion	along Pangani River Bank	
Marine pollution	Pangani River valley, Pangani Town	Uncontrolled solid and liquid waste disposal, human excreta (sewage) due to lack of latrines, coconut husk disposal on the beach. Large plantations in the highland drain into Pangani basin and hence fertilizers, pesticides, herbicides and fungicides from up land far to Kilimanjaro highlands may pose as threat
Fisheries decline	All along the coastal shore water and especially Matakani	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods as well as coral mining for lime production, SCUBA fishing
Decline in sea turtle population	Along Ushongo beaches and other sandy beaches and dunes	Deforestation of old Maziwe Island (now is just a sand bank), destruction of turtle nesting areas, turtle catching and killing for having meet purposes
Increase of HIV infection	All along the district	Unsafe sex, alcoholism and drug abuse, early age sex engagement
Land use conflicts	Saadani and Buyuni border. Ushongo and vicinity. Various district areas	Between Sadani NP and Buyuni Village Community. Hotelier vs village communities on beach access. Land use conflict between livestock keeper and farmer on the grazing vs cultivation land
Loss of habitat and agricultural area	Various district areas	Mangrove cutting, forest clearing for firewood collection, agricultural and animal rearing purposes, use of fire in cultivation,

CRIAM Ranking of Threats to Local Communities in Pangani District

Table 18: Prioritisation of threats to local communities in Pangani District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	Along shore water and especially Matakani	3	3	3	2	2	63	4					
Beach pollution	Pangani Town, Pangani River valley	3	2	3	2	2	42	4					
Beach erosion	Along entire coast and in particular at Pangani Town, Ushongo	3	2	3	2	2	42	4					

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Decline in sea turtle population	Along Ushongo and other sandy beaches and dunes	3	2	3	2	2	42	4					
Land use conflicts	Saadani and Buyuni border. Ushongo and vicinity. Various district areas	2	2	3	2	2	28	3					
Loss of habitat + agricultural area	Various district areas	2	2	3	2	1	24	3					
Increase of HIV infection	All along the district	1	2	3	2	3	16	2					
River erosion	along Pangani River Bank	1	2	3	2	2	14	2					
Marine pollution	Pangani River valley + Town	1	2	3	2	2	14	2					

Major Opportunities

Opportunities available for coastal communities:

Livelihood opportunities yet to be pursued according to PD-ICMAP (2009) are:

- Aquaculture – well-planned and controlled aquaculture especially in abandoned saltpans and other coastal lowlands.
- Tourism – Pangani has many tourist attractions for ecotourism as well as mainstream of tourism.
- Fisheries – Tanga coast has very high potential for open water and oceanic fisheries.
- Beekeeping – the district is endowed with many forest reserves both in land and mangrove forests which are very suitable for beekeeping.
- Livestock husbandry.

Climate Change Impacts

Table 19: Estimated area losses of sea level rise scenarios on overall area and on land uses in Pangani district.

Pangani	Total (km^2)	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
		ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation		67	0.04	264	0.15	697	0.39	1,269	0.72	2,250	1.27	48,59	27.50
Built-up area	15	7.17	6.04	9.71	8.19	9.71	8.19	10.57	8.91	11.70	9.86	7.17	6.04

No significant impacts from sea level rise are felt over the general land area except for a rise of 10 m whereby 27.5 % of the land would be flooded, since much of the district is low-lying and thus vulnerable to inundation. Although there is very little build-up area, it is vulnerable to inundation, with over 8 % likely to be inundated with a 2 m rise. Storm surges resulting in rises equivalent to 7 m, will likely flood almost 18 % of the district, with higher surges (10 m) penetrating creeks and rivers and flooding over a quarter of the district (27 %).

Projects and Plans

The entire coastline of Panagni is part of the internationally-recognised "Msambweni-Tanga" area of eco-regional importance (WWF, 2004) as described above (see Mkinga, Chapter 2). There are five principal environmental and coastal management initiatives that have been implemented in the Tanga Region that include the Pangani coastline.

Tanga Coelacanth Marine Park (TCMP) – The TCMP was gazetted in August 2009, with park boundaries that include Tanga Bay and extend southward into the northern end of Pangani District's shore. The TCMP covers an area of 552 km^2 of which 85 km^2 are terrestrial; it encompasses nine villages and a population of 45,000 residents (URT, 2011).

Tanga Coastal Zone Conservation and Development Programme (TCZCDP) – Of relevance to Pangani is the Mkwaja-Sange Collaborative Management Area (with closed reefs) and Boza-Sange Collaborative Management Area (with closed reefs) (see full description of TCZCDP in Mkinga chapter 2, above).

Sustainable Environmental Management through Mariculture Activities (SEMMA) - (see description in Mkinga chapter 2, above).

Maziwe Island Marine Reserve (MR) – Maziwe is one of the oldest MRs in Tanzania and is located about 8 km off the coast of Pangani District and 27 km from Pangani town. It was established in 1975 and given the status of a Marine Reserve (No -Take Zone) to protect the forest on the island as well as the important reef system surrounding the island. Maziwe Island also one of the most important breeding place for three species of sea turtles in Tanzania. About 40 years ago Maziwe was totally covered with dense forest which has since disappeared due to natural as well as anthropological causes. The Island (now just a sand bank, covered during spring high tides) is fringed by coral reef slopes and coral gardens rich in diversity. The reserve has about 400 fish species and a number of coral genera. The area is very important for shore birds. A recent count by Danish bird experts found more than 35,000 terns either roosting or passing the area. It is currently managed collaboratively with Pangani District Council and a local NGO supported by the tourism sector.

Saadani National Park – Gazetted in 1969 as a Game Reserve then as a Saadani NP in 2005, it includes a section of 5 km of shoreline and a cluster of sand banks (Mafui) offshore Madete beach. The NP covers 1,100 km^2 and extends into neighboring Bagamoyo District to the south. Approximately 60 % of the park is in Pangani, the remainder in Bagamoyo District.

Natural gas pipeline from Dar es Salaam to Tanga (Tanzania) and Mombasa (Kenya) – The six routes presently being considered for the 527-550 km pipeline include five that traverse all or some of the coastal districts between Ilala, Bagamoyo, Pangani, Tanga Urban, Muheza and Mkinga and one offshore marine route (see full description in Mkinga chapter 2, above).

6. Bagamoyo District

Bagamoyo District is the northern-most district of the Coast Region having a land area of around 8,534 km^2 and with a coastline of 205 km.

Climate Profile

Temperature

The climate is predominantly hot and humid over the wide coastal plains, and cooler over the slightly higher ground and hills to central west of Bagamoyo district. Average monthly temperature data, from nearby Dar es Salaam Airport weather station, from 1989 to 2012, reveals ranges from a low of around 18.8 ˚C during the coolest months of July and August when maximum temperatures are 29.4 ˚C and 29.7 ˚C respectively, to the highest monthly means of 31.9 ˚C to 32.6 ˚C during the hot season from December to March, during which temperatures drop to only 23.7 ˚C to 24.5 ˚C. Relative humidity at nearby Dar es Salaam, ranges from 67-70 % from August to October, increasing to 82 % during the wettest months of April.

Precipitation

The average annual rainfall for Bagamoyo, based on the nearest weather station (at Dar es Salaam Airport) is 1,073 mm (ranging from 585 mm to 1,536 mm), over the period 1989 to 2013. The monthly rainfall peaks are March to May (main wet season) with about 550 mm of rain during those three months, and November to December (short rains) with 235 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern, with less significant short rains.

Winds

Based on 26 years of data (1987 to 2012) from the Dar es Salaam Airport weather station, in the morning (9 am) winds are generally light (5-9 knots), with strongest morning mean wind speeds during the months of January and February. Slightly stronger wind speeds (8-12 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (11-12 knots) during the months of January (12 knots), February and August to October (11 knots) resulting from typical north-east monsoon variability from light to strong winds within a few days, compared to the typically steady winds of the southeast monsoon period.

In a study by Dubi (2001) of maximum coastal wind speeds, from 1972 to 1996, the mode of the highest wind speeds reached in Dar es Salaam was 20 knots, with peak speeds during both January and July. Dar es Salaam is considered an area of coastline that is more influenced by coastal winds rather than from offshore winds. Over the studied period, the maximum wind speed has shown two peaks: one peak is seen in the period 1975–1979 and another during 1981–84, after which the speeds decrease (Dubi, 2001).

Population

Population size: 311,740 with 157,542 females and 154,198 males. The district has experienced a high average annual growth rate between 2002 and 2012 of 3.45 % leading to more than 42.30 % increase of the population over the ten-year period and documenting a significant in-migration. The population density in the district has grown to 37 persons/km^2 in 2012 from 26 persons/km^2 of 2002.

Based on 2002 census data, the percentage of the population living below the poverty line was 40 %, the over 15 years of age literacy coverage was 63 % and under five years of age mortality was 174 per 1,000 live births.

Economy

Agriculture is the main economic activity in Bagamoyo District. Other economic activities in the area include fisheries, livestock keeping, tourism, trade, and small-scale industries. In 2011, Bagamoyo's Economic Processing Zone (EPZ) operators exported products worth more than USD 380 million, compared with USD 130 million-worth of exports in 2010. Processing activities are grouped in three main categories. These are agro products (fruits, textiles, cotton lint); precious minerals (lapidary), and leather industry products.

Agriculture

Arable land in Bagamoyo District covers 934 km^2 with the main cash crops being coconut and cashew nuts. Food crops are cassava, rice, millet, legumes, maize and sweet potatoes (NBS-CRCO, 2007). Kiwangwa – Bagamoyo is an area known for production of pineapples. Land suitable for irrigation is 16,620 ha of which only 700 ha are under irrigation. Main crops under irrigation include rice and vegetables. The Bagamoyo-based agro firm Bagamoyo Fruits Company Ltd. engages in fruit-farming at the Kiwangwa village, growing pineapples, oranges and passion fruits on a commercial basis. Livestock keeping is also practiced in Bagamoyo, although in small numbers, with only about 62,270 cattle, 10,028 goats, 2,022 sheep kept (NBS-CRCO, 2007).

Fisheries

Bagamoyo District has 11 landing sites, of which ten are permanent and one temporary; nine BMUs with three FMPs (MLFD, 2010). According to 2009 frame survey data, there are 1,691 fishers of which 229 are foot fishers; the rest used different types of vessels. Of the 412 vessels recorded, 226 used sail for propulsion, 135 paddles and 51 engines. The generally muddy condition of Bagamoyo's coastal waters restricts seaweed farming to small areas, resulting in few engaged in the activity, with 60 seaweed farmers reported (URT, 2010).

Tourism

Gautum (2009) described tourism in Bagamoyo in great detail. In the southern portion of the Saadani NP are located four wildlife lodges plus several tourism activities and attractions that include Mlingotini ecological and cultural tourism, a hotels and beach lodges close to Bagamoyo and Mbegani (e.g. Lazy Lagoon). Bagamoyo is rich for her history and was a major maritime trading centre in 12th and 13th Centuries. Kaole village which was established in that era with early Arabs and Portuguese still have a number of artifacts, tombs and very old mosques. Dunda village as an old stonetown was declared as UNESCO world heritage. Bagamoyo was an early point of European entry in mainland East Africa. Famous explorers such as David Livingstone, Richard Francis Burton, John Hanning Speke, Henry Morton Stanley and James Augustus Grant started their inland safaris from Bagamoyo.

Minerals

The mining activities undertaken in Bagamoyo district include sand, gravel stone or boulders, aggregates and limestone extraction, mostly for building. Salt works cover 1,106 ha which is about 0.13 % of its total land, and about a third of the mainland total area under solar salt production. Precious minerals processing (lapidary) is conducted in the Bagamoyo EPZ.

Description of the coast

Physical

To the north, Bagamoyo borders with Pangani District for a short section close to the coast, and with Handeni District further inland, to the west with Morogoro District and to the south with Kibaha District except for a short, 10 km border with Kinondoni Municipal Council. Bagamoyo District is endowed with coastal and marine natural resources. Two main rivers drain the district, the northern Wami River which begins in Londoa District (north of Dodoma) as the Kangasungwa River, passing through Kilosa District (west of Morogoro), before joining the Wami River some 350 km to the west, discharges in the southern portion of the Saadani National Park, and the Ruvu River further south and close to Bagamoyo town, which drains from as far as Morogoro Region, discharging just north of Bagamoyo town. Smaller rivers include the Mligaji and Mvave that are less than 40 km long and discharge along the Saadani NP coast, north of Mvave Railway Station (dormant). Most of the shore is soft substratum extending to the subtidal, with sediments predominantly clay bound sands and gravel with beach sands predominantly silicilastic due to the presence of numerous rivers, with some carbonate sand around sand banks offshore**.**

Coastal ecology

The coastline and inshore waters of Bagamoyo District support few reefs due to the lack of hard substrate and the presence of heavy silt and sediment loads from the four main rivers. Bare sand and seagrass expanses extend into the subtidal areas and dominate inshore waters. Mangrove forests are present in patches at the estuaries of the main rivers and around Mbegani and Lazy Lagoon in the south.

Coral reefs – Bagamoyo coral reefs are stressed by high influx of sediment from adjacent rivers, especially Ruvu River. There are no fringing reefs but a number of isolated patch reefs exist. High coral cover is found at Mwamba Kuni and Mwamba Mshingwi reefs (Mkama et al, 2013), 8-15 km from the coast close to Bagamoyo; with five smaller patch reefs closer to shore and stressed by sediment loads and poor water quality. Reefs located further away from the Ruvu River, such as Mwamba Winde and Fungu Miko, are in relatively better condition

Mangroves – In Bagamoyo mangroves cover an area of 4,620 ha and are distributed along the coast, in six main patches, associated with the river estuaries (Wami River, 862 ha, Utondwe creek 834 ha, Ruvu River 2,123 ha, and south of Bagamoyo to Mpiji River, 809 ha (Semesi, 1991 as quoted by Tobey et al., 2013). The southernmost mangrove patch stretches from Ras Mbegani to Mlingotini occurring as mangrove fringes with relatively denser thickets at Mbegani and Mlingotini. Dense mangrove thickets are also common on most of the raised reef inside the Lazy Lagoon Bay. Outside the Bay, there are stands of mangroves at Kaole, and Kondo sheltered creeks and lagoons. There is also a narrow band which extents further south to Mbweni, in Kinondoni District. Overall the Bagamoyo mangroves are reported to have not significantly changed between 1990 and 2000 (Wang et al., 2003).

Beach and rock shorelines – Generally Bagamoyo's shoreline is sandy with some formation of reefs along some areas where hard limestone or sandstone outcrops allow coral growth close to the shore, for example on the outer margins of Lazy Lagoon, in the south of the district. Much of the northern shore is sandy. The wide expanses of intertidal sand and mud flats off Bagamoyo provide important bird feeding areas during low tide, and important fish and shellfish breeding and feeding grounds, in part thanks to the discharges from the various small to medium sized river systems.

Coastal waters

The peak outflow from the many rivers of Bagamoyo occurs from March to May and the influence of freshwater from these rivers contributes large amounts of freshwater and sediment to coastal

waters resulting in reduced water salinity near the coast and high turbidity, especially during periods of heavy rainfall.

The results of a study by Ngoye and Machiwa (2002) show impairment of the water quality of the river by anthropogenic activities in the catchment.

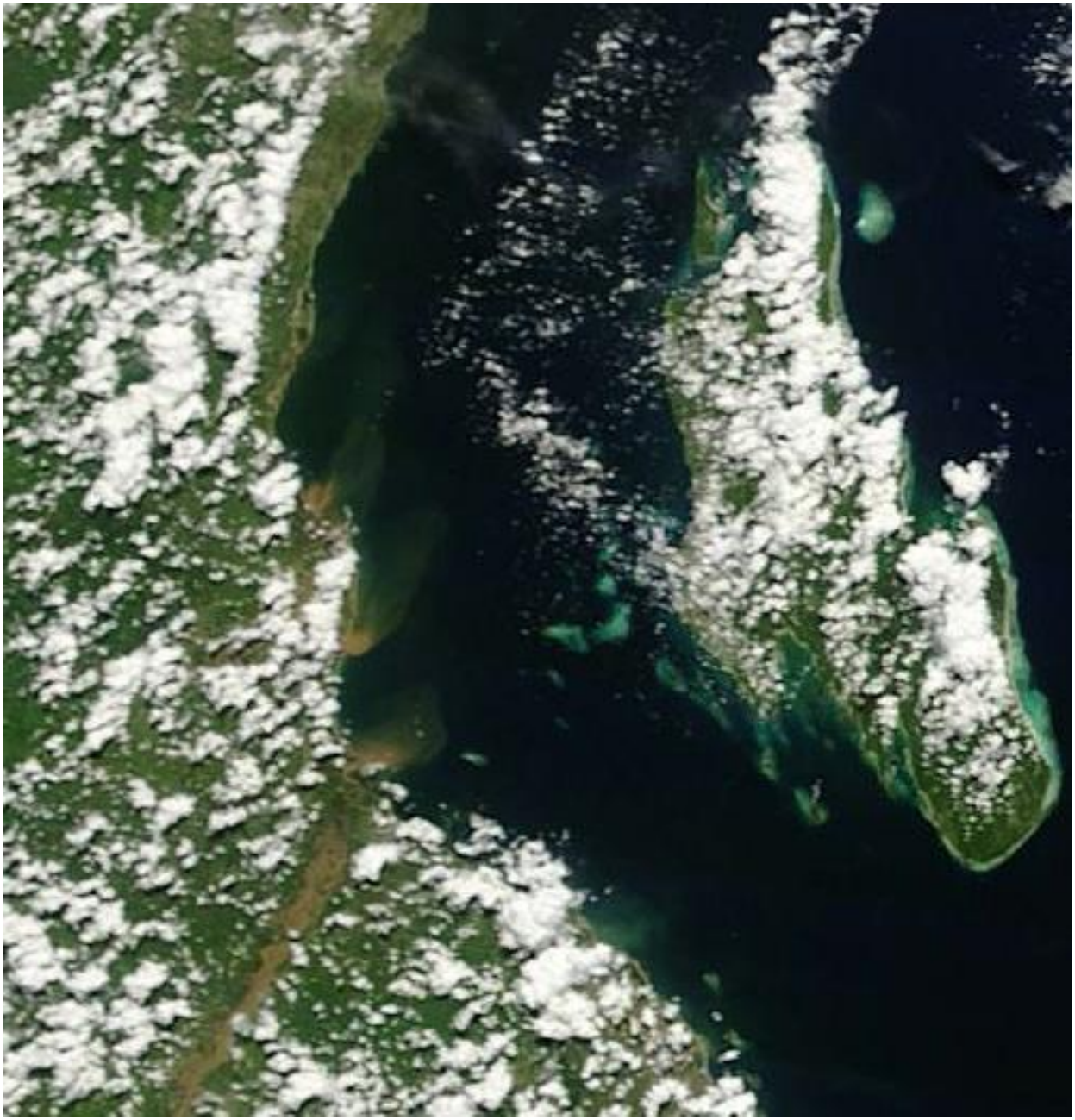

Figure 2: MODIS Satellite image of Bagamoyo coast (20 April 2014) showing plumes of sediment extending from the mouths of the rivers Ruvu, Wami and Machuisi being carried northward by the prevailing currents.

Marine species of importance

Cetaceans - Humpback whales are reported within short distances of the coastline especially during July to November.

Turtles – Beaches of Saadani NP are very important turtle nesting site in Bagamoyo.

Shorebirds – Water birds including shorebirds and others are a feature of Saadani NP contributing to the diversity of birds in the park, with approximately 300 species recorded. The Bagamoyo wide intertidal coast is well-known for the large numbers of Palaearctic wading birds that visit during the months of November to March. A large population of crab plovers has led to the area being designated IBA 46 (see Baker and Baker, 2002).

Natural resources

Bagamoyo has extensive natural forests which cover 1,125 km^2 or about 13.18 % of the total Bagamoyo district area, plus 3,338 km^2 of woodland (39 % of district area). There are a number of forest reserves including Saadani NP (110,000 ha), Gwani FR (5,633 ha), Kikoka FR (1,655 ha), Msakulembe Simbo FR (609 ha), Mtakuja FR (1,249), Pongwe FR (875 ha), Simbo-Bagamoyo FR (591 ha). Only Saadani NP is under defined management. Bush land covers 2,072 km^2 and grassland approximately 923 km^2 (11 %).

Settlements

About 12 km^2 (0.14 % of total Bagamoyo area) is built up, mainly around the town of Bagamoyo, but also along the three main regional roads, between Bagamoyo and Dar es Salaam to the south (about 30 km), and the road west from Bagamoyo to Msata (about 60 km to the junction of the Dar es Salaam to Arusha trunk road A14) and along the Dar es Salaam to Morogoro trunk road and in major settlements such as Chalinze. The areas in between these major routes, especially to the north and western portions of Bagamoyo have much lower densities of inhabitants and the land use gives way to more agricultural land with smaller settlements.

Infrastructure

There are four airstrips in Bagamoyo, the Saadani NP airstrip, one at Mkwaja North, one at Razaba Ranch to the south, and the Bagamoyo airstrip, all unpaved, but suitable for light aircrafts. Most serve for tourism purpose. There are three major harbours (Bagamoyo Town Habour serves for both cargo and as landing site, Mlingotini landing site and Mbegani Institute harbour serves mainly for institute crafts) and a number of small unofficial harbours. The district has a number of roads of various, length, rank and conditions such as 201 km of trunk roads, 315 km of regional roads, 321 km of district roads and 173 km of feeder roads. Of the 1,010 km roads in Bagamoyo only 202 km is tarmac and 326 km is gravels while the remaining are earthen roads. Almost all major mobile phone networks are working in Bagamoyo (NBS–CRCO, 2007). The railway line from Dar es Salaam to Tanga passes through the district and north into Pangani but is non-operational and in need of major rehabilitation.

Major Threats

Table 20: Overview of threats to coastal communities in Bagamoyo district, mostly extracted from Bagamoyo ICMAP (2009) and Tobey et al., (2013).

Threat	Location	Cause
Beach pollution	Beach front Bagamoyo harbour and vicinity	Uncontrolled solid and liquid waste disposal, often in creeks. lack of easily accessible public toilets
Beach erosion	coastal stretch towards Mbegani	Wave erosion due to physiographic setting or mangrove coverage (Shagude, 2011).
Beach erosion	Kaole	Mangrove cutting, Dynamite fishing, beach sand mining, unplanned construction along the coast.
Fisheries decline	Mbegani, Mlingotini, Kaole and Kondo	Destruction of fish nurseries e.g. mangrove cutting, illegal fishing e.g. dynamite and other poor methods e.g. beach seine and spear fishing, coral mining for lime. Use of small mesh reduces shrimp population. Community denied access and use of beaches which front some tourist hotels.
Mangrove	Uondwe creek, Wami River Mouth, Bagamoyo town to Mpiji River Mouth Makurunge Forest	Illegal and un controlled cutting of mangroves, salt production
Forest habitat destruction	Several forest reserves	fuelwood collection, logging, pole cutting, forest fires and hunting, due to lack of proper management of the reserve.
Land use conflicts	Near shore waters	Trawlers trawling in the areas where artisanal fishers use lead to destruction of artisanal fishers traps. All fisher types fishing in seaweed farms
Loss of land and environmental damage	Mwambani port project	Mwambani port project so far developed without due procedures on impact assessment and local livelihood analysis
Loss of habitat and agricultural area	South side of the district	Rapid urbanization, high increase of people immigration in the city.

CRIAM Ranking of Threats to Local Communities in Bagamoyo District

Table 21: Prioritisation of threats to local communities in Bagamoyo District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Beach erosion	Kaole, along coast	3	3	3	2	3	72	5					
Loss of habitat and agricultural area	Many areas	3	3	3	2	3	72	5					
Fisheries decline	Bagamoyo Town, Mbegani, Mlingotini, Kaole/Kondo, estuaries	2	3	3	2	2	42	4					
Mangrove	Uondwe creek, Wami and Ruvu River mouth, Bagamoyo Town to Mpiji River Mouth	2	2	3	2	2	28	3					
Beach pollution	Beachfront Bagamoyo harbour and vicinity. Coastal villages.	3	1	3	2	2	21	3					
Forest habitat destruction	Makurunge Forest Reserve	1	3	3	2	2	21	3					
Loss of land, envir-onmental damage	Near shore waters	1	3	3	2	1	18	2					
Beach erosion	Coastal stretch towards Mbegani.	1	2	3	2	2	14	2					

Major Opportunities

Opportunities available for coastal communities:

- Aquaculture – Bagamoyo have large area (520 ha) of salt flats suitable for fish farming (Mutatini, 2013).
- Tourism – There is a very high potential for tourism, both ecotourism, cultural tourism and mainstream tourism (Mutatini, 2013; Bagamoyo-ICMAP 2009; Gautum, 2009).
- Beekeeping - Bagamoyo is the second district for beekeeping in the region and the trend increases, hence eco-friendly forest use such as beekeeping is an opportunity (RCO, 2011).
- Irrigated agriculture - The area with potential for irrigation is more than 16,600 ha, however only 700 ha are currently irrigated. There are more than 16,000 ha suitable for irrigation (RCO, 2011).

Climate Change Impacts

Table 22: Estimated area losses of sea level rise scenarios on overall area and on land uses in Bagamoyo district.

Bagamoyo	Total (km^2)	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
		ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation		143	0.02	674	0.08	1,271	0.15	2,778	0.33	10,225	1.20	41,881	4.92
Built-up area	12	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.06	2.96	0.25	20.83	1.74

Significant impacts from sea level rise are felt over the general land area for rise levels only above 10 m (surges), since much of the district is sufficiently raised to avoid inundation. Even with a 10 m rise scenario, or equivalent storm surge, less than 2% of land covered by built-up infrastructure will be impacted, though storm surges that coincide with spring high tides are likely to have significant impacts further inland, along much of the length of the various rivers and creeks with potential seawater penetration into agricultural land and shallow wells.

Projects and Plans

Saadani National Park – Approximately 40 % of the park is in Bagamoyo District, the remainder in Pangani District (see more details under Pangani District, Chapter 5 above).

Mbegani Fisheries Development Centre (MFDC) - The MFDC was established in 1966 as a government institution and in 1975 it was assisted by funding from NORAD to expand its remit to offer specialist fisheries courses. At present, it is the only tertiary education establishment, under the Department of Fisheries, to provide diploma level National Technical Award (NTA) level 6, vocationally-based fisheries related courses. Diploma level courses provide successful participants with qualifications to either enter employment with the competent authority or take on a management position with local authorities or the private sector.

Natural gas pipeline from Dar es Salaam to Tanga (Tanzania) and Mombasa (Kenya) – The six routes presently being considered for the 527-550 km pipeline include five that traverse all or some of the coastal districts between Ilala, Bagamoyo, Pangani, Tanga Urban, Muheza and Mkinga and one offshore marine route (see full description in Mkinga chapter 2, above).

Mbegani (Bagamoyo) Port – The plan for construction of a hub port in Bagamoyo (TPA, 2011) is expected to boost local economy and improve the movements of transit goods destined to Malawi and eastern DRC that presently are unloaded in Dar es Salaam Port. Bagamoyo will have the capacity

to handle 20 million containers a year, compared with Mombasa's installed capacity of 600,000 and Dar es Salaam's 500,000.

Special Economic Zone (SEZ) - Export Processing Zone Authority (EPZA) has developed plans designed to enable Bagamoyo to serve as a SEZ complete with the requisite infrastructure to support economic activities. To be implemented under public-private partnership arrangements (PPP), the project involves the development of a new port at Mbegani (see above), a new Bagamoyo airport, major roads, industrial areas, trade areas and tourism attraction sites, as well as residential areas and facilities for social activities.

Kidomole to Mbegani railway line - Construction of 25 km of a railway link line from Kidomole (on the Dar es Salaam to Kigoma or Central Line) to the proposed port at Mbegani in Bagamoyo. These lines will be constructed in line with the Tanzania Port Authority (TPA) implementation schedule as port rail connections from the proposed new ports of Mwambani – Tanga and Mbegani in Bagamoyo. Feasibility studies and engineering design will be commissioned once the exact location and design of the proposed ports are determined by TPA.

7. Kinondoni District

Kinondoni District is in the Dar es Salaam Region. It has a land area of around 542 km^2 and a coastline of 49 km.

Climate Profile

Temperature

The climate for Kinondoni is hot and humid. Average monthly temperature data, from nearby Dar es Salaam Airport weather station, from 1989 to 2012, reveals ranges from a low of around 18.8 ˚C during the coolest months of July and August when maximum temperatures are 29.4 ˚C and 29.7 ˚C respectively, to the highest monthly means of 31.9 ˚C to 32.6 ˚C during the hot season from December to March, when the temperatures drop to only 23.7 ˚C to 24.5 ˚C during that period. Relative humidity in Kinondoni, based on Dar es Salaam data, ranges from 67-70 % from August to October, increasing to 82 % during the wettest months of April.

Precipitation

The average annual rainfall for Kinondoni, based on the weather station at Dar es Salaam Airport is 1,073 mm (ranging from 585 mm to 1,536 mm), over the period 1989 to 2013. The monthly rainfall peaks are March to May (main wet season) with about 550 mm of rain during those three months, and November to December (short rains) with 235 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern, with less significant short rains.

Winds

Based on 26 years of data (1987 to 2012) from the Dar es Salaam Airport weather station, in the morning (9 am) winds are generally light (5-9 knots), with strongest morning mean wind speeds during the months of January and February. Slightly stronger wind speeds (8-12 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (11-12 knots) during the months of January (12 knots), February and August to October (11 knots) resulting from typical north-east monsoon variability from light to strong winds within a few days, compared to the typically steady winds of the southeast monsoon period.

In a study by Dubi (2001) of maximum coastal wind speeds, from 1972 to 1996, the mode of the highest wind speeds reached in Dar es Salaam was 20 knots, with peak speeds during both January and July. Dar es Salaam is considered an area of coastline that is more influenced by coastal winds rather than from offshore winds. Over the studied period, the maximum wind speed has shown two peaks: one peak is seen in the period 1975–1979 and another during 1981–84, after which the speeds decrease (Dubi, 2001).

Population

Population size: 1,775,040 with 914,247 females and 860,802 males. The district has experienced a high average annual growth rate between 2002 and 2012 of 5,09 % leading to more than 65 % increase of the population over the ten year period, and documenting a high level of net in-migration. The population density in the district has grown to 3,249 persons/km^2.

Based on 2002 census data, the percentage of the population living below the poverty line was 14 %, the over 15 years of age literacy coverage was 92 % and under five years of age mortality was 138 per 1,000 live births.

Economy

Kinondoni district (or Municipal Council) depends on large scale and small-scale trade, small scale livestock keeping, horticulture, tourism as well as small scale and heavy industries (including cement factories at Wazo Hill). A small number of coastal villages engage in fisheries.

Industrial production and business transactions contribute over 80 % of the Dar es Salaam regional economy and employs about 90% of the workforce in the Region (PMO-RALG, 2013). Within Kinondoni, industries are concentrated mainly in the Mikocheni light industrial area. The main source of cash income activity for smallholder households in Kinondoni district is business followed by sales of food crops. It is estimated that about 95 % of Kinondoni residents are self-employed, informal sector and the remaining 5 % are employed in various public institutions.

Agriculture

Agriculture suitable land in Kinondoni district is estimated to be 315 km^2 (58 % of entire Kinondoni land area) of which only 4,022 ha are under cultivation. 12,074 households engage in agriculture of various forms (NBS-CRCO, 2007). Food crops are mainly cassava, sorghum, maize, rice, sweet potatoes, bananas, and legumes. Main cash crops include cashew nut and coconuts. Fruits (such as oranges, pineapples and mangoes) and vegetables are normally cultivated as cash as well as food crops.

Livestock keeping includes cattle, pigs, goats, sheep, dogs, turkey, ducks and rabbits. The municipality farmers are also involved in beekeeping of which there are about 516 beehives; among them 469 are modern hives.

Fisheries

Kinondoni District has six landing sites, all permanent; and five BMUs (MLFD, 2010). According to 2009 frame survey data, there are 2,513 fishers of which 23 are foot fishers; the rest used different types of vessels. Of the 473 vessels recorded, 307 used sail for propulsion, 60 use paddles and 106 use engines. Kinondoni has no seaweed farmers (URT, 2010). Aquaculture (of fish) exists in the district, with an estimated 16 ponds under production.

Tourism

Kinondoni District is endowed with numerous places of interest and tourist attractions including tourist hotels which are rapidly increasing in numbers. There are several beach hotels and resorts which are established along the coast, as well as a number of hotels, guesthouses and other attractions far from beaches. Major tourist hotels include Protea Hotel Oyster Bay, Golden Tulip, Hotel Sea Cliff, Msasani Beach Apartments, Mediterenean Beach Resort, Chinese Apartment, Jangwani Sea Breeze, Belinda Beach Resort, Villa Resort, White Sands Hotel, Beach Comber Beach Resort and Water World, Maua Beach Resort, Kunduchi Beach Hotel, Wet n Wild, Silversands Hotel, Bahari Beach Hotel, Rengwe Oceanic Beach Hotel. Some of the Kunduchi resorts utilise the North Dar es Salaam Marine Reserves for recreation and SCUBA diving.

Minerals

The mining activities undertaken in Kinondoni district include excavation of sand, gravel stone or boulders, aggregates and limestone, mainly from coastal riverbed sources. Approved sand quarrying areas include Mbagala, Chamazi, Pande and Bunju with other more urban areas where mining is carried out unofficially such as Kawe, Mbezi beach, Tegeta Mtongani. Stone is mainly extracted from Bunju and quarries, supplemented by small-scale family operations in disused quarries scattered throughout the urban area. Limestone is quarried from Wazo-Kunduchi outcrops

for the Tanzania Portland Cement Company Ltd. at Wazo Hill cement factory. There are 87 ha of salt works in the district, all located inshore of the mangrove creeks.

Description of the coast

Physical

This is the second largest of the three Dar es Salaam districts, bordered to the north by Bagamoyo (Coast Region), to the south by Ilala Municipality, to the southwest by Kisarawe District and to the west by Kibaha. The district is penetrated by six small rivers (Nyakasangwe, Tegeta, Sinza, Tabata, Minerva and Mbezi) and the Mpiji River forms the northern border with Bagamoyo, all less than 20 km in length.

The shore is mostly soft substratum extending to the subtidal, with small sections of limestone outcrop, evident in headlands such as Ras Kiromoni and Ras Kankadya. Pleistocene limestone rocky outcrops also exist in the form of three nearshore islands (Bongoyo, Mbudya and Pangavini) as well as one main patch reef (Fungu Yasin). Shoreline sediment types vary greatly, from clay bound sands and gravel to more unconsolidated coralline sands and sediments of recent times. Beach sands vary from silicilastic in river-dominated areas to carbonate sand around islands far from river influences.

Coastal ecology

The coastline and inshore waters of Kinondoni District support mangrove forests, intertidal rocky and sand expanses, with large areas of seagrass beds that extend subtidal and coral reefs.

Coral reefs – Reefs are well developed offshore as isolated patch reefs (e.g. Fungu Yasin) or fringing the three small islands (Pangavini, Mbudya and Bongoyo) and small sections of fringing coral reef are present along the eastern shore of Msasani Peninsula (Coco Beach). The coral reefs described above are highly damaged (TCMP, 2001; Francis et al., 2002) due to various destructive uses such as dynamite fishing, dragging nets, and anchoring, as well as due to natural causes including storms, the 1998 El Nino and occurrences of sea urchins (secondary effect of over-fishing).

Mangroves – Total area covered with mangrove in Kinondoni district is 314 ha, distributed over three main forest areas (Kunduchi Creek with 68.7 ha; Ras Kiromoni 20.2 ha, and Mbweni area 100.6 ha).

Beach and rock shorelines – Most of the shoreline of Kinondoni supports sand beach, in a few locations (especially headlands) giving way to rocky cliffs e.g. Ras Kankadya and Ras Kiromoni. The wide expanses of intertidal sand and mud flats off sheltered sections of Kinondoni's coast provide important bird feeding areas during low tide, most prominent in Msasani Bay, as well as important fish and shellfish breeding and feeding grounds, in part thanks to the discharges from these small river systems

Coastal waters

All Kinondoni's rivers are seasonal, yet they discharge onto the coast large amounts of sediment, freshwater, nutrients (and pollutants), especially during periods of heavy rainfall. Peak outflow from Kinondoni's rivers occurs from March to May and the distinctive sediment (and solid waste) laden waters are evident as a plume stretching many kilometres of shore, especially after heavy rains.

Marine species of importance

Turtles – Green turtle nesting takes place in some sandy beaches within the district, though generally in small numbers due to heavy disturbance of the shoreline from development.

Marine mammals - Bottlenose dolphins are regularly reported within short distances of the coastline, often around the north Dar es Salaam marine reserves and humpback whales are seen during June to November.

Shorebirds – Kinondoni coast and the islands receive large numbers of Palaearctic wading birds (crab plovers, roseate terns, saunders terns and numerous migrants from the northern winter). Pande Forest is IBA 47 (Baker & Baker, 2002).

Natural resources

Natural forests in Kinondoni covers 20 km^2 equivalent to 3.70 % of the total land area, with 68 km^2 of woodland (over 12 % of the district). There is only one forest reserve in Kinondoni District, Pande Game Reserve, of 1,226 ha. Kinondoni also shares a small forest reserve with neighbouring Ilala, the Dondwe FR (and IBA 49), covers 380 ha. Both reserves are continuously threatened with and suffering from encroachment by humans through logging, mining, settlement and agriculture. Pande Game Reserve is estimated to have decline in area by 60 % (Doggart, 2003). Bush land covers 10 km^2 (about 2 % of the district land area), while grasslands cover 20 km^2 (about 7 % of the district land area).

Settlements

Approximately 17.3 % of Kinondoni is built-up area (94 km^2), concentrated in the eastern and especially southern portion of the district, adjacent to the city centre and the main arterial routes (by road and rail) to the west (along Morogoro Road). These areas also include industrial and manufacturing sectors, sited along the main Morogoro Road heading west and Bagamoyo Road heading north. The north and western portions of Kinondoni have lower densities of inhabitants and the land use gives way to more agricultural land with smaller settlements.

Infrastructure

In addition to housing the northern spread of the developing city, including manufacturing, light industry and housing areas, Kinondoni district also includes two of the major communication axes (Morogoro and Bagamoyo road) along which commercial and residential development are concentrated. Kinondoni has no operative sewage collection infrastructure. For the entire Dar es Salaam Region it covers an area of 130 km of sewer and consists of 11 networks supported by 17 pumping stations, including the City Center, parts of Sinza, Ubungo and Vingunguti. The sewerage system is old and degenerated; built in the late 1950's, attempted rehabilitated in the period 1980–1988 has been unsuccessful. Sewage from the areas supposed to be served is discharged into oxidation ponds and directed to the ocean untreated. Poor management of these ponds results in overflowing and spreading of sewerage to the surroundings. Only four of the eight oxidation ponds are considered to be operating (University of Dar-es-Salaam, Kurasini, Mikocheni and Vingunguti). Only 15 % of the households are connected to the system while 80 % of the households in the rest of the city use on-site pit latrines and septic tanks. High water table in various parts of the city during the short and long rains further compounds the poor sanitary conditions with many pits overflowing into the drainage system emptied manually, often by the families themselves and occasionally by private companies at a cost.

Major Threats

Table 23: Overview of threats to coastal communities in Kinondoni district.

Threat	Location	Cause
Beach pollution	Kunduchi, Ununio, Mbweni	Uncontrolled solid and liquid waste disposal, often in creeks.
Beach erosion	Kunduchi area, Ununio and Mbweni	Mangrove cutting, dynamite fishing, beach sand mining, unplanned construction along the coast.
Fisheries decline	Entire district coastal are including Ununio, Mbweni and Kunduchi	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite use and other destructive methods, coral mining for lime.
Heavy metal pollution	Msimbazi river valley, Kunduchi, Mbweni and Ununio	Wastes from tourist hotels, construction sites, workshops, garages and industries located upstream.
Diseases outbreaks	Throughout the coastal and urban areas of the district	Inadequate sewerage control, flooding, poor quality of sewerage construction, poor solid waste management, uncontrolled food vending.
Flooding	Suna and Makuti B in Magomeni ward, Mkunguni A, Mkunguni B and Hanna-Nassif in Hanna-Nassif ward	Construction in vulnerable river valleys, absence of sieves in drainage channels, disposing solid wastes in drainage, poor drainage, and blockage of drainage channels and unplanned constructions and developments.
Land use conflicts	Along the coastal front.	Conflict between environmental conservation groups and investors; conflicting interests between sectors e.g. Forestry (mangrove) and mining (salt pans), forestry (mangrove) and lands; conflict between hotel owners and communities on addressing the issue of erosion at Kunduchi Beach areas.
Loss of habitat and agricultural area	Mwabe Pande Forest, Mpiji River Valley	Rapid urbanization, high increase of people immigration in the city.

CRIAM Ranking of Threats to Local Communities in Kinondoni District

Table 24: Prioritisation of threats to local communities in Kinondoni District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Beach erosion	Entire Coast, particularly at Kunduchi area, Ununio and Mbweni	3	3	3	2	2	63	4					
Fisheries decline	Entire district coastal are including Ununio, Mbweni and Kunduchi	3	3	3	2	2	63	4					
Land use conflicts	Along the coastal front.	3	3	3	2	2	63	4					
Beach pollution	Entire coast, particularly at Kunduchi, Ununio and Mbweni	3	2	3	2	2	42	4					
Flooding	Suna and Makuti B in Magomeni ward, Mkunguni A, Mkunguni B and Hanna-Nassif in Hanna-Nassif ward	2	3	3	2	2	42	4					
Diseases outbreaks	Throughout the coastal and urban areas of the district	2	2	3	2	3	32	3					
Heavy metal pollution	Msimbazi river valley, Kunduchi, Mbweni and Ununio	2	2	3	2	2	28	3					
Loss of habitat and agricultural area	Mabwe Pande Forest, Mpiji River Valley	2	2	3	2	2	28	3					

Major Opportunities

Opportunities available for coastal communities:

- Aquaculture – Kinondoni Municipality have high potential to mariculture.
- Tourism – continued high potential for ecotourism.
- Tree nursery establishment.
- Beekeeping.

Climate Change Impacts

Table 25: Estimated area losses of sea level rise scenarios on overall area and on land uses in Kinondoni district.

Kinondoni	Total km²	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
		ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation		20	0.04	68	0.12	162	0.30	470	0.86	851	1.56	6,514	11.92
Built-up area	94	1.01	0.01	15.70	0.17	74.12	0.79	231.71	2.47	315.97	3.37	1,193.85	12.72

Significant impacts from sea level rise are felt over the general land area for rise levels only above 10 m, since much of the district is sufficiently raised to avoid inundation. However, even a 1 m rise will significantly impact the seafront properties and infrastructure, already witnessed at Kunduchi where many groynes have been haphazardly constructed to protect residences and hotels. At Kunduchi Creek and other smaller inlets, storm surges that coincide with spring high tides are likely to have significant impacts further inland, along much of the length of the creeks with potential seawater penetration into agricultural land and shallow wells.

Projects and Plans

Education and research institutions - In the Dar es Salaam Region, there are 21 higher learning institutions (Universities, Colleges and Institutes) providing tertiary education as well as research institutes. Many of these are in the Kinondoni District, such as the University of Dar es Salaam (UDSM), Open University of Tanzania (OUT) and Tanzania Fisheries Research Institute (TAFIRI), Commission for Science and Technology (COSTECH).

Kinondoni Integrated Coastal Management Project (KICAMP) – KICAMP is managing conservation of coastal and marine resources in coastal Kunduchi, Mbweni and Bunju.

North of Dar es Salaam Marine Reserve System – Ranked under IUCN category II, these comprise of four Marine Reserves: Fungu Yasin, Mbudya, Bongoyo and Pangavini designated as Marine Reserves in 1975 and 1999 placed under the mandate of Marine Parks and Reserves Unit.

Dar es Salaam Marine Ecology Conservation Project – Supported by the World Care-Tanzania, the project objectives are conservation and restoration of marine ecology in Dar es Salaam coastal areas, through activities that promote community awareness in sustainable management of coastal and marine ecology, use of appropriate technology in conservation and restoration of marine ecology including reef ball and mangrove development. The status of the project is unclear.

8. Ilala District

Ilala District is in the Dar es Salaam Region. It has a land area of around 341 km^2 and a coastline of 11 km.

Climate Profile

Temperature

The climate for Ilala is hot and humid. Average monthly temperature data, from Dar es Salaam Airport weather station, from 1989 to 2012, reveals ranges from a low of around 18.8 ˚C during the coolest months of July and August when maximum temperatures are 29.4 ˚C and 29.7 ˚C respectively, to the highest monthly means of 31.9 ˚C to 32.6 ˚C during the hot season from December to March, when the temperatures drop to only 23.7 ˚C to 24.5 ˚C during that period. Relative humidity in Ilala, based on Dar es Salaam data, ranges from 67-70 % from August to October, increasing to 82 % during the wettest month of April.

Precipitation

The average annual rainfall for Ilala, based on the weather station at Dar es Salaam Airport is 1,073 mm (ranging from 585 mm to 1,536 mm), over the period 1989 to 2013. The monthly rainfall peaks are March to May (main wet season) with about 550 mm of rain during those three months, and November to December (short rains) with 235 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern, with less significant short rains.

Winds

Based on 26 years of data (1987 to 2012) from the Dar es Salaam Airport weather station, in the morning (9 am) winds are generally light (5-9 knots), with strongest morning mean wind speeds during the months of January and February. Slightly stronger wind speeds (8-12 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (11-12 knots) during the months of January (12 knots), February and August to October (11 knots) resulting from typical north-east monsoon variability from light to strong winds within a few days, compared to the typically steady winds of the southeast monsoon period.

In a study by Dubi (2001) of maximum coastal wind speeds, from 1972 to 1996, the mode of the highest wind speeds reached in Dar es Salaam was 20 knots, with peak speeds during both January and July. Dar es Salaam is considered an area of coastline that is more influenced by coastal winds rather than from offshore winds. Over the studied period, the maximum wind speed has shown two peaks: one peak is seen in the period 1975–1979 and another during 1981–84, after which the speeds decrease (Dubi, 2001).

Population

Population size: 1,220,611 with 624,683 females and 595,928 males. The district has experienced a high average annual growth rate between 2002 and 2012 of 6,60 % corresponding to almost a doubling of the population over the ten year period, and documenting a high level of net in-migration. The population density in the district has grown to 3,583 persons/km^2.

Based on 2002 census data, the percentage of the population living below the poverty line was 16 %, the over 15 years of age literacy coverage was 93 % and under five years of age mortality was 130 per 1,000 live births.

Economy

Ilala district (or Municipal Council) comprises the traditional business and original city centre of Dar es Salaam, housing the main government ministries and higher office residences and offices. The main economic activities taking place in Ilala District are retail and wholesale businesses (including small and medium shops, hotels, bars and restaurants), transportation services, including Dar es Salaam Port (the largest and busiest port in Tanzania), clearing and forwarding, agro-businesses, medical services, handicraft businesses, banking, and construction.

Agriculture

Although urban agriculture in conducted in the district, agriculture is very important for the rural population, to the west. About 168 km^2 (50 %) of Ilala is agricultural land, where land under use for both cash and food crops is estimated to be 116 km^2 (crops are mainly cassava, sorghum, maize, rice, sweet potatoes, bananas, and legumes). Main cash crops include cashew nut and coconuts. Fruits (such as oranges, pineapples, mangoes) and vegetables are normally cultivated as cash as well as food crops. Ilala farms provide the city with 55,597 t of food annually (Dar es Salaam City Council, 2004). Bush land covers approximately 24 % of the district.

Fisheries

Ilala District has a very small coast and adjacent fishing grounds, presented by a narrow passage about 10 km wide between waters of the two neighbouring districts. Fishing related activities and fish vending are conducted within the district, at Dar es Salaam's main market, Kivukoni Fish Market, with product obtained from various sources within the region and beyond (e.g. Mafia, Kilwa and Zanzibar). The district has a single fish landing site (at Kivukoni). According to 2009 frame survey data, there are 1,331 registered fishers despite the small are of fishing grounds, of which none fish on foot. These boat fishers use 222 vessels, of which 22 used sail for propulsion, 96 use paddles and 104 use engines (URT, 2010).

The inshore waters off Ilala are relatively shallow and calm, protected by a line of islands and reefs to the south that create ideal conditions for the fishery for small pelagic fish species (sardines and anchovies). This fishery is the target of many of the 74 ring-nets, mostly operated by 104 motorised vessels noted above (URT 2010). The small pelagic fish are a significant component of the catch in Ilala District, though data are not available.

Tourism

Ilala is endowed with some places of interest and tourist attractions, supporting numerous large and important tourist hotels (e.g. Holiday Inn Hotel, Kilimanjaro Hyatt Hotel, New Africa Hotel and Serena Hotel). There are only two beaches (Ocean Road – heavily polluted with official bathing disadvised notice) and the Selander Bridge beach (with bathing prohibited).

Minerals

The mining activities undertaken in Ilala district include excavation of sand, gravel stone or boulders, aggregates and limestone, from inland sources. Clay is extracted from upper Msimbazi river valley for the manufacturing of bricks.

Description of the Coast

Physical

This is the smallest of the three Dar es Salaam districts, bordered to the north by Kinondoni Municipality, to the south by Temeke Municipality to the west by Kisarawe District. The district is penetrated by two major coastal river systems, the Msimbazi River that empties in the northern sector of the coast, and the Mtoni River (with two branches Kizinga and Mzinga creeks), that also forms the border with the southern sister district of Temeke, and is the site of the Dar es Salaam Port. The shore is mostly soft substratum extending to the subtidal.

Msimbazi River and creek are among the most polluted water bodies in Dar es Salaam. The river and creek receive large quantities of untreated domestic wastes from the city's residents in addition to industrial wastes from various industries, discharged into the main four tributaries that spread across the northern part of the city (Mohammed, 2002; Othman, 2002; Kaseva & Mbuligwe, 2005; Mrutu et al., 2013). Heavy metals are deposited in inshore sediments such as Msasani Bay (Muzuka, 2007).

Figure 3: Aerila view east over the main (southern) tributary and lower floodplain of Msimbazi River in Dar es Salaam flowing toward the coast where it forms the border between Kinondoni District (to the left) and Ulaya District (right); showing sediment -laden waters after heavy showers (April 2014) and both housing and industry along river margins.

Coastal ecology

Ilala's short seafront (only 11 km) is mostly located in the northern shores of the Mtoni River estuary that forms the entrance to Dar es Salaam Port, and the 2.8 km of Ocean Road beachfront. The coastal ecology is characterised by a long stretch of sandy beach, a single main mangrove creek and some isolated coral patch reefs, with seagrass beds present along the lower shores extending into the subtidal. River inputs have a strong influence on the water quality and the soft substrate predominant in the area.

Coral reefs - The nearshore coastline of Ilala does not support any fringing coral reefs due to the shore being soft substrate. Offshore, small patch reefs exist.

Mangroves - Ilala district has about 39 ha of mangrove forest mainly presented on one mangrove stand situated at Msimbazi River mouth estimated to be 25.3 ha. The remainder are part of the mangrove forest of the Mtoni River creek along the southern border with Temeke district.

Beach and rock shorelines - About 1 km of rocky shore is present along the Ocean Road headland that separates the two beaches of Ilala. The latter together comprise approximately 3.6 km of sand beach. The two rivers (Msimbazi and Mtoni) that discharge onto the coast of Ilala contribute large amounts of sediment, freshwater, nutrients (and pollutants), especially during periods of heavy rainfall. The wide expanses of intertidal sand and mud flats off Ocean Road (Obama Drive) provide important bird feeding areas during low tide, and important fish and shellfish breeding and feeding grounds, in part thanks to the discharges from these two main river systems.

Coastal waters

The peak outflow from the Msimbazi and Mtoni rivers occurs from March to May and the influence of freshwater from these two rivers reduces water salinity near the coast. These two rivers also add large amounts of sediment that can be transported further along the coast, into neighbouring districts. Indeed large amounts of sediment, freshwater, nutrients (and pollutants), especially during periods of heavy rainfall are visibly obvious, with the distinctive sediment (and solid waste) laden plume stretching many kilometres.

Marine species of importance

Shorebirds – The Ilala portion of the Dar es Salaam coast receives large numbers of Palaearctic wading birds (crab plovers, roseate terns, saunders terns and numerous migrants from the northern winter) that visit during the months of November to March, plus flamingos, storks, herons, ibis and other species has led to the area being designated an Important Bird Area (IBA 21) fronting Ocean Road (Obama Drive) where 25 km^2 of intertidal sand and mud flats extend from the entrance to Dar es Salaam Port to the western side of the Msimbazi Creek outlet (under Selander Bridge) (see Baker and Baker, 2002).

Natural resources

Only 6 km^2 of Ilala District is natural forest, with an additional 10 km^2 of woodland (representing 3 %), hence the Zingiziwa forest and associated dam, is valued not only at district level but also at the national level as a potential water source for coastal regions and for its richness in wildlife resources, including unique species of birds, trees, snakes and aquatic organisms. The dam and its surrounding forest have been proclaimed as the Zingiziwa FR. Ilala also shares a small forest reserve with neighbouring Kinondoni, the Pande and Dondwe Coastal Forests (and IBA 49), covers 380 ha. Bush land covers 81 km^2 (about 24 %) of the district, while grasslands cover only 8 km^2.

Settlements

Approximately 18.4 % of Ilala is built-up area, some 62 km², with housing, offices, business and infrastructure concentrated in the eastern portion, and more open land to the west. Industrial and manufacturing sectors are sited along the main Pugu Road heading southwest. Further to the west, human densities decrease significantly giving way to more agricultural land with smaller settlements.

Infrastructure

In addition to housing the traditional city centre and main government institutions of the entire country, Ilala district also includes some of the city's major infrastructure elements such as Dar es Salaam International Airport, Dar es Salaam Port, TAZARA railway station, and the city's major solid waste dump site (at Pugu).

Ilala has no operative sewage collection infrastructure. For the entire Dar es Salaam Region it covers an area of 130 km of sewer and consists of 11 networks supported by 17 pumping stations, including the City Center, parts of Sinza, Ubungo and Vingunguti (see Kinondoni, Infrastructure Chapter 7, above). The sewerage system is old and degenerated. It was built in the late 1950's and an attempted rehabilitated of the system in the period 1980–1988 has been unsuccessful. Sewage from the areas supposed to be served is discharged into oxidation ponds and directed to the ocean untreated. Poor managing of these ponds result in overflowing and spreading of sewer to the surroundings. Only four of the eight oxidation ponds are considered to be operating (University of Dar-es-Salaam, Kurasini, Mikocheni and Vingunguti). Only 15 % of the households are connected to the system while 80 % of the households in the rest of the city use on-site pit latrines and septic tanks. High water table in various parts of the city during the short and long rains further compounds the poor sanitary conditions with many pits overflowing into the drainage system emptied manually, often by the families themselves and occasionally by private companies at a cost.

The Songo Songo to Dar es Salaam gas export pipeline passes through Ilala district to Ubungo Power Station, with feeder branches extending into Kinondoni (Wazo Hill cement factory) and other industrial areas.

Major Threats

Table 26: Overview of threats to coastal communities in Ilala district.

Threat	Location	Cause
Beach and nearshore pollution	Selander Bridge beach	Uncontrolled solid waste disposal into Mzimbazi Creek valley, being washed down stream during heavy rain.
Sewage pollution	Ocean Road beach	AgaKhan Hospital and nearby residences discharging untreated sewage directly onto shore.
Beach Erosion	Ocean Road	Inappropriate shoreline protection along the coast.
Fisheries decline	Msimbazi Bay, district marine waters.	Destruction of fish nurseries due to beach seining and dynamite fishing.
Heavy metals pollution	Msimbazi River valley, Dar Harbour and vicinity, Mtoni River area	Wastes from construction sites, workshops, garages and industries located upstream along the two rivers.
Oil pollution	Dar Harbour and vicinity	Waste products from Kigamboni oil terminal, loading and offloading of fuel at Dar es Salaam port, disposal of untreated liquid wastes from some industries and garages
Industrial pollution	Mtoni Ward	Effluent from KTM and other industries
Diseases outbreaks	Throughout urban areas of the district	In adequate sewerage control, flooding, poor quality of sewerage construction, poor solid waste management.

CRIAM Ranking of Threats to Local Communities in Ilala District

Table 27: Prioritisation of threats to local communities in Ilala District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	Msimbazi Bay, district marine waters.	3	3	3	2	2	63	4					
Diseases outbreaks	Throughout urban areas of the district	2	3	2	2	3	42	4					
Oil pollution	Dar es Salaam Harbour and vicinity	2	3	2	2	2	36	4					
Heavy metals pollution	Msimbazi River valley, Dar es Salaam Harbour and vicinity, Mtoni River area	2	2	3	2	3	32	3					
Sewage pollution	Ocean Road beach	1	3	3	2	3	24	3					
Industrial pollution	Dar es Salaam Harbour and vicinity	1	3	3	2	3	24	3					
Beach and nearshore pollution	Selander Bridge beach	1	3	3	2	2	21	3					
Beach Erosion	Ocean Road	1	3	3	2	2	21	3					

Major Opportunities

Opportunities available for coastal communities:

- Tourism – Expansion of mainstream tourism

Climate Change Impact

Table 28: Estimated area losses of sea level rise scenarios on overall area and on land uses in Ilala districts.

Ilala	Total (km^2)	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
		ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Area	335	1	0.00	2	0.00	2	0.00	8	0.02	17	0.05	564	1.66
Built-up area	62	0.74	0.01	1.43	0.02	1.43	0.02	3.77	0.06	9.18	0.15	180.56	2.93

Significant impacts from sea level rise are felt over the general land area for levels above 5 m, since much of the district is sufficiently raised to avoid inundation. However, even a 1 m rise will significantly impact the seafront at both beach areas (Selander Bridge and Ocean Road), with flooding of built-up areas (especially road infrastructure) very likely. At Msimbazi Creek and the Mtoni River creeks, storm surges that coincide with spring high tides are likely to have significant impacts further inland, along much of the length of the creeks with potential seawater penetration into agricultural land and shallow wells.

Projects and Plans

Ilala Municipal Investment Plan - The objectives are (i) improve disposal site management that mitigates environmental and health impacts; (ii) improve efficiency in waste collection and transportation, contributing to energy savings and decrease of environmental burdens; and (iii) prevent pollution of groundwater (used for drinking water).

Education and research institutions - In the Dar es Salaam Region, there are 21 higher learning institutions (Universities, Colleges and Institutes) providing tertiary education as well as research institutes. Many of these are in the Ilala District, such as the Maritime Institute, Institute of Finance Management (IFM), Muhimbili University College of Health and Allied Sciences (MUCHS).

9. Temeke District

Temeke District is in the Dar es Salaam Region. It has a land area of around 739 km^2 and a coastline of 122 km.

Climate Profile

Temperature

The climate ranges from hot and humid in the wide coastal plains of Temeke, to cooler in the hills to the west. Average monthly temperature data, from nearby Dar es Salaam Airport weather station, from 1989 to 2012, reveals ranges from a low of around 18.8 ˚C during the coolest months of July and August when maximum temperatures are 29.4 ˚C and 29.7 ˚C respectively, to the highest monthly means of 31.9 ˚C to 32.6 ˚C during the hot season from December to March, when the temperatures drop to only 23.7 ˚C to 24.5 ˚C during that period. Relative humidity in Temeke, based on Dar es Salaam data, ranges from 67-70 % from August to October, increasing to 82 % during the wettest months of April.

Precipitation

The average annual rainfall for Temeke, based on the nearest weather station (at Dar es Salaam Airport) is 1,073 mm (ranging from 585 mm to 1,536 mm), over the period 1989 to 2013. The monthly rainfall peaks are March to May (main wet season) with about 550 mm of rain during those three months, and November to December (short rains) with 235 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern, with less significant short rains.

Winds

Based on 26 years of data (1987 to 2012) from the Dar es Salaam Airport weather station, in the morning (9 am) winds are generally light (5-9 knots), with strongest morning mean wind speeds during the months of January and February. Slightly stronger wind speeds (8-12 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (11-12 knots) during the months of January (12 knots), February and August to October (11 knots) resulting from typical north-east monsoon variability from light to strong winds within a few days, compared to the typically steady winds of the southeast monsoon period.

In a study by Dubi (2001) of maximum coastal wind speeds, from 1972 to 1996, the mode of the highest wind speeds reached in Dar es Salaam was 20 knots, with peak speeds during both January and July. Dar es Salaam is considered an area of coastline that is more influenced by coastal winds rather than from offshore winds. Over the studied period, the maximum wind speed has shown two peaks: one peak is seen in the period 1975–1979 and another during 1981–84, after which the speeds decrease (Dubi, 2001).

Population

Population size: 1,368,881 with 669,056 males and 699,825 females. The district has experienced a very high average annual growth rate between 2002 and 2012 of 6.60 % corresponding to almost a doubling of the population over the ten year period, and documenting a high level of net in-migration. During that period, the population density in the district has grown to 1,945 persons/km^2 from 1,084 persons/km^2.

Based on 2002 census data, the percentage of the population living below the poverty line was 29 %, the over 15 years of age literacy coverage was 88 % and under five years of age mortality was 134 per 1,000 live births.

Economy

Temeke District's main economic activities are commerce, industries and agriculture. Temeke has the greatest accumulation of industries of any district in Tanzania, concentrated in the north-western portion of the district, close to Dar es Salaam city centre and extending along the Kilwa Road. In total there are 198 industries of which 40 are large-scale industries and 158 are medium-scale. Manufacturing is the main source of formal employment for Temeke residents as well as other residents from neighbouring Ilala and Kinondoni. The soon-to be completed Lake Cement plant at Kimbiji will create employment in the rural area. About 49 % of Temeke residents are either employed or self-employed in the formal and informal sectors, with about 20 % employed as civil servants. Agriculture engages 13 % of the population (http://www.dsm.go.tz/kurasa/halmashauri/lga4/index.php).

Agriculture

Land utilised for agriculture totals 200 km² (about 27 % of Temeke) and plays an important role especially in sub-urban areas to the south, such as Pemba Mnazi, Somangila, Vijibweni and Kimbiji, where a large proportion of residents engage in agriculture. The main food crops produced are paddy, maize and sweet potatoes while cash crops are coconut and cashew nuts (TD-ICMAP, 2009).

Fisheries

For coastal Temeke residents, especially of sub-urban wards, fisheries is very important, often being the main source of protein in such areas. The main fishing grounds are considerable, and extend 5-10 km from the shore, from the mouth of the Dar es Salaam Harbour, to Sinda Islands and south beyond the Buyuni coast where the fishable area (shallower than 100 m) extends 20 km from the shore, resulting in a fishing ground that covers approximately 1,200 km². Fishing related activities and fish vending are conducted within the district, but also at Dar es Salaam's main market, Kivukoni Fish Market, in neighboring Ilala District. The district has nine BMUs and three FMPs with no bylaws. There are 16 landing sites of which 15 are permanent and one temporary (MLFD 2010). According to the 2009 frame survey data, there are 3,586 fishers of which 235 are foot fishers; the rest used different types of vessels. Of the 489 vessels recorded, 92 used sail for propulsion, 222 paddles and 175 use engines. Temeke has 15 seaweed farmers (URT, 2010).

The inshore waters off Temeke District are relatively shallow and calm, protected by a line of islands and reefs to the south that create ideal conditions for the fishery for small pelagic fish species (sardines and anchovies). This fishery is the target of many of the 119 ring-nets, mostly operated by 175 motorised vessels noted above (URT 2010). The small pelagic fish are a significant component of the catch in Temeke District, though data are not available.

Tourism

The district is endowed with attractive sand beaches, especially in Mjimwema, Kimbiji, Kigamboni and Pemba Mnazi, in total extending over approximately 40 km. There are several beach hotels including Protea Hotel Amani, Ras Kutani, South Beach, Sunrise, Bounte, Barakuda, Kipepeo, Chadibwa, Ngoda Beach Camp, Hunters Beach Resort and Mikadi. Most of these enterprises are with the 40 km from Dar es Salaam City, with the southernmost coast least developed. Close to the Dar es Salaam harbour are two Marine reserves: Makatumbe Island and Sinda Island that provide a snorkelling site for visitors to the district.

Minerals

Mining is not an important economic activity in Temeke District except for sand mining and Pleistocene coral mining for construction purposes. A major coral rock kilning operation exists at Kigamboni, located on the beach and nearshore, producing lime for construction. The potential presence of gas and fuel in Kimbiji area in Temeke District is under exploration. Mining of limestone for cement is soon to begin at Kimbiji to supply the Lake Cement operations at the same location. Saltpans occupy on 64 ha in Temeke. Oil and gas exploration drilling was conducted in the 1970-80s with no successful discoveries.

Description of the Coast

Physical

This is the largest of the three Dar es Salaam districts, bordered to the north-west by Ilala Municipality, and to the south by Mkuranga District of the Coast Region. The district is penetrated by two major coastal river systems, the Mtoni River with a catchment that extends inland over 60 km, into the higher grounds of Kisarawe District, and the northern of two main lower reaches that also forms portions of the border with the northern sister district of Ilala (where Dar es Salaam Port is located) and four smaller independent catchments in the southern portion of the district. The shore is partly rocky limestone, interspersed with a long section of soft substratum extending to the subtidal.

Coastal ecology

Temeke's 122 km seafront extends south from the Mtoni River estuary that forms the entrance to Dar es Salaam Port. The coastal ecology is characterised by long stretches of sandy beach, interspersed with rock headlands and five mangrove creeks, with three small, nearshore islands (Inner and Outer Makatumbe, Inner and Outer Sinda) plus five isolated coral patch reefs. Seagrass beds are present along the lower shores extending into the subtidal along much of the coast. River inputs have a strong influence on the water quality and the soft substrate predominant in the area.

Coral reefs – Reefs are well developed along much of the coastline of Temeke as fringing coral reefs within a few hundred metres of the shore, in total extending some 60 km. Three small patch reefs are present close to Dar es Salaam Harbour and one further south, north of Kimbiji. Beyond the village of Buyuni, water conditions (with high suspended sediment levels) prevent the development of major reef structures.

Mangroves - Temeke district has about 2,066 km^2 of mangrove forest mainly around five areas: the two branches of the Mtoni River, landward of Dar es Salaam Port into Mbagala Kuu, Kurasini, Somangila, and Mtoni Wards; in three creeks along the north-facing shores extending from Kigamboni, Mjimwema, Vijibweni to Ras Dege; at the Ras Buyuni and Pemba Mnazi headlands; and both shores of the southernmost Mbezi River estuary at Boza (also the southern boundary with Mkuranga District).

Coastal forests also exist in Temeke, covering 100 km^2 and include important and rare species such as Mpingo (African Blackwood) (TD-ICMAP, 2009). Forest resources in this district are under constant pressure due to high demand. Forests are exploited for firewood, charcoal, fuel to burn corals for lime production and salt production as well as exotic wood (Mpingo) for export (TD-ICMAP, 2009).

Beach and rock shorelines – About 20 km of rocky shore is present, mainly as short sections of 1-2 km on 15 rocky promontories scattered along the 122 km coastline, including Ras Dege, Ras Kutani, and Ras Kimbiji. The wide expanses of intertidal sand and mud flats between the headlands of

Kinondoni provide important bird feeding areas during low tide, most prominent on the coast between Mtoni River and Ras Dege (including various islands and reefs), and in the southern portion off Ras Buyuni and Boza, providing important fish and shellfish breeding and feeding grounds, in part thanks to the discharges from the district's small river systems.

Coastal waters

The main river (Mtoni) that discharge onto the coast between Ilala and Temeke, at the entrance to Dar es Salaam Port, contributes large amounts of sediment, freshwater, nutrients (and pollutants), especially during periods of heavy rainfall, with peak outflow from the rivers from March to May. In general, the coastal currents transport discharges northwards, with plumes stretching many kilometres, especially after heavy rains. The northern shore, of Temeke District, exhibits wide expanses of intertidal sand and mud flats that benefits from the discharges from Mtoni River, while the central and southern sections of coast benefit from the smaller, often seasonal, rivers. Most of the smaller rivers of the district are seasonal, with general low volumes. Nguva River, east of Gezaulole is one of the permanent rivers, as is the border river at Boza.

Marine species of importance

Turtles – Green turtle nesting takes place in many sandy beaches within the district, though there is some disturbance of the shoreline from development and human predation.

Marine mammals - Bottlenose dolphins are regularly reported within short distances of the coastline and humpback whales are seen during June to November.

Shorebirds – Temeke coast and the islands receive large numbers of Palaearctic wading birds (crab plovers, roseate terns, saunders terns and numerous migrants from the northern winter) that visit during the months of November to March.

Natural resources

Natural forests in Temeke are virtually non-existent and there is only one forest reserve in the district, Ngaramia Riverine FR of 3,000 ha, threatened with timber harvesting, pole cutting, and agricultural encroachment. Woodlands cover in Temeke is 41 km^2 (4.1 % of the district), bush land 12 km^2 (1.6 %) and 349 km^2 (47 %) of the district is grassland.

Settlements

Only 79 km^2 (or 11 %) of Temeke is built-up, concentrated in the north-western portion of the district, adjacent to the Dar es Salaam Port and city centre around Kigamboni where the ferry terminal for vehicles and passengers provides crossings all day to and from the Fish Market of Ilala close to the city centre. Dense settlements are also present along the main arterial route to the south (the Kilwa Road) through Mbagala. Industrial and manufacturing is also present along the Kilwa Road. The remainder of the Temeke District have much lower densities of inhabitants and the land use gives way to more agricultural land with smaller settlements. The rapid development of residential plots and estates is evident in a fringe around the existing northern settlements, with some isolated residential development projects over 20 km from the city centre.

Infrastructure

Infrastructure in this district displays two extremes. The urban wards of Kurasini, Mbagala Kuu, Mtoni, Kigamboni and Mjimwema (mostly north and north-west) have good networks of roads, electricity coverage and communication. The peripheral wards, mainly central and southern (Vijibweni, Somangila, Kimbiji and Pemba Mnazi) are rural, agricultural areas with poor roads, in most cases no electricity and variable communication coverage. There are two roads connecting the north with the central southern portions of the district, with the coastal road only partly paved (first 20 km of 73 km), connecting Mjimwema to Pemba Mnazi. Rural roads are earthen and some are difficult to use during rainy seasons. No electricity and no sea transport that connect the periphery wards (TD-ICMAP, 2009).

Temeke has no operative sewage collection infrastructure. For the entire Dar es Salaam Region it covers an area of 130 km of sewer and consists of 11 networks supported by 17 pumping stations, including the City Center, parts of Sinza, Ubungo and Vingunguti (see Kinondoni, Infrastructure Chapter 7, above).

The liquid fuel depot at Kigamboni and single point mooring (SPM) located about 5 km offshore serves for importation and storage of liquid fuel (diesel and petrol), with an export liquid fuel pipeline traversing the district westward to Malawi. The Mtwara to Dar es Salaam gas pipeline is under construction and will pass through part of the district, from the south into Ilala District to Ubungo and beyond, with expected completion in late 2014.

Major Threats

The following are the district resource threats as mentioned and prioritized in (TD-ICMAP, 2009).

Table 29: Overview of threats to coastal communities in Temeke district.

Threat	Location	Cause
Beach pollution	Mbagala Kuu and Mjimwema	Uncontrolled solid and liquid waste disposal, often in creeks (such as branches of Mtoni River)
Beach erosion	Kimbiji, Kigamboni, and Vijiweni	Beach sand collection, mangrove clearing, unplanned coastal development
Fisheries decline	Mjimwema, Vijiweni, Kigamboni, Mtoni and Kimbiji	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods as well as coral mining for lime production.
Forest decline	Kimbiji, Mjimwema, Mtoni	Exploitation and uncontrollable use of coastal forest and mangrove
River condition decline	Mtoni River, Nguva River, seasonal streams	Pollution from dumping of solid waste has begun on
Heavy metal pollution	Mtoni River and Dar es Salaam Port	Wastes from construction sites, workshops, garages and industries located upstream.
Oil pollution	Kigamboni and vicinity, Inner Makutumba Island, Msimbazi river valley	Waste products from Kigamboni refinery plant, loading and offloading of fuel at Dar es Salaam port, disposal of untreated liquid wastes from some industries and garages
Industrial Pollution	Mbagala and Mtoni wards	Effluents from KTM textile industry
Flooding	Mtoni River valley	Construction in vulnerable river valleys, absence of sieves in drainage channels, disposing solid wastes in drainage system, poor drainage system, and blockage of drainage channels and unplanned constructions and developments.
Loss of habitat and agricultural area	Forest reserve and river valley vegetation	Rapid urbanization, high increase of people immigration in the city and spilling over into the northern portions of Temeke.

CRIAM Ranking of Threats to Local Communities in Temeke District

Table 30: Prioritisation of threats to local communities in Temeke District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	Mjimwema, Vijibweni, Kigamboni, Mtoni and Kimbiji	3	3	3	2	2	63	4					
Beach erosion	Kimbiji, Kigamboni, and Vijibweni and small islands	3	2	3	2	2	42	4					
Heavy metal pollution	Mtoni River and Dar es Salaam Port	2	2	3	2	3	32	3					
Beach pollution	Mbagala Kuu and Mjimwema	2	2	3	2	2	28	3					
River condition decline	Mtoni River, Nguva River, seasonal streams	2	2	3	2	2	28	3					
Oil pollution	Kigamboni and vicinity, Inner Makutumba Island, Msimbazi river valley	2	2	3	2	2	28	3					
Flooding	Mtoni River valley	2	2	3	2	2	28	3					
Forest decline	Kimbiji, Mjimwema, Mtoni	2	2	2	2	2	24	3					
Industrial Pollution	Mbagala and Mtoni wards	1	3	3	2	2	21	3					
Loss of habitat and agricultural area	Forest reserve and river valley vegetation	2	1	3	2	2	14	2					

Major Opportunities

Opportunities available for coastal communities:

- Aquaculture – Temeke has some potential for mariculture.
- Tourism – continued high potential for ecotourism.
- Beekeeping
- Irrigation horticulture, especially close to permanent rivers and streams, or where there are productive wells and boreholes.

Climate Change Impacts

Table 31: Estimated area losses of sea level rise scenarios on overall area and on land uses in Temeke district.

Temeke	Total (km^2)	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
		ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Area	739	2.82	0.00	8.22	0.01	20.32	0.03	46.75	0.07	264.78	0.38	1,846.17	2.62
Built-up area	79	0.85	0.01	2.07	0.03	5.91	0.08	15.68	0.20	28.04	0.36	310.42	3.95
Agriculture	200	2.82	0.01	8.22	0.04	20.32	0.10	46.75	0.23	264.78	1.33	1,846.17	9.25

Significant impacts from sea level rise are felt over the general land area for rise levels only above 10 m, since much of the district is sufficiently raised to avoid inundation. About 9 % of agricultural land would be inundated with such a rise (or storm surge), though storm surges that coincide with spring high tides are likely to have significant impacts further inland, along much of the length of the various creeks with potential seawater penetration into agricultural land and shallow wells.

Projects and Plans

South of Dar es Salaam Marine Reserves System – Ranked as IUCN Category II, the marine reserve comprises four units (Inner and Outer Mwakatobe Islands, Kendwa Island and Inner and Outer Sinda Islands), gazetted in 2007.

Conservation of Water Resources in Temeke (proposed) – Objective to minimize saltwater intrusion into ground water and conservation of water resources along the coastal belt of Temeke Municipality.

10. Mkuranga District

Mkuranga District is in the Coast Region. It has a land area of around 2,739 km^2 and a coastline of 144 km.

Climate Profile

Temperature

The climate ranges from hot and humid in the wide coastal plains of Mkuranga, to cooler in the hills to the north. Average monthly temperature data, from nearby Dar es Salaam Airport weather station, from 1989 to 2012, reveals ranges from a low of around 18.8 ˚C during the coolest months of July and August when maximum temperatures are 29.4 ˚C and 29.7 ˚C respectively, to the highest monthly means of 31.9 ˚C to 32.6 ˚C during the hot season from December to March, when the temperatures drop to only 23.7 ˚C to 24.5 ˚C during that period. Relative humidity in Mkuranga, based on Dar es Salaam data, ranges from 67-70 % from August to October, increasing to 82 % during the wettest months of April.

Precipitation

The average annual rainfall for Mkuranga, based on the nearest weather station (at Dar es Salaam Airport) is 1,073 mm (ranging from 585 mm to 1,536 mm), over the period 1989 to 2013. The monthly rainfall peaks are March to May (main wet season) with about 550 mm of rain during those three months, and November to December (short rains) with 235 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern, with less significant short rains.

Winds

Based on 26 years of data (1987 to 2012) from the Dar es Salaam Airport weather station, in the morning (9 am) winds are generally light (5-9 knots), with strongest morning mean wind speeds during the months of January and February. Slightly stronger wind speeds (8-12 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (11-12 knots) during the months of January (12 knots), February and August to October (11 knots) resulting from typical north-east monsoon variability from light to strong winds within a few days, compared to the typically steady winds of the southeast monsoon period.

In a study by Dubi (2001) of maximum coastal wind speeds, from 1972 to 1996, the mode of the highest wind speeds reached in Dar es Salaam was 20 knots, with peak speeds during both January and July. Dar es Salaam is considered an area of coastline that is more influenced by coastal winds rather than from offshore winds. Over the studied period, the maximum wind speed has shown two peaks: one peak is seen in the period 1975–1979 and another during 1981–84, after which the speeds decrease (Dubi, 2001).

Population

Population size: 222,921 with 114,896 females and 108,024 males. The district has experienced an average annual growth rate between 2002 and 2012 of 1.76 % leading to around 17 % increase of the population over the ten-year period. The population density in the district has grown to 79 persons/km2 in 2012 from 66 persons/km2 of 2002.

Based on 2002 census data, the percentage of the population living below the poverty line was 40 %, the over 15 years of age literacy coverage was 47 % and under five years of age mortality was 173 per 1,000 live births.

Economy

The economy of Mkuranga district hinges on crop production, livestock, fishing, and trade, and small amount on industry. Substantial amount of income is drawn from smallholder cultivators.

Agriculture

Agricultural land in the district covers 646 km² (24 % of total district area) and engages 90 % of the population. The major food crop is cassava, also a cash crop especially when there is surplus and is second after cashew nuts. Other food crops are rice, millet, legumes, maize and sweet potatoes (www.pwani.go.tz/Mkuranga.index.php). Potential area for irrigation in Mkuranga is 164,500 ha of which only 254 ha is under irrigation. The main crops utilizes irrigation are paddy, vegetables and fruits. The district has about 3,000 cattle, 8,000 goats, about 600 goats and 475 pigs.

Fisheries

There are 15 landing sites - all permanent (MLFD, 2010); 11 BMUs and three FMPs. According to the 2009 frame survey, there are 2,279 artisanal fishers of which 845 are foot fishers, the rest used different types of vessels. Of the 384 vessels used by the 1,434 boat fishers, 169 used sail, 203 use paddles and 12 vessels use engines. The generally muddy condition of Mkuranga's coastal waters prevents seaweed farming, resulting in no seaweed farmers reported (URT, 2010). Mkuranga's annual fish production is estimated at 120 tonnes (Coast Region Commissioner's Office, 2006).

Tourism

Mkuranga District has little tourism activity. There are no documented historical or monumental sites of interest. Tourism infrastructure such as hotels and camps are not available. Yet the potential for tourism is present as explained under "opportunities" below.

Minerals

Apart from sand and limestone in some areas no minerals of economic importance are available in the district. There are 117 ha of salt works in the district, all located inshore of the mangrove creeks. Oil and gas exploration drilling was successfully undertaken by the French company Maurel & Prom, with a significant gas discovery at the Mkuranga well (yet to be commercialized).

Description of the coast

Physical

Mkuranga district is located in Pwani Region, bordering Temeke District (Dar es Salaam Region) to the north, separated at the coast by Mbezi River discharging near Boza, and to the south the Rufiji district, with Kisarawe district westward. The district coastal plains extend for 20 km to the west, rising along the Dar es Salaam to Kilwa main road (B2). The district is penetrated by one major water body, the Mbezi River that extends over 100 km from the source in Kisarawe District to the west, and drains the northern half of the district, plus three smaller rivers (including Luhute River that discharges at Kisiju) and a longer river that acts as the border with Rufiji. The shore is almost exclusively soft substratum extending subtidal, with small sections of limestone outcrop. Sediment types are mainly clay bound siliac-based sands and gravel, including beach sands.

Coastal ecology

The coastline of Mkuranga District can be divided into two main sections; the northern half is comprised of four hard substrate portions of about 5-7 km in length with short sand beaches,

separated by mangrove creeks and a southern half of almost complete sand beach. Seagrass beds are likely to be present where water clarity remains high enough throughout the year.

Coral reefs – Reefs are not especially well developed inshore due to the predominance of soft substratum and high levels of suspended sediment. Fragmented nearshore fringing reefs exist in the northern half, and on more offshore areas, as isolated patch reefs (e.g. off Boza) and around the small islands of Kwale and Koma. Diversity and extent are expected to be low because of the turbid conditions.

Mangroves – Total mangrove coverage in the district is 4,390 ha, concentrated in a 2-3 km wide strip from the northern border with Temeke District, extending 50 km south to Kisiji.

Beach and rock shorelines – The first 40 km of shoreline is fringed by mangrove creeks and mostly muddy with a number of small sandy beaches, while the southern section is a virtually uninterrupted sand beach shore extending over 40 km to the Rufiji border. Rocky shore is present only along portions of the northern half and virtually absent from the southern coast.

Coastal waters

Inshore waters of Mkuranga are predominantly turbid from suspended sediment and freshwater transported north mainly from Rufiji River estuary, but also from its own six estuaries. Peak out-flow from the rivers occurs from March to May with a short rains season in November-December.

Marine species of importance

Turtles – Green turtle nesting takes place in some sandy beaches within district, though not much is known generally in small numbers due to heavy disturbance of the shoreline from development.

Cetaceans - Bottlenose dolphins are regularly reported within short distances of the coastline and humpback whales are seen during June to November.

Shorebirds – Mkuranga coast and the islands receive large numbers of Palaearctic wading birds (crab plovers, roseate terns, saunders terns and numerous migrants from the northern winter).

Red colobus monkey – The endangered Red colubus is found at Dendeni Island (Mkuranga ICMAP, 2009).

Whale shark – Fisher observations showed that whale sharks were seen mainly in two locations: in Kilindoni Bay (close to Kilindoni, Mafia Island) and near Koma Island which is located close to the mainland 50 km north-west of Kilindoni (WWF, 2013).

Natural resources

Natural forest covers 186 km^2, about 7 % of the total Mkuranga District area. There are three forest reserves in Mkuranga namely Marenda FR (184 ha), Vikindu FR (1,599 ha) and Masangaya FR (2,599 ha) (Minja, 2006). Mkuranga is losing its forest due to growing demands of forestry products, especially charcoal. Woodland covers 1,153 km^2 (about 42 % of the district), and bush land 210 km^2 (7.6 %) and grassland 464 km^2 (17 %).

Settlements

The settlement and built-up portion of Mkuranga is extremely small and concentrated in the central, north-south corridor along the main trunk road from Dar es Salaam to Kilwa (B2), with main settlements at Vikindu, Mkuranga, Bigwa and Lukanga. To the west and east lower densities of inhabitants give way to more agricultural land with smaller settlements and more open land.

Infrastructure

Mkuranga is connected to Dar es Salaam with a trunk road (B2) that runs north-south through the entire district. There are a number of municipality roads some of which are all weather and few are impassable during rainy season. The Songo Songo to Dar es Salaam gas export pipeline passes through Mkuranga district to Ubungo Power Station (Ilala district). The Mtwara to Dar es Salaam gas pipeline in under construction and will pass through the entire district, south to north, with expected completion in late 2014.

Major Threats

Table 32: Overview of threats to coastal communities in Mkuranga ICMAP (2009).

Threat	Location	Cause
Beach pollution	Koma, Kwale, Kisiju Pwani,	Indiscriminate dumping of household waste on beaches and vicinities. Uncontrolled dumping of fish remains and carcasses. Lack of toilets in some coastal households. Weak of enforcement of public health regulations
Beach erosion	Kisiju	Mangrove cutting, dynamite fishing, unplanned construction along coast.
Fisheries decline	Entire district coastal are including	Destruction of fish nurseries for action such as Mangrove cutting, illegal fishing such as Dynamite fishing and other poor fishing methods (fine meshed nets, beach seining) as well as coral mining for lime production. Over utilization of fisheries resources by large number of fisher in the small area
Loss of biodiversity (namely Dugong)	Coastal waters	Destructive fisheries, mangrove cutting, salt production
Diseases outbreaks	Throughout the coastal areas of the district	Inadequate sewerage control, flooding, poor quality of sewerage construction, poor solid waste management, uncontrolled food vending. Lack of latrines and toilets in some coastal dwellings
Habitat loss as well as loss of agricultural area		Rapid urbanization, high increase of people immigration in the city,
Land use conflicts	Along the coastal front	Land use conflict between villages
Mangrove/forest habitat and agricultural area	Koma, Kwale, Kisiju Pwani, Kimazichana	Illegal and uncontrolled mangrove cutting. Illegal trees cutting in the forest for charcoal burning. Mangrove clearing for salt production. Increase urbanisation and settlement construction.

CRIAM Ranking of Threats to Local Communities in Mkuranga District

Table 33: Prioritisation of threats to local communities in Mkuranga District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	Entire district coastal are including	3	3	3	2	2	63	4					
Beach pollution	Koma, Kwale, Kisiju Pwani,	2	2	3	2	2	28	3					
Decrease in man-grove forest and agricultural area	Koma, Kwale, Kisiju Pwani, Kimanzichana	2	2	3	2	2	28	3					
Habitat loss and loss of agricultural area	Here and there along the coast	2	2	3	2	1	24	3					

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Diseases outbreaks	Throughout coastal areas of the district	3	1	2	2	3	21	3					
Beach erosion	Kisiju	1	2	3	2	2	14	2					
Land use conflicts	Along coastal front	1	2	3	2	2	14	2					
Loss of biodiversity (i.e. loss of Dugong)	Kisiju and vicinity	1	2	2	2	2	12	2					

Major Opportunities

Opportunities available for coastal communities, mostly identified by Mkuranga ICMAP (2009):

- The marine area of Mkuranga District has been shown to have huge potential for shrimps therefore this fishery could be expanded.
- Large coastal forests (mangroves and terrestrial) if managed properly could provide a good source of income from beekeeping to eco-tourism.
- A number of islets could be promoted as tourist attractions due to the fact that they harbour different types of birds and hatching ground for turtles.
- Suitable areas for mariculture can be exploited for alternative livelihoods and relieve pressures on marine fishing.

Climate Change Impacts

Table 34: Estimated area losses of sea level rise scenarios on overall area and on land uses in Mkuranga district.

Mkuranga	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation	51	0.02	167	0.06	282	0.10	573	0.20	1,650	0.59	12,019	4.26

Significant impacts from sea level rise are felt over the general land area for rise levels only above 10 m, whereby over 4 % of the total land area will be inundated. Most of the district is sufficiently raised to avoid inundation even at 5 m level, inundating approximately 0.6 % and virtually all infrastructures is set 15-20 km from the coast. Storm surges that coincide with spring high tides are likely to have significant impacts inland, along much of the length of the various creeks with potential seawater penetration into agricultural land and shallow wells.

11. Rufiji District

Rufiji District is in the Coast Region, with a land area of around 13,229 km^2 and a coastline of 320 km.

Climate Profile

Temperature

The climate ranges from hot and humid in the wide plains Rufili River flood plains of Rufiji, to cooler in the hills to the south and west. The climate of Rufiji, based on data for nearby Mafia Island District, is an average monthly temperature range from the coolest months, of July to August with lows of around 22.5 ˚C to highest temperatures of 27.4 ˚C, to the hottest months of December to March with lows of around 25.0 ˚C up to 31.7 ˚C. Relative humidity ranges from 61 % in September to 80-81 % for March and April (source: www.mafiaislandtourism.com).

Precipitation

The average annual rainfall for Rufiji, based on the Utete weather station is 834 mm (ranging from 344 mm to 1,248 mm), over the period 1981 to 2007. Though there are monthly data gaps for some years, the monthly rainfall peaks are March and April (main wet season) with about 300 mm of rain during those two months, and December (short rains) with 126 mm of rain. Utete is over 60 km from the coast and likely to experience drier condition, nevertheless, the lower overall rainfall also follows a more uni-modal rainfall pattern, with a less significant short rains and a more extended main wet season, with scattered rains from December to May.

Winds

The closest weather station with wind data is Mtwara Airport, from where 26 years of data (1987 to 2012) show that, for mornings (9 am) winds are generally light to moderate (7-14 knots), with strongest morning mean wind speeds during the months of May to July. Stronger wind speeds (9-14 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (13-14 knots) during the months of July to February and calmest during March and April (10 and 9 knots, respectively).

Also relevant specifically to Mtwara, but with likely similarities as far north as Rufiji, the study by Dubi (2001) of maximum coastal wind speeds, from 1972 to 1996, found the mode of the highest wind speeds was 30 knots at Mtwara, with peak speeds in July. Rufiji coast is sheltered by Mafia Island directly to the east and northeast, and by the isles and reefs of the Songo Songo Archipelago to the south.

Population

Population size: 217,278 with 112,423 females and 104,851 males. The district has experienced an average annual growth rate between 2002 and 2012 of 0.97 % leading to around 13 % increase of the population over the ten-year period. The population density in the district has grown to 17 persons/km^2 from 15 persons/km^2 of 2002.

Based on 2002 census data, the percentage of the population living below the poverty line was 34 %, the over 15 years of age literacy coverage was 51 % and under five years of age mortality was 158 per 1,000 live births.

Economy

The main economic activity of the district is agriculture and fisheries, with the tourism sector growing steadily.

Agriculture

Land in Rufiji District under agriculture accounts for 686 km^2 (equivalent to 5 %), of which 91 % is demarcated for household agriculture. Total area cultivated in 2002/3 season, according to NBS (2007), was 36,033 ha. Land under irrigation is 298 ha. Main cash crops are cashew nuts (10,591 ha) and coconut (1,906 ha) that make up less than 10 % of the net economic value (Mkindi and Meena 2004). Main food crops cultivated include cassava (9,761 ha), maize (12,653 ha) and paddy (10,516 ha), though there is no clear distinction in some crops as to whether they are grown for cash or as food. Other important crops include oranges (1,294 ha), pineapples (533 ha), pigeon peas (207 ha), mangos (160 ha) and sesame. The district has small amount of agro-machineries use and most of cultivation work is done by hand with 78 % of people engaged in agriculture (NBS-CRCO, 2007).

Livestock keeping is also conducted in Rufiji. The numbers of animals kept are as follow goats (13,406), cow (3,503) and chicken (311,759). The district is third in livestock rearing in the region. Most animals reared are indigenous with very low number of modern breeds.

Fisheries

Rufiji District's coast is unlike others of the Tanzania coast due to the presence of the Rufiji Delta, an area of approximately 50,000 ha which supports various types of fisheries. Consequently, fishery is a highly important activity to the district, reflected in the high number of landing sites (31), of which 19 are permanent, as well as 23 BMUs and accompanying 23 FMPs, with 14 fisheries bylaws (MLFD 2010). Fisheries are of three major types in the district, in order of importance being marine, estuarine and freshwater. According to the 2009 frame survey data, there are 4,247 artisanal fishers of which 691 are foot fishers, the rest used different types of vessels. Of the 1,369 vessels used (the highest district number for the entire coast), 161 used sail for propulsion, 1,190 paddles and only 18 vessels use engines.

The high number of paddle vessel (i.e. canoes) responds to the prawn fishery that is conducted using small gill-nets in the estuarine water of the delta. One notable feature of Rufiji fisheries is the large catch of prawns from the delta accounting for about 80 % of the total national prawn landings (Annual Fisheries Statistics Reports 1993- 96; Semesi 2000, as quoted by Muhando and Rumisha, 2008). The dugout canoes and gill-nets are also engaged in the capture of a sardine (seven-spot herring) that inhabits the shallow muddy waters of the delta and make a significant contribution of overall fin-fish landings, though no data are available. The generally muddy condition of Rufiji's coastal waters prevents seaweed farming, resulting in no seaweed farmers reported (URT, 2010).

Tourism

Tourism is not a big industry in this area as there are a number of shortcomings such as poor access of coastal Rufiji caused by poor infrastructure – especially roads. However, the Selous Game Reserve to the west of the district has a number of specialist wildlife lodges that have been attracting tourists since the early 1990s.

Minerals

The mining activities undertaken in Rufiji district include excavation of sand and gravel mainly from coastal river-bed sources. There are 49 ha of salt works in the district, all located inshore of the mangrove creeks. A single exploratory oil and gas well was drilled by Maurel & Prom in the southeast corner of the district, close to Mohoro, but failed to yield hydrocarbons.

Description of the coast

Physical

Rufiji District is the southernmost district of the Coast Region. The north borders with Mkuranga District, the west with Morogoro Region, and the south with Kilwa District. To the east, across the 10-20 km wide Mafia Channel, lies Mafia District. One major water body, the Rufiji River, drains approximately 30 % of Tanzania area and is the largest river in the country, penetrates the district. Numerous tributaries exist on both banks of the Rufiji River and other four small coastal rivers drain directly into the sea, the largest being the Mohoro River in the southern section of the Rufiji delta.

Simaye Island is a tiny rocky outcrop off the southern portion of the delta, where other rocky outcrops exist, though overall the shores of the district are mostly soft substratum (mud, silt and sand) extending to the subtidal. Beach sands are present away from mangrove estuaries (at Simba Uranga and Jaja) and formed from silicilastic origins.

Coastal ecology

A prominent feature of the district is the Rufiji River, with its large floodplain and delta, the most extensive in the country. Mangrove forests flank the tributaries of the delta. The river, from which the district takes its name, divides the district geographically into roughly equal halves (Mkindi & Meena, 2005)

Coral reefs – Due to high suspended sediment levels, significant coral growth is limited within Rufiji District waters.

Mangroves – Rufiji District has the greatest mangrove coverage in the country, with 49,149 ha.

Beach and rock shorelines – most of the shore line of Rufiji is characterised by long continuous stands of mangrove forest with muddy substratum and in some places sand. The wide expanses of intertidal sand and mud flats of Rufiji provide important bird feeding areas during low tide, and important fish and shellfish breeding and feeding grounds, in part thanks to the discharges from these small river systems.

Coastal waters

The inshore waters of Rufiji are predominantly turbid from suspended sediment and freshwater transported north mainly from the Rufiji River estuary's five main outlets, and also from the smaller Mohoro River to the south of the delta. The peak outflow from the rivers occurs from March to May with a short rains season in November-December, dominated by discharges of the Rufiji River, typically bearing heavy loads of suspended sediments, as well as nutrients and agricultural pesticides (Mascarenhas, 2004).

Marine species of importance

Turtles – Green turtle nesting takes place in some sandy beaches within the district, though generally in small numbers due to heavy disturbance of the shoreline from development.

Dugong - Listed as Critically Endangered. Ecological importance of Rufiji delta particularly for the endangered seagrass-eating dugong (Muir 2003).

Shorebirds – Rufiji coast is well-known for the migratory shore birds (IBA 32) (see Baker & Baker, 2002).

Whale shark – Fisher observations showed that whale sharks were seen mainly in two locations: in Kilindoni Bay (close to Kilindoni, Mafia Island) and near Koma Island which is located close to the Mkuranga mainland, 50 km north-west of Kilindoni (WWF, 2013). There are likely to be times or

seasons when whale sharks venture into Rufiji District waters.

Natural resources

Rufiji District has extensive natural forests, which covers 1,986 km^2 (15 %), added to which woodlands cover 5,553 km^2 (42 %), resulting in over half of the district being wooded to some degree. Bush land covers 1,605 km^2 (12 %) and grasslands 2,379 km^2 (18 %). There are seven forest reserves in Rufiji, Katundu FR (4727 ha), Kichi Hills FR (14,432 ha), Kikale FR (1,000 ha), Kipo FR (1,749 ha), Kiwengoma FR (3,506 ha), Mnchungu FR (1,035 ha) and Mohoro River FR (2,349 ha) (NEMC, 2009).

Settlements

The settlement and built-up portion of Rufiji is estimated at 10 km^2 (less than 0.1 %) and is concentrated in the district headquarters at Utete and the scattered other settlements close to the Dar es Salaam to Kilwa trunk road (B2). The western portion of Rufiji District has lower densities of inhabitants and the land use gives way to more agricultural land with smaller settlements and more open wilderness, especially approaching the Seloius Game Reserve.

Infrastructure

Rufiji is connected to Dar es Salaam with a trunk road (B2) that runs north-south through the entire district. There are a number of municipality roads some of which are all weather and few are impassable during rainy season. The Songo Songo to Dar es Salaam gas export pipeline passes through Mkuranga district to Ubungo Power Station (Ilala district). The Mtwara to Dar es Salaam gas pipeline in under construction and will pass through the entire district, south to north, with expected completion in late 2014.

Major Threats

Table 35: Overview of threats to coastal communities in Rufiji district.

Threat	Location	Cause
Beach pollution	Populated area such as Kibanjo, Kiasi, Simbauranga	Uncontrolled solid and liquid waste disposal, often in creeks.
Marine pollution	Along the near shores	Large plantations in the highland drain into Rufiji basin and hence fertilizers, pesticides, herbicides and fungicides may pose as threat
Fisheries decline	All along the shore	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods
Diseases outbreaks	In coastal villages such as Kiasi and Kibanjo	Inadequate sewerage control, flooding, poor quality of sewerage construction, poor solid waste management, uncontrolled food vending. lack of latrines, lack of clean domestic water
Flooding	Rufiji delta and river basin	Construction in vulnerable river valleys, climate changes such as El-Nino and storm rains, heavy rains up Rufiji Valley Basin
Land use conflicts	Ikwiriri, Kibiti and in many villages and wards	Land utilization for animal grazing and cultivation (cultivators vs grazers). Conflicts between villages on village borders disputes. Conflicts between districts on district borders disputes
Fishing grounds use conflicts	Shallow waters within the near shore areas	Conflict between commercial trawlers and artisanal fishers
Loss of habitat and agricultural area	Along Rufiji Delta and coastal forests	Rapid urbanization, high increase of people immigration in the city. Uncontrolled mangrove cutting, forest clearing for firewood collection, charcoal production, logging and pole collection
River and estuary pollution	Rufiji River	Organochlorine pesticides used to control crab pest in rice paddies, potentially affecting carapace formation in prawn and other shellfish (Stadlinger et al 2011).

CRIAM Ranking of Threats to Local Communities in Rufiji District

Table 36: Prioritisation of threats to local communities in Rufiji District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	All along the shore	3	3	3	2	2	63	4					
Loss of habitat and agricultural area	Along Rufiji Delta and coastal forests	3	3	3	2	1	54	4					
Marine pollution	Along the near shores	3	2	3	2	3	48	4					
Beach pollution	Populated area such as Kibanjo, Kiasi, Simbaulanga	3	2	3	2	2	42	4					
Land use conflicts	Ikwiriri, Kibiti and in many villages and wards	2	3	2	2	1	30	3					
Diseases outbreaks	In coastal villages such as Kiasi and Kibanjo	2	2	2	2	3	28	3					
River and estuary pollution	Rufiji River	3	1	2	2	3	21	3					
Flooding of construction areas and vulnerable river valleys	Rufiji delta and river basin	2	2	2	2	1	20	3					

Major Opportunities

Opportunities available for coastal communities:

- Aquaculture – well-planned and controlled aquaculture.
- Tourism – Ecotourism.
- Eco-friendly forest use such as beekeeping.
- Irrigation agriculture.

Climate Change Impacts

Table 37: Estimated area losses of sea level rise scenarios on overall area and on land uses in Rufiji district.

Rufiji	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation	733	0.06	2,299	0.18	3,073	0.24	3,946	0.30	5,209	0.40	62,953	4.84

Significant impacts from sea level rise are felt over the general land area for rise levels only above 10 m, whereby almost 5 % of the total land area will be inundated. Most of the district is sufficiently raised to avoid inundation even at 5 m level, inundating approximately 0.4 % and virtually all infrastructures is set 15-20 km from the coast. Storm surges that coincide with spring high tides are

likely to have significant impacts on fishing camps in the Rufiji Delta and inland, along much of the length of the various creeks with potential seawater penetration into agricultural land and shallow wells.

Projects and Plan

Mafia-Rufiji-Kilwa Ramsar Site - Rufiji Delta forms a large part of the Mafia-Rufiji-Kilwa Ramsar Site, was in late 2004 formally gazetted under the Ramsar Convention as an 'Area of Wetlands of Global Importance', and referred to as the Rufiji-Mafia-Kilwa Marine Ramsar Site.

Eco-Region Globally Important site – The Rufiji Delta and neighbouring Mafia Island and Songo Songo Archipelago (Kilwa District) was identified during a WWF process (2004) as having globally important biodiversity richness within the Eastern African Marine Ecoregion, and was the focus of the WWF Rufiji-Mafia-Kilwa Seascape Programme (or RUMAKI), that ended in 2010.

12. Mafia District

Mafia District is in the Coast Region. It has a land area of around 477 km^2 and a coastline of 238 km.

Climate Profile

Temperature

The climate of Mafia Island is hot and humid, with an average monthly temperature range from the coolest months, of July to August with lows of around 22.5 ˚C to highest temperatures of 27.4 ˚C, to the hottest months of December to March with lows of around 25.0 ˚C up to 31.7 ˚C. Relative humidity ranges from 61 % in September to 80-81 % for March and April (source: www.mafiaislandtourism.com).

Precipitation

The average annual rainfall for Mafia, based on the Mafia weather station is 1,893 mm (ranging from 1,479 mm to 2,663 mm), over the period 1989 to 2007. Though there are monthly data gaps for some years, the monthly rainfall peaks are March to May (main wet season) with over 1,100 mm of rain during those two months, and November to February (short rains) with over 500 mm of rain. Overall annual rainfall begins to follows a uni-modal pattern, with a more extended main wet season, of scattered rains from December to May, usually with a significant monthly peak during one of the months from March to May.

Winds

The closest weather station with wind data is Mtwara Airport, from where 26 years of data (1987 to 2012) show that, for mornings (9 am) winds are generally light to moderate (7-14 knots), with strongest morning mean wind speeds during the months of May to July. Stronger wind speeds (9-14 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (13-14 knots) during the months of July to February and calmest during March and April (10 and 9 knots, respectively).

Also relevant specifically to Mtwara, but with likely similarities as far north as Mafia, the study by Dubi (2001) of maximum coastal wind speeds, from 1972 to 1996, found the mode of the highest wind speeds was 30 knots at Mtwara, with peak speeds in July. Based on the conclusion from Mtwara, the outer coast of Mafia is likely to be more influenced by offshore winds rather than from coastal winds. The possibility of cyclones or strong winds exists for Mtwara and neighbouring districts as far north as Mafia, especially for the months of January to March during the main cyclone season off Madagascar and Comoros.

Population

Population size: 46,438 with 23,484 females and 22,954 males. The district has experienced a low average annual growth rate between 2002 and 2012 of 1.92 % leading to only 14.75 % increase of the population over the ten-year period, and indicating a low level of net in-migration. The population density in the district has grown to 70 persons/km^2 from 61 persons/km^2 of 2002.

Based on 2002 census data, the percentage of the population living below the poverty line was 43 %, the over 15 years of age literacy coverage was 67 % and under five years of age mortality was 176 per 1,000 live births.

Economy

Mafia District's economy relies on agricultural cultivation and fisheries, with a substantial amount of revenue also contributed by trade and, increasingly by tourism.

Agriculture

Arable land in Mafia District covers 26 km^2 of which most is cultivated, rendering this the only district in Coastal Region with almost fully utilized arable land. Land suitable for irrigation is 80 ha. Main cash crops are coconut and cashew nuts, with cassava, paddy and sweet potatoes the dominant food crop in the district. Other cultivated food crops including maize, sorghum and to some extent fruits (NBS-CRCO, 2007).

Livestock keeping is also conducted in Mafia, although in a small amount. Only about 11,498 cattle, 720 goat, 203 donkeys, few sheep and about 25,000 poultry recorded (NBS-CRCO, 2007).

Fisheries

Mafia waters are described as one area with the best fishing grounds. This is mirrored by the 43 landing sites, the greatest number of all coastal districts, of which 29 are permanent and 14 temporary, and the ten BMUs, with ten FMPs and ten fisheries bylaws (MLFD, 2010), and reflected by the high number of fishers. According to the 2009 frame survey data, there are 4,200 fishers (the highest number of all Tanzania coastal districts) of which 698 are foot fishers, the rest used different types of vessels. There are 965 vessels recorded, with 342 using sail for propulsion, 560 using paddles and 81 using engines. Mafia has 189 seaweed farmers (URT, 2010).

The sheltered waters between Mafia and the Rufiji Delta, the Mafia Channel, are relatively shallow and calm and protected, creating ideal conditions for the fishery for small pelagic fish species (sardines and anchovies). This fishery is the target of many of the 365 ring-nets, mostly operated by 81 motorised vessels noted above (URT 2010). The small pelagic fish are a significant component of the catch in Mafia District, though data are not available.

Fisheries in Mafia has been commercialized to a large extent, with a fish processing plant operational in Kilindoni since the 1980s, now run by Alpha Krust Ltd (part of the Alpha Group) who purchase and process lobster, shrimp, octopus and squid, some of which is exported. Alpha Krust also operates a prawn farm in northern Mafia of approximately 100 ha. Finfish are important for local consumption and exported to Dar es Salaam as dried or fresh preserved in cold boxes.

The fisheries sector on Mafia employs 10 % of the total population and contributes 48.8 % of Mafia District's income (Mafia District ICMAP 2007). Fish production tends to vary with season. Mafia also tends to experience high annual in migration of fishermen (Mafia District ICMAP 2007).

Tourism

Tourism is conducted more on the southeast part of the Island, Utende and Chole, where tourist hotels are present. There are about four tourist hotels all of them owned by foreign investors. The tourism potential is high since the area has almost pristine marine environment characterized by shallow water with high quality coral reefs and SCUBA diving sites. These pristine environments are safeguarded by Mafia Island Marine Park (MIMP). Although Mafia ecology offers one of the best diving and snorkeling center in East Africa the number of tourists is still low.

Minerals

The only mineral excavation takes place in Mafia is sand and gravel. Oil and gas exploration drilling was successful undertaken by the French company Maurel & Prom, with a significant gas discovery at the Mafia Deep (yet to be commercialized).

Description of the coast

Physical

Mafia is situated of the coast of mainland Tanzania, approximately 195 km south of Dar es Salaam. Mafia District is an archipelago comprised of the Mafia main island, of approximately 407 km^2 area of land mass, plus several smaller inhabited islands to the east and south, including Chole, Juani, Jibondo and Bwejuu to the west (Mafia ICMAP, 2007). Additional uninhabited islands include Jina (off Chole Bay on the east) and Shungumbili, Niororo and Bakaruni in the northwest.

Coastal ecology

The area included within MIMP boundaries is one of the most important marine habitats in the world, with mangroves, seagrass beds, coral reefs, inter-tidal reef flats, lagoons and coastal forests.

Coral reefs – Coral reefs around Mafia are habitat of 380 fish species and 45 genera of corals are reported to be among the best on east Africa Coast. In Mafia there are extensive reefs around the island and small offshore islets, with well-developed fringing reefs, extensive particularly in the south with deep spur and groove formation on outer slopes. Seaward of Kitutia reef and Chole Island are reefs to depth of 20 m. On the eastern fringing reef of Mafia, there is good coral cover with high diversity down to 25-30 m. Western coast of Mafia has fewer reefs because of periods of heavy sedimentation from the Rufiji River.

Mangroves – Statistics from ICMAP (2007) cite mangrove forests in Mafia covering 3,473 ha, with the largest and most dense stands concentrated on the west and south coasts. The main mangrove stands include Ras Mkumbi on the northern tip (about 52 ha), Kanga to Kirongwe (approximately 1,231 ha), Ras Mbizi-ngera (about 704 ha) and between Kilindoni and Chole Island around the south coast (approximately 539 ha).

Beach and rock shorelines - The shoreline backing fringing reefs, extending for most of the main island's eastern coast, is raised fossil limestone coral, some 33 km of unbroken raised reef. Small beaches are present in sheltered southern areas, especially around Chole Bay. Most of the northern coast is characterised by long sandy beaches notably on the west, from Tikwiri northwards. Large intertidal sand banks and seagrass beds contribute to the diversity and productivity of the Mafia marine ecosystem.

Coastal waters

Mafia District experiences two distinctly different coastal water bodies. To the east, the Indian Ocean waters are cool and clear, with very little run-off influences other than freshwater seepage through the raised limestone cliff and reefs after heavy rain. The west coast in contrast is bathed by waters of the Mafia Channel that are influenced greatly by the discharges of the Rufiji River, typically bearing heavy loads of suspended sediments, nutrients and agricultural pesticides (Mascarenhas, 2004). The peak outflow from the rivers occurs from March to May, with a short rains season in November, and the influence of fresh water and turbidity from the rivers is felt across the Mafia Channel reaching Kilindoni shores.

Marine species of importance

Turtles – Green turtle nesting takes place in some beaches within the district (Sea Sense, 2013).

Cetaceans - Bottlenose and humpback dolphins are regularly reported within short distances of the coastline, especially inside the marine park, and humpback whales are seen during June to November, on both coasts.

Dugong - Listed as Critically Endangered. Ecological importance of Rufiji delta particularly for the endangered seagrass-eating dugong (Muir, 2003).

Seahorses - At least two species of seahorses have been reported by divers and found in by-catch in various landing sites on Mafia. Some species of seahorse are also endangered.

Shorebirds – Mafia coast as well as the archipelago is well-known for the large numbers of Palaearctic wading birds that visit during the months of November to March. The area designated an Important Bird Area (IBA 12) (see Baker and Baker, 2002).

Whale shark – Fisher observations showed that whale sharks were seen mainly in two locations: in Kilindoni Bay (close to Kilindoni, Mafia Island) and near Koma Island which is located close to the Mkuranga mainland, 50 km north-west of Kilindoni (WWF, 2013).

Natural resources

Natural forests account for 9 km^2 which is equivalent to about 2 % of entire Mafia land area, plus 5 km^2 (about 1 %) of woodland and bush covering 3 km^2 (0.6 %) and grassland 2 km^2 (0.5 %). There is only one forest reserve in Mafia District, Mlola FR (300 ha). The reserve is continuously threatened from encroachment by human through settlement and agriculture.

Settlements

The settlement and built-up portion of Mafia is very small, concentrated in the western district headquarters town of Kilindoni. The road east to Utende, inside the MIMP is scattered with villages and the islands of Chole, Juani and Jibondo have large village populations. The north and southern portions of Mafia have lower densities of inhabitants and the land use gives way to more agricultural land with smaller settlements.

Infrastructure

There is one airstrip in the district, at Kilindoni. The road networks in Mafia are in poor condition and there are only earth roads. Kilindoni port is the only port facility in Mafia and it lack cargo handling facilities, though the Mafia Jetty is almost completed and is expected to facilitate cargo handling and vessel docking. Mobile telecommunication services centered in Kilindoni and a few kilometers away network is not reliable. Mafia electricity is obtained from two generators which can supply up to 800 KW and serve only Kilindoni and Kiegeani wards (Mafia ICMAP 2007).

Major Threats

Table 38: Overview of threats to coastal communities in Mafia district.

Threat	Location	Cause
Beach pollution	Kilindoni	Uncontrolled solid and liquid waste disposal, lack of toilets for public as well as residential houses
Beach erosion	Utende, Kilindoni, Bwejuu, Juani, Jibondo	Mangrove cutting, dynamite fishing, beach sand mining for construction purposes, unplanned construction along the coast
Fisheries decline	All along the near shore areas	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods such as purse seine, beach seine, poisonous fishing, SCUBA gun fishing, etc.
Marine pollution	Kilindoni	Possible oil leakages and pollution from loading and off loading at Kilindoni Harbour, garages, and factory
Diseases outbreaks	Kilindoni, Bwejuu, Jibondo	Inadequate sewerage control, poor solid waste management, uncontrolled food vending.
HIV/AID increases	Especially at Kilindoni and dago areas	In-migration of many seasonal fishers from Dar es Salaam, Pemba. Unguja and other mainland coastal areas.
Land use conflicts	Mafia Island Marine Park area	Conflict between environmental conservation authorities and groups and community which want to utilize resources, especially marine resources, e.g. MIMP and fishermen.

Fishing ground access conflict	Shallow waters west of Mafia	Marine resource uses between industrial trawlers and artisanal fishers
Loss of habitat area	All along the coast	Mangrove cutting, blast fishing, coral mining, salt production, prawn farming

CRIAM Ranking of Threats to Local Communities in Mafia District

Table 39 Prioritisation of threats to local communities in Mafia District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	All along the near shore areas	3	3	3	2	2	63	4					
Beach pollution	Kilindoni	2	2	3	2	2	28	3					
Diseases outbreaks	Kilindoni, Bwejuu, Jibondo	2	2	2	2	3	28	3					
Loss of habitat area	All along the coast	2	2	2	2	2	24	3					
HIV/AIDS increases	Especially at Kilindoni and dago areas	2	2	2	2	1	20	3					
Beach erosion	Utende, Kilindoni, Bwejuu, Juani, Jibondo	2	1	3	2	2	14	2					
Marine pollution	Kilindoni	1	2	3	2	2	14	2					
Land use conflicts	Mafia Island Marine Park area	2	1	2	2	1	10	2					

Major Opportunities

Opportunities available for coastal communities, partly from Mafia ICMAP (2007):

- Offshore fisheries – The fishery for deep-water and more open water species is not fully exploited due to inadequate skills and boats.
- Aquaculture – Fish farming has started with prawns and is identified as a coastal opportunity in Mafia that could be further expanded.
- Tourism – Mafia Island has many tourist attractions including marine sites, beaches, old German Boma and jail (Chole Island), tower at Ras Mkumbi, Kua ruins and Ngome caves. Ecotourism as well as cultural tourism are underutilized.
- Eco-friendly forest use such as beekeeping is potential according to

Climate Change Impacts

Table 40: Estimated area losses of sea level rise scenarios on overall area and on land uses in Mafia district.

Mafia	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation	64	0.10	286	0.43	656	0.98	1,091	1.63	1,843	2.76	10,972	16.43

Significant impacts from sea level rise are felt over the general land area for rise levels only above 5 m, inundating just under 3 % of the district. However, a 10 m rise equivalent of a storm surge, and one that coincides with spring high tides is likely to have damaging impacts inland, along much of the length of the small creeks with potential seawater penetration into agricultural land and shallow wells.

Projects and Plans

Mafia Island Marine Park (MIMP) – Mafia is the site of Tanzania's first Marine Park, gazetted in 1995. The park covers the southern half of the island and part of the north-east shores.

Mafia-Rufiji-Kilwa Ramsar Site - Rufiji Delta form a large part of the Mafia-Rufiji-Kilwa Ramsar Site, was in late 2004 formally gazetted under the Ramsar Convention as an 'Area of Wetlands of Global Importance', and referred to as the Rufiji-Mafia-Kilwa Marine Ramsar Site.

Eco-Region Globally Important site – The Rufiji Delta and neighbouring Mafia Island and Songo Songo Archipelago (Kilwa District) was identified during a WWF process (2004) as having globally important biodiversity richness within the Eastern African Marine Ecoregion, and was the focus of the WWF Rufiji-Mafia-Kilwa Seascape Programme (or RUMAKI), that ended in 2010.

13. Kilwa District

Kilwa District is in the Lindi Region. It has a land area of around 13,656 km^2 and a coastline of 713 km.

Climate Profile

Temperature

The climate of Kilwa district is hot and humid, with an average monthly temperature, based on that of nearby Lindi, of 23.0 ˚C in the coolest month is July and 27.0 ˚C during the hottest month of December. To the west the land rises to low hills where the climate is cooler. Relative humidity, based on data from nearby Lindi, ranges from 87 % in March to 79 % in October (source: www.lindi.go.tz/kilwa.html).

Precipitation

The average annual rainfall for Kilwa, based on the Lindi Airport weather station, is 890 mm (ranging from 489 mm to 1,699 mm), over the period 1971 to 2011 (though there are monthly data gaps for some years). The monthly rainfall peaks are March to April (main wet season) with over 370 mm of rain during those two months, and December to February (short rains) with over 410 mm of rain during those three months. Overall annual rainfall follows a clear uni-modal pattern, with a five month main wet season of scattered rains from December to April, usually with a significant monthly peak during one of the months from February to April.

Winds

Based on 26 years of data (1987 to 2012) from the Mtwara Airport weather station, in the morning (9 am) winds are generally light to moderate (7-14 knots), with strongest morning mean wind speeds during the months of May to July. Stronger wind speeds (9-14 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (13-14 knots) during the months of July to February and calmest during March and April (10 and 9 knots, respectively).

In a study by Dubi (2001) of maximum coastal wind speeds, from 1972 to 1996, the mode of the highest wind speeds reached in Mtwara was 30 knots, with peak speeds in July. The coast of Kilwa, particularly the south, and outer islands and reefs of the Songo Songo Archipelago, like Mtwara, are likely to be more influenced by offshore winds rather than from coastal winds. Over the studied period, the maximum wind speed has followed a linear increase, reaching a peak of 35 knots (Dubi, 2001). The possibility of cyclones or strong winds exists, especially for the months of January to March during the main cyclone season off Madagascar and Comoros. These features are likely also to apply to the Kilwa coastline.

Population

Population size: 190,744 with 99,083 females and 91,661 males. The district has experienced an average annual growth rate between 2002 and 2012 of 1.10 % leading to about 7.69 % increase of the population over the ten-year period, indicating low level of net in-migration. The population density in the district has grown to 14 persons/km2 in 2012.

Based on 2002 census data, the percentage of the population living below the poverty line in Kilwa was 35 %, the over 15 years of age literacy coverage was only 52 % and under five years of age mortality was 217 per 1,000 live births.

Economy

The economy of Kilwa district hinges on crop production, livestock, fishing, trade, some minor tourism and to a very limited extent on industrial activities (including Songo Songo gas industry).

Agriculture

Land suitable for agriculture in Kilwa district is estimated to be 928 km^2 (7 % of entire Kilwa land area). Food crops are mainly cassava, sorghum, maize, rice, sweet potatoes, bananas, and legumes. Main cash crops are including cashew nut and coconuts. Fruits (such as oranges, pineapples and mangoes) and vegetables are normally cultivated as cash as well as food crops.

Livestock includes cattle, pigs, goats, sheep, dogs, turkey, ducks and rabbits. Municipality farmers are also involved in beekeeping of which there is about 516 hives, mostly of modern design.

Fisheries

Kilwa is described as the district with the best fishing grounds in the country and the population is highly dependent on fisheries as a main source of protein and income, mainly from marine sources. The importance of fishing is reflected in the 27 landing sites (17 permanent and ten temporary), 16 BMUs though with no FMPs or fisheries bylaws (URT 2010). According to the 2009 frame survey data, there are 3,500 fishers of which 580 are foot fishers; the rest used different types of vessels. Of the 619 vessels recorded, 253 used sail for propulsion, 285 paddles 81 use engines. Kilwa has 2,649 seaweed farmers, the highest number of all coastal districts (URT, 2010). Seaweed farming is however on the decrease since 2007 due to a problem of seaweed die-off (source: www.lindi.go.tz/kilwa.html).

The inshore waters off Kilwa District, especially northwards into Songo Songo Archipelago are relatively shallow and calm, protected by a line of islands and reefs to the east that create ideal conditions for the fishery for small pelagic fish species (sardines and anchovies). This fishery is the target of many of the 69 ring-nets, mostly operated by 81 motorised vessels noted above (URT 2010). These are a significant component of Kilwa District catches, though data are not available.

Tourism

Tourism is not a major contributor to the economy of Kilwa at present, partly due to difficult and expensive access from Dar es Salaam. When the Kilwa Road construction is finally completed tourism is likely to increase, as the potential is high. The area harbors the most historical monuments of pre-colonial Tanganyika, impressive ruins, regarded as the most spectacular on the East African coast, which are now gazetted under World Heritage Site status. The focal point is Kilwa Kisiwani, where in the 12th wealth Dynasty was built. Near to Kilwa Kisiwani are other historic sites such as Mtitimira, Songo Mnara, Sanje ya Kati and Sanje Majoma. Clear marine waters to the south, with good coral cover and good fishing are features of the coast, with mangrove inlets and islands and hunting in the interior gamer reserves.

Minerals

The mining activities undertaken in Kilwa district include excavation of sand, gravel stone or boulders, aggregates and limestone, mainly from coastal riverbed sources. There are 417 ha of salt works in the district, all located inshore of mangrove creeks.

Oil and gas exploration has been significant in Kilwa, with more successful wells drilled to date than in any other district. Presently there are six wells in production of natural gas around Songo Songo Island (Pan African Energy), plus at least one other yet to produce (Ndovu Resources). Additional gas discoveries have been made at Muyuni Island and unsuccessful drilling has taken place inland

by Dominion Tanzania Limited. The Songo Songo reservoir is producing gas that is processed on the island and piped to Dar es Salaam.

Increased exploration and development are planned for Songo Songo gas processing plant (PanAfrican Energy, Orca) to increase production, probably with more drilling. Another operator (Ophir East Africa Ventures Limited) may explore within the nearshore areas south of Kilwa in deep water. Other operators (e.g. Ndovu Resources, Aminex) may explore further.

Description of the coast

Physical

Kilwa district is located in Lindi Region in south of Tanzania. To the north it borders with Rufiji District (Coast Region) and to the south Lindi Rural and southwest Ruangwa districts, with Liwale district to the west. The coastal plains are 20-30 km wide, rising to hilly inland areas 150-500 m in elevation, mainly covered in miombo woodland.

Several small rivers, plus numerous seasonal streams penetrate Kilwa district, with the largest river being the Matandu (or Gingwera) that begins on the western side of neighbouring Liwale District, almost 200 km to the west. A river of similar length separates the district from Lindi Rural, the Bwemburu River, also beginning in the southwest, in Nachingwea District.

The shore is a mixture of sandstone with limestone rocky outcrops, some as headlands, with others extending several kilometres along the southern coast, from Songo Mnara to Msungu Bay. Numerous small islands are present along the Kilwa coast, with four in the Songo Songo Archipelago (Okuza, Nyuni, Fanjove and Songo Songo), plus several large islands south of Kilwa Masoko (Kilwa Kisiwani, Songho Mnara, Songo ya Kati. Sediments types vary greatly, from clay bound sands in the north to unconsolidated limestone and biogenic origin of recent times. Similarly, beach sands vary from silicilastic in river-dominated areas to the north, carbonate sand around islands and the southern shores, far from river influences**.**

Coastal ecology

The coastline and inshore waters of Kilwa District support coral reefs, intertidal rocky and sand expanses, some with seagrass beds that extend into the subtidal areas, and extensive mangrove forests.

Coral reefs – From the south, coral reef systems begin in the southern border of Kilwa to Lindi and extending northward to Tikwiri. There are several gaps in between, such as within the Kiswere embayment, Ras Ngumbe Sukani, Sunganungu and Kilwa Masoko pass, and the embayment which extends from Songo Mnara to Kilwa Masoko. North of Kilwa, the coast is characterised by an extensive archipelago of small islets and sand banks (including Songo Songo). Most of these islets and sand dunes lie in shallow water with sandy bottom, surrounded with coral reefs. There are fringing coral reef on the reef patches and outer islands in the Songo Songo Archipelago, and on the south coast.

Mangroves – Total area covered with mangrove in Kilwa district is 21,771 ha distributed over four main clusters. The southern one lies within the Kiswere embayment (Kiswere Harbour, Ruhaha and Mamba). The Songa Mnara – Kilwa Masoko and the embayment within is characterised with vast area with a number of mangrove islets as well as main coast mangrove forest. Ras Tikwiri to Gigwera River forms a thin strip of mangrove on the south and dense mangrove forest on the north, Gigwera area. The northern mangrove starts just south of Ras Wango and extends northward to south of Somanga Funga in a thin belt.

Beach and rock shorelines – The shoreline backing fringing reefs, extending for most of the district's southern coast, is fossil limestone coral. Small beaches are present in sheltered southern areas. Rocky limestone headlands include Ras Nudumba, Ras Wango, Ras Tikwiri, Ras Matudo and 30 km of raised limestone cliffs extending to the border with Lindi Rural, at Mzungu Bay (estuary of the River Mbewmburu). Most of northern coast is characterised of long sandy beaches especially west of Kilwa Archipelago, the areas extends from Tikwiri northwards.

Coastal waters

The inshore waters of Kilwa vary greatly in their turbidity, with the northern portion predominantly turbid from suspended sediment and freshwater associated with discharges from the Rufiji and Mohoro rivers, while the southern portion is exposed to open water, with very little river inputs. The peak outflow from the rivers occurs from December to May, yet some of the larger rivers that flow all year continue to discharge sediment-laden waters for most of the year, such as the Bwemburu River, into Msungu Bay. Offshore the outer reefs and islands (Muyuni and Fanjove) of the Songo Songo Archipelago, coastal waters are oceanic in quality. The wide expanses of intertidal sand and mud flats off Kilwa Masoko and Rushungi, for instance, provide important bird feeding areas during low tide, and important fish and shellfish breeding and feeding grounds.

Marine species of importance

Coelacanth (*Latimera chalumnae*) - Listed as Critically Endangered, the first recorded for Tanzania was caught in 2003 off Songa Mnara, Kilwa Masoko in a shark net (Nyandwi, 2006).

Turtles – Green turtle nesting takes place in some sandy beaches within the district, though generally in small numbers due to heavy disturbance of the shoreline from development.

Cetaceans - Bottlenose dolphins are regularly reported within short distances of the coastline and humpback whales are seen during June to November.

Shorebirds – Kilwa coast and the islands receive large numbers of Palaearctic wading birds (crab plovers, roseate terns, saunders terns and numerous migrants from the northern winter).

Natural resources

Natural forest in Kilwa covers 1,342 km^2, about 10 % of the total Kilwa District land area, plus 8,156 km^2 of woodland (about 60 %), with 1,890 km^2 of bush land (about 14 %) and grassland 864 km^2 (about 6 %), resulting in a district with almost 90 % natural vegetation cover, though subjected to varying levels of use and degradation.

There are 11 forest reserves in Kilwa, include: Pindiro FR (117.8), Ngarama south Reserve (20.7), Ngarama North FR (396.3), Mitundumbea FR (85.5), Kitope FR (33.7), Mitarure FR (604.8), Tongomba FR (19.98), Pungo (225.8), Malehi FR (388.5), Mbinga FR (18.6), Mangrove FR (154.1) and proposed Mbarawala LAFR 14. About 14.7 % of the total Kilwa district area (2,056.7 km^2) is forest reserves and out of this 15,410 ha are mangrove forest reserves. The reserves consist primarily of miombo woodland, endowed with log gable tree species.

Songo Songo Archipelago (four islands and 25 main patch reefs) are a large part of the Mafia-Rufiji-Kilwa Ramsar Site, was in late 2004 formally gazetted under the Ramsar Convention (See Project and Plans, below).

Settlements

The settlement and built-up portion of Kilwa is very small and concentrated in Kilwa Masoko town and Kilwa Kivinje. Several large villages occur along the Dar es Salaam to Kilwa road (B2), as well as those on the coast, such as Somaga, Mitega, Kizimbani and Mitole, and those on the main islands

(Songo Songo and Kilwa Kisiwani). The western portion of Kilwa has much lower densities of inhabitants and the land use gives way to more agricultural land with smaller settlements and eventually open woodland, largely un-disturbed.

Infrastructure

There is one airstrip in Kilwa Masoko, unpaved, where small aircrafts of up to 19-seaters can land. Kilwa Masoko harbour can accommodate one big vessel at a time. There are two jetties at Songo Songo Island, one dedicated to the villagers use and the other for gas refinery uses. The main road which connects Kilwa with Lindi to the south is in the last phase of construction and the northern part which connects Kilwa to Dar es Salaam is to be completed in a near future. There are a number of municipality roads some of which are all weather and numerous are impassable during rainy season.

The Songo Songo Gas to Electricity Project now exports natural gas from the gas plant in the northwest of Songo Songo Island, to Dar es Salaam across 22 km of shallow sea in the Archipelago to Somanga and then passes through the northern corner of Kilwa district across Rufiji District and north to the Ubungo Power Station (Ilala district). A feeder gas pipe now extends to the smaller power station close to Kilwa, providing power to the entire area. The Mtwara to Dar es Salaam gas pipeline is under construction and will pass through the entire district, south to north, with expected completion in late 2014.

From south of Kilwa Kivinje, to the border with Lindi, a number of rocky intertidal causeways traverse the lagoon from the upper shore to the reef crest. The origin of these causeways has been studied and they are thought to have been constructed between the 13th and 16th centuries (Pollard, 2011). They continue to be used by local fishers and shellfish collectors on foot.

Major Threats

Table 41: Overview of threats to coastal communities in Kilwa district.

Threat	Location	Cause
Beach pollution	Kilwa Kivinje	Uncontrolled solid and liquid waste disposal, often in creeks.
Beach erosion	Mtoni, Rushungi, Kilwa Kisiwani World Heritage monuments. Kunduchi area, Ununio and Mbweni	Mangrove cutting, dynamite fishing, beach sand mining, unplanned construction along the coast.
Fisheries decline	All along the Kilwa coast including Kiswere Harbour, Ruhaha, Mamba, Songo Mnara, Kilwa Masoko, Tikwoiri, Gigwera, Ras Wango, Songo Songo archipelago	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods as well as coral mining for lime production
Marine pollution	Songo Songo, Kilwa Masoko and Kilwa Kivinje	Potential oil spills from Songo Songo gas processing plant (plant discharges and fuel transfers), Kilwa Masoko and Kilwa Kisiwani Harbour fuel transfers, agrochemicals from upstream agriculture.

CRIAM Ranking of Threats to Local Communities in Kilwa District

Table 42: Prioritisation of threats to local communities in Kilwa District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	All along the Kilwa coast including Kiswere Harbour, Ruhaha, Mamba, Songo Mnara, Kilwa Masoko, Tikwoiri, Gigwera, Ras Wango, Songo Songo archipelago	3	3	3	2	2	63	4					
Beach pollution	Kilwa Kivinje	1	2	3	2	2	14	2					
Beach erosion	Masoko, Rushungi, Kilwa Kisiwani World Heritage monuments.	2	1	3	2	2	14	2					
Marine pollution	Songo Songo, Kilwa Masoko and Kilwa Kivinje	2	1	3	2	2	14	2					

Major Opportunities

Opportunities available for coastal communities:

- Offshore fisheries
- Post harvest improvement to fish landings
- Aquaculture – the area has high potential for mariculture
- Tourism – natural and historical high potential for eco and cultural tourism
- Beekeeping
- Oil and gas industry expansion of activities and infrastructure

Climate Change Impacts

Table 43: Estimated area losses of sea level rise scenarios on overall area and on land uses in Kilwa district.

Kilwa	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation	959	0.07	1,173	0.09	1,431	0.10	2,147	0.16	3,112	0.23	50,783	3.72

No significant impacts from sea level rise are felt over the general land area, even with a rise level of 10 m, inundating just under 4 % of the district. However, storm surge of that equivalent rise, especially one that coincides with spring high tides is likely to have damaging impacts inland, along

much of the length of the small creeks with potential seawater penetration into agricultural land and shallow wells.

Projects and Plans

Gas and oil exploration – Increased exploration and development are planned for Songo Songo gas processing plant (PanAfrican Energy, Orca) to increase production, probably with more drilling. Another operator (Ophir East Africa Ventures Limited) may explore within the nearshore areas south of Kilwa. Other operators (e.g. Ndovu Resources, Aminex) may explore further.

Kilwa World Heritage Site - stone ruins of the Kilwa settlement remain, most of which are included in the UNESCO World Heritage Site (WHS) gazetted in 1981.

Mafia-Rufiji-Kilwa Ramsar Site - Rufiji Delta form a large part of the Mafia-Rufiji-Kilwa Ramsar Site, was in late 2004 formally gazetted under the Ramsar Convention as an 'Area of Wetlands of Global Importance', and referred to as the Rufiji-Mafia-Kilwa Marine Ramsar Site.

Eco-Region Globally Important site – The Rufiji Delta and neighbouring Mafia Island and Songo Songo Archipelago (Kilwa District) was identified during a WWF process (2004) as having globally important biodiversity richness within the Eastern African Marine Ecoregion, and was the focus of the WWF Rufiji-Mafia-Kilwa Seascape Programme (or RUMAKI), that ended in 2010.

Kilwa Cement – A Chinese investment plans to construct a USD 12.5 million cement plant in Lindi to utilise local limestone to produce cement. The Chinese firm Lee Building Materials plans construction of the plant, with a capacity of 300,000 metric tonnes per annum and is also expected to rejuvenate the dormant Kilwa port in Lindi Region.

14. Lindi Rural District

Lindi Rural District is in the Lindi Region. It has a land area of around 6,483 km^2 and a coastline of 246 km.

Climate Profile

Temperature

The climate of Lindi Rural district is hot and humid on the coastal plains, cooler to the west due to the presence of hills. The coast experiences average monthly temperatures, based on that of Lindi town, of 23.0 ˚C in the coolest month is July and 27.0 ˚C during the hottest month of December. The Relative humidity, based on data from nearby Lindi, ranges from 87 % in March to 79 % in October (source: www.lindi.go.tz/kilwa.html).

Precipitation

The average annual rainfall for Lindi Rural, based on the Lindi Airport weather station, is 890 mm (ranging from 489 mm to 1,699 mm), over the period 1971 to 2011 (though there are monthly data gaps for some years). The monthly rainfall peaks are March to April (main wet season) with over 370 mm of rain during those two months, and December to February (short rains) with over 410 mm of rain during those three months. Overall annual rainfall follows a clear uni-modal pattern, with a five-month main wet season of scattered rains from December to April, usually with a significant monthly peak during one of the months from February to April.

Winds

Based on 26 years of data (1987 to 2012) from the nearby Mtwara Airport weather station, in the morning (9 am) winds are generally light to moderate (7-14 knots), with strongest morning mean wind speeds during the months of May to July. Stronger wind speeds (9-14 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (13-14 knots) during the months of July to February and calmest during March and April (10 and 9 knots, respectively).

Maximum coastal wind speeds, from 1972 to 1996, in a study by Dubi (2001), recorded the mode, in nearby Mtwara of 30 knots, with peak speeds in July. Lindi, like neighbouring Mtwara is considered an area of coastline that is more influenced by offshore winds rather than from coastal winds. Over the studied period, the maximum wind speed has followed a linear increase, reaching a peak of 35 knots (Dubi, 2001). The possibility of cyclones or strong winds exists, especially for the months of January to March during the main cyclone season off Madagascar and Comoros. These features are relevant to the coast of Lindi.

Population

Population size: 194,143 with 102,496 females and 91,647 males. The district has experienced a low average annual growth rate between 2002 and 2012 of -1.01 % leading to - 8.82 % decrease of the population over the ten-year period, and documenting out-migration. The population density in the district was reduced to 31 persons/km^2 in 2012 from 34 persons/km^2 in 2002.

Based on 2002 census data, the percentage of the population living below the poverty line was 51 %, the over 15 years of age literacy coverage was 53 % and under five years of age mortality was 220 per 1,000 live births.

Economy

Main economic activity of the district is agriculture. Other economic activities include fisheries, bee keeping and informal trade.

Agriculture

Agriculture covers 1,460 km² (23 %) of Lindi Rural (including Lindi Urban) and the main cash crops are cashew nuts, sesame, and coconut while major food crops include maize, sorghum, rice and cassava.

Fisheries

Lindi Rural district has 14 fish landing sites, all of which are permanent; with eight BMUs and three FMPs (MLFD 2010). According to the 2009 frame survey data, there are 1,376 artisanal fishers of which 511 are foot fishers; the rest used different types of vessels. Of the 286 vessels used by the boat fishers, 110 used sail for propulsion, 169 use paddles and only seven vessels use engines. The generally clear water condition of Lindi's coastal waters promotes seaweed farming, supporting 1,001 seaweed farmers (URT, 2010).

Tourism

Tourism does not contribute significantly to the local economy; however the tourism potential is high since the area harbors some tourist attractions such as the Mpingo area at Tendaguru, the home of dinosaur fossils (Maier, 2003). Lindi rural has a number of sandy beaches as well as rich biodiversity in marine and coastal forest ecosystems.

Minerals

The mining activities undertaken in Lindi Rural district include excavation of sand, gravel stone or boulders, aggregates and limestone, mainly from coastal riverbed sources. In some places marble excavations and few gem stone mining. Salt works in the district are all located inshore of the mangrove creeks, particularly those close to Lindi town.

Description of the coast

Physical

To the north Lindi Rural borders with Kilwa District and to the south Mtwara region, with Ruangwa District to the west. The coastal plains are 20-30 km wide, rising to a hilly inland area 500-1,000 m in elevation, within a short distance from the coast, mostly covered in miombo woodland.

Several small rivers, plus numerous seasonal streams penetrate Kilwa district, with the largest river being the Bwemburu River, beginning in the southwest, in Nachingwea District, almost 200 km inland. Others are the Namguru River, discharging at Mkinga Bay, and the Nguru Mahamba River that empties into the Lukuledi River then into Lindi Harbour.

The shore is characterised by predominantly limestone outcrops, broken by inlets at Rushingi, Mchinga, Lindi Harbour, Sudi Bay at the southern border with Mtwara Rural District. Sediment types are predominantly unconsolidated limestone and biogenic origin of recent times, with clay-bound and silicaseous portions close to the bays and rivers. Similarly, beach sands vary from silicilastic in river-dominated areas, to carbonate sands far from river influences.

The coastline and inshore waters of Lindi Rural District support coral reefs, intertidal rocky and sand expanses, some with seagrass beds that extend into the subtidal areas, and some mangrove forests.

Coral reefs – Lindi Rural District is characterised by long sections of fringing reef, interrupted at river mouths/bays such as Lukuledi River mouth within Lindi Bay, Sudi Bay, Nondo, etc. Lindi has a narrow continental sheath and no formation of patch reefs. There is little knowledge on coral diversity in this area.

Mangroves – Lindi Rural district has about 3,000 ha of mangrove forest in small patches in lagoons off the northern shores, in the sheltered bays at Mchinga, and in small creeks close to Sudi in the south. The largest single patch is the so Lukuledi River estuary prior to entry into Lindi Urban District.

Beach and rock shorelines - The shore of Lindi Rural is a predominantly limestone outcrop, interrupted by inlets at Rushingi, Mchinga, Lindi Harbour and Sudi Bay where sand beaches are found. The shoreline backing fringing reefs, extending for most of the coast of the district and is largely of fossil limestone coral. Small to large and wider sandy beaches are present in sheltered areas, some of which form a spectacular pan aroma.

Coastal waters

The inshore waters of Lindi Rural are mainly exposed to open water, with very little river inputs, consequently they are clear and oceanic. However, during peak outflow from the Lindi rivers, between December and May, there can be discharges of sediment-laden waters, in some cases for most of the year, such as the Bwemburu River, into Msungu Bay. The wide expanses of intertidal coralline sand and mud flats adjacent to the mangrove creeks are important breeding and nursery areas for fish and shellfish.

Marine species of importance

Coelacanth (*Latimore chalumnae*) - The Lindi coast area is identified as a potential Coelacanth habitat (see Green et al., 2009).

Turtles – The whole coastal belt of Lindi Region is greatly marked as important breeding sites for sea turtles. In Lindi Rural district turtles nest in beaches such as bays of Rushungi, Mchinga, Kyela, Shuka, Sudi and many other places. All the four species of sea turtles found in Tanzania are present in Lindi region.

Cetaceans - Bottlenose dolphins are regularly reported within short distances of the coastline and humpback whales are seen during June to November.

Natural resources

Natural forest comprises 308 km^2 (about 5%) and includes Lindi Urban, with woodland covers 1,800 km^2 (about 28 %) of the combined Lindi Rurual and Urban districts. Bush land covers 2,583 km^2 (about 40 % of both districts combined), and grassland covers 475 km^2 (about 7 %) of both districts combined. There are eight forest reserves in the district, which cover an area of approximately 375 km^2.

Settlements

The settlement and built-up portion of Lindi Rural (and Lindi Urban) comprises 14 km^2, equivalent to about 0.2 % of both districts combined. The major settlement is Lindi town, though several medium sized villages occur along the Kilwa to Mtwara trunk road (B2), such as Kitomagi and Mchinga, as well as a few scattered villages inland and away from the main trunk road. The western portion of Lindi Rural has very low densities of inhabitants and the land use gives way to more agricultural land with smaller settlements and eventually open woodland, largely un-disturbed.

Infrastructure

Lindi Rural has one airstrip good for light aircrafts, 193 km of national roads of which only 103 km are with tarmac and remaining 90 km are gravel road. Other roads are regional, municipal and village roads same of which are difficult to navigate during rainy seasons. All major mobile phone networks are operating in the district. The Mtwara to Dar es Salaam gas pipeline is under construction and will pass through the entire district, south to north, with expected completion in late 2014.

Major Threats

Table 44: Overview of threats to coastal communities in Lindi Rural district.

Threat	Location	Cause
Beach pollution	Mchinga	Uncontrolled solid waste disposal, lack of latrines in some coastal houses, lack of proper fish landing facilities
Beach erosion	Sudi, Shuka, Mmumbu, Kikwetu, Mbanja, Mchinga na Kijiweni	Mangrove cutting, dynamite fishing, beach sand mining, unplanned construction along the coast.
Fisheries decline	All along the nearshore Lindi	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods as well as coral mining for lime production, poisonous fishing
Sea pollution	River mouths	Influx of agrochemicals from upstream, poisonous fishing
Water source drying	River valley wells throughout	Forest clearing for agricultural purposes, burning charcoal, shifting cultivation
Loss of habitat	Forested areas	Forest clearing for agricultural purposes, burning charcoal, shifting cultivation, mangrove cutting, dynamite fishing and other poor fishing methods

CRIAM Ranking of Threats to Local Communities in Lindi Rural District

Table 45: Prioritisation of threats to local communities in Lindi Rural District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	All along the nearshore Lindi	3	3	3	2	2	63	4					
Water source drying	River valley wells throughout	2	3	3	2	2	42	4					
Loss of habitat	Forested areas	2	2	3	2	1	24	3					
Beach erosion	Sudi, Shuka, Mmumbu, Kikwetu, Mbanja, Mchinga na Kijiweni	2	1	3	2	2	14	2					
Beach pollution	Mchinga	1	1	3	2	2	7	1					
Sea pollution	River mouths	1	1	2	2	2	6	1					

Major Opportunities

Opportunities available for coastal communities:

- Offshore fisheries
- Aquaculture
- Tourism. According to official Lindi government website, there are a number of incentives to attract tourism. These include:
    - Home of dinosaurs, Tangaguru village
    - Attractive sandy beaches in the village such as Sudi, Shuka, Mmumbu, Kikwetu, Mbanja, Mchinga and Kijiweni. Some of which beach land plots are already demarcated for tourism development
    - Rich marine as well as forest biodiversity
    - Attractive valleys/plains obtained in Rondo, Nyangamana, Mipingi, Mtamba, Nanguru, Mingoyo, Sudi, Ngapa and Milola
    - Cultural tourism especially traditional dances and "Jando na Unyago"
- Livestock rearing – Lindi Rural district chosen as destination of livestock from uplands (SHILDA 2012)
- Eco-friendly forest use, such as beekeeping (Lalika and Machangu 2008)
- Irrigation agriculture

Climate Change Impacts

Table 46: Estimated area losses of sea level rise scenarios on overall area and on land uses in Lindi Rural district (combined with Lindi Urban District).

Lindi Rural and Urban	Total (km^2)	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
		ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation		111	0.02	268	0.04	425	0.07	659	0.10	1,148	0.18	11,880	1.88
Built-up area	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.06	69.92	4.84

Significant impacts from sea level rise are felt over the general land area for rise levels only above 10 m, since much of the district is sufficiently raised to avoid inundation. However, considering that most of the infrastructure is around Lindi town, a 10 m rise equivalent storm surge (inundating about 5 % of built-up areas), especially when coinciding with spring high tides are likely to have more significant impact on infrastructure as well as further inland, along much of the length of the creeks with potential seawater penetration into agricultural land and shallow wells.

15. Lindi Urban District

Lindi Urban District is in the Lindi Region. It has a land area of around 239 km² and a coastline of 68 km.

Climate Profile

Temperature

The climate of Lindi Urban is hot and humid, with an average monthly temperature, of 23.0 ˚C in the coolest month of July and 27.0 ˚C during the hottest month of December. To the west the land rises to low hills where the climate is cooler. Relative humidity, based on data from nearby Lindi, ranges from 87% in March to 79 % in October (source: www.lindi.go.tz/kilwa.html).

Precipitation

The average annual rainfall for Lindi Urban, based on the Lindi Airport weather station, is 890 mm (ranging from 489 mm to 1,699 mm), over the period 1971 to 2011 (though there are monthly data gaps for some years). The monthly rainfall peaks are March to April (main wet season) with over 370 mm of rain during those two months, and December to February (short rains) with over 410 mm of rain during those three months. Overall annual rainfall follows a clear uni-modal pattern, with a five month main wet season of scattered rains from December to April, usually with a significant monthly peak during one of the months from February to April.

Winds

Based on 26 years of data (1987 to 2012) from the nearby Mtwara Airport weather station, in the morning (9 am) winds are generally light to moderate (7-14 knots), with strongest morning mean wind speeds during the months of May to July. Stronger wind speeds (9-14 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (13-14 knots) during the months of July to February and calmest during March and April (10 and 9 knots, respectively).

In the Dubi (2001) study of maximum coastal wind speeds, from 1972 to 1996, the mode of the highest wind speeds reached in Mtwara was 30 knots, with peak speeds in July. Mtwara is considered an area of coastline that is more influenced by offshore winds rather than from coastal winds. Over the studied period, the maximum wind speed has followed a linear increase, reaching a peak of 35 knots (Dubi, 2001). The possibility of cyclones or strong winds exists, especially for the months of January to March during the main cyclone season off Madagascar and Comoros. These features are also applicable to the Lindi coastline.

Population

Population size: 78,841 with 41,316 females and 37,525 males. The district has experienced a high average annual growth rate between 2002 and 2012 of 6.57 % leading to more than 92.6 % increase of the population over the ten-year period, and documenting a high level of net in-migration. In 2012 the population density in the district was 314 persons/km² almost double the 163 persons/km² of 2002.

Based on 2002 census data, the percentage of the population living below the poverty line was 18 %, the over 15 years of age literacy coverage was 71 % and under five years of age mortality was 159 (per 1,000 live births).

Economy

Agriculture continues to be the main economic activity of the district. Some percentage of the population engages in fisheries, wholesale and in retail trade.

Agriculture

Agriculture is the main economic activity in which a large part of population participates. About 50 % of Lindi Urban population are cultivators. In Lindi Urban, agriculture activities are conducted in the following villages: Kineng'ene, Mitwero, Tulieni and Kitumbikwela. Main food crops are cassava, maize and sorghum while main cash crops are cashew nuts, sesame, and coconut. Livestock keeping is an option but so far contribute very little in the district economy.

Fisheries

Lindi Urban district has six landing sites of which all are permanent and 13 BMUs with three FMPs but no fisheries bylaws (MLFD, 2010). According to the 2009 frame survey data, there are 396 artisanal fishers of which 20 are foot fishers; the rest used different types of vessels. Of the 142 vessels used, 48 used sail for propulsion, 83 used paddles and only 11 vessels use engines. The generally clear water condition of Lindi Urban's coastal waters supports seaweed farming, with 971 seaweed farmers reported (URT, 2010).

Tourism

Tourism is not a big industry in this area however there is potential for tourism.

Minerals

Mining activities undertaken in Lindi Urban district include excavation of sand, gravel stone or boulders, aggregates and limestone. Salt works in the district are all located close to Lindi town.

Description of the coast

Physical

Except for the southwest part all Lindi-Urban district is surrounded with Lindi Rural District, with a few small streams and the main Lukeledi River discharging into Lindi Bay. The shore is a mixture of sandstone or limestone outcrops and soft substratum extending to the subtidal. Sediment types vary greatly, from clay bound sands and gravel to a more unconsolidated suite of recent times. Beach sands are mostly from silicilastic river-dominated influences**.**

Coastal ecology

The coastline and inshore waters of Lindi Urban District supports some small sections of coral reefs, long and wide sand beaches, some with seagrass beds that extend into the subtidal areas, and a few mangroves along the main estuary.

Coral reefs – Lindi Urban District is characterised by fringing reef which lies on the short span around the north-east end where the district bordered with Lindi Rural District. No formation of patch reefs. There is little knowledge on coral diversity in this area.

Mangroves – Lindi Urban district has about 1,000 ha of mangrove forest mainly around the Lukuledi River creek on the southern border.

Beach and rock shorelines – The shore of Lindi Urban is predominantly sandstone and geology of similar age, with interspersed fossil limestone outcrops. Small sandy beaches are present in sheltered areas of the Lindi Bay.

Coastal waters

The inshore waters of Lindi Urban, that comprise Lindi Bay, are mainly exposed to open water mixed with the discharges of Lukuledi River, which between December and May, can be significant and affect levels of suspended matter. The wide expanses of sand and mud flats adjacent to the mangrove creeks are important breeding and nursery areas for fish and shellfish.

Marine species of importance

Coelecanth (*Latimera chalumnae*) - The Lindi coast area is identified as a potential Coelecanth habitat (see Green et al., 2009).

Cetaceans - Bottlenose dolphins are regularly reported within short distances of the coastline and humpback whales are seen during June to November, all of which may enter Lindi Bay at times.

Natural resources

There are no protected forests in Lindi Rural.

Settlements

The settlement and built-up portion of Lindi Urban (and Lindi Rural) comprises 14 km^2, equivalent to about 0.2 % of both districts combined. The major settlement is Lindi town, though several medium sized villages occur along the Kilwa to Mtwara trunk road (B2), such as Kitomagi and Mchinga, as well as a few scattered villages inland and away from the main trunk road. The western portion of Lindi Rural has very low densities of inhabitants and the land use gives way to more agricultural land with smaller settlements and eventually open woodland, largely un-disturbed.

Infrastructure

Lindi Urban depends on Lindi Rural District for the airstrip, which is good for light aircrafts. The district is traversed with few kilometres of national and regional road, as well as village roads. Lindi Harbour is small yet considered an important infrastructure element that connects Lindi with both south and north of the country by sea.

Major Threats

Table 47: Overview of threats to coastal communities in Lindi Urban district.

Threat	Location	Cause
Beach pollution	Lindi Mjini	Uncontrolled solid and liquid waste disposal, lack of latrines in public areas (e.g. landing sites) and residential houses
Beach erosion	Many spots along the district beach stretch	Mangrove cutting, dynamite fishing, beach sand mining, coral mining
Fisheries decline	All along the near shore waters	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing, poisonous fishing, beach seining and other poor fishing methods as well as coral mining for lime production
Diseases outbreaks	Urban centre and settlements	Inadequate sewerage control, flooding, poor quality of sewerage construction, poor solid waste management, uncontrolled food vending, lack of toilets in public areas
Loss of habitat and agricultural area		Rapid urbanization, high increase of people immigration in the city, shifting cultivation
Bush fires	Sub-urban wards	Agricultural use of fire to clear land

CRIAM Ranking of Threats to Local Communities in Lindi Urban District

Table 48: Prioritisation of threats to local communities in Lindi Urban District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	All along nearshore	3	3	3	2	2	63	4					
Bush fires	Sub-urban wards	2	2	2	2	1	20	3					
Beach pollution	Lindi Town	1	2	3	2	2	14	2					
Beach erosion	Many spots on beaches	2	1	3	2	2	14	2					
Diseases outbreaks	Urban centre/settlements	1	1	2	2	3	7	1					
Loss of habitat and agricultural area	Lindi Town	1	1	3	2	2	7	1					

Major Opportunities

Opportunities available for coastal communities:

- Offshore fisheries and aquaculture
- Tourism. Lindi Urban benefits from almost all tourism opportunities in Lindi Rural, e.g.:
  - Home of dinosaurs, Tangaguru village
  - Attractive sandy beaches at the Lindi Bay
  - Rich marine as well as forest biodiversity
  - Attractive valleys/plains obtained in Rondo, Nyangamana, Mipingi, Mtamba, Nanguru, Mingoyo, Sudi, Ngapa and Milola
  - Cultural tourism especially traditional dances and "Jando na Unyago"
- Eco-friendly forest use such as beekeeping (Lalika and Machangu, 2008)
- Small scale horticulture and irrigation agriculture

Climate Change Impacts

Table 49: Estimated area losses of sea level rise scenarios on overall area and on land uses in Lindi Urban (and Lindi Rural) district combined.

Lindi Rural and Urban	Total (km^2)	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
		ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation		111	0.02	268	0.04	425	0.07	659	0.10	1,148	0.18	11,880	1.88
Built-up area	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.06	69.92	4.84

Significant impacts from sea level rise are felt over the general land area for rise levels only above 10 m, since much of the district is sufficiently raised to avoid inundation. However, considering that most of the infrastructure is around Lindi town, a 10 m rise equivalent storm surge (inundating about 5 % of built-up areas), especially when coinciding with spring high tides is likely to have more significant impact on infrastructure as well as further inland, along much of the length of the creeks with potential seawater penetration into agricultural land and shallow wells.

16. Mtwara Rural District

Mtwara Rural District is in the Mtwara Region. It has a land area of around 3,745 km^2 and a coastline length of 282 km.

Climate Profile

Temperature

The climate ranges from hot and humid in the wide coastal plains of Mtwara, to cooler in the hills to the west. Average monthly temperature data, from nearby Mtwara Airport weather station, from 1987 to 2012, reveals ranges from a low of around 18.5 ˚C during the coolest months of July to September when maximum temperatures are under 31.0 ˚C; to the highest monthly means of 31.9 ˚C to 32.5 ˚C during the hot season from December to April, when the temperatures drop to only 22.5 ˚C to 23.3 ˚C during that period. Relative humidity in Mtwara ranges from 69-72 % from June to October, increasing to 79 % by February and over 82 % during the wettest month of April.

Precipitation

The average annual rainfall for Mtwara Rural, based on Mtwara Airport weather, is 1,044 mm (ranging from 515 mm to 1,589 mm), over the period 1987 to 2012. There is only one monthly rainfall peak, from December to April (the main wet season) with over 851 mm of rain during those five months. A uni-modal rainfall pattern is clear, with a five-month main wet season of scattered rains from December to April, usually with a significant monthly peak during March or April.

Winds

Based on 26 years of data (1987 to 2012) from the Mtwara Airport weather station, in the morning (9 am) winds are generally light to moderate (7-14 knots), with strongest morning mean wind speeds during the months of May to July. Stronger wind speeds (9-14 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (13-14 knots) during the months of July to February and calmest during March and April (10 and 9 knots, respectively).

In a study by Dubi (2001) of maximum coastal wind speeds, from 1972 to 1996, the mode of the highest wind speeds reached in Mtwara was 30 knots, with peak speeds in July. Mtwara is considered an area of coastline that is more influenced by offshore winds rather than from coastal winds. Over the studied period, the maximum wind speed has followed a linear increase, reaching a peak of 35 knots (Dubi, 2001). The possibility of cyclones or strong winds exists, especially for the months of January to March during the main cyclone season off Madagascar and Comoros.

Population

Population size is 228,003 with 120,081 females and 107,928 males. The district has experienced an annual growth rate between 2002 and 2012 of 1.11 % leading to a 11.7 % increase of the population over the ten-year period, and documenting a low level of net in-migration. The population density in the district has grown to 57 persons/km^2 in 2012 from that 51 persons/km^2 of 2002.

Based on 2002 census data, the percentage of the population living below the poverty line was 37 %, the over 15 years of age literacy coverage was 46 % and under five years of age mortality was 231 per 1,000 live births.

Economy

The economy of Mtwara District is highly dependent on agriculture, with fisheries contributing especially to coastal communities. Livestock has a small contribution to the economy.

Agriculture

Agriculture occupies 1,898 km^2 (32 %) of combined Mtwara Rural and Mtwara Urban districts. The main food crops are cassava (20,102 ha), maize (4,929), paddy (5,906), and sorghum (3,643). Potential available arable land is 114,959 ha of which 77 % has been utilized (NSCA, 2012). About 97,915 of households engage in agriculture. Cashew nut (1,492 ha) is the most important cash crop followed by groundnuts (1,569 ha). Coconut (235 ha) is important along the coastal belt.

Only 16 % of households in the district engage in livestock keeping, that includes goats (41,822), sheep (2,482) and chicken (202,532) but very few cattle.

Fisheries

Mtwara Rural has 23 fish landing sites of which 15 are permanent. There are nine BMUs and six FMPs with three fisheries bylaws (MLFD, 2010). According to the 2009 frame survey data, there are 4,739 artisanal fishers (the highest number of all coastal districts) of which 2,461 are foot fishers, the rest use different types of vessels. Of the 881 vessels used, 475 used sail for propulsion, 392 used paddles and only 14 vessels use engines. Mtwara Rural's coastal waters supports seaweed farming, with 80 seaweed farmers reported (URT, 2010).

Tourism

Tourism is underdeveloped and can be significant source of employment and foreign exchange. The district tourism attractions include its closeness to two game reserves (Msanjesi and Lukwika), the Ruvuma River, a long coastline with sandy beaches and being close to the historical Mikindani old town, rich tribal cultures (Makonde, Makua and Yao) and famous carvings.

Minerals

Mining activities undertaken in Mtwara Rural District include excavation of sand, gravel stone or boulders, aggregates and limestone. There are 738 ha of salt works in the district, all located inshore of the mangrove creeks.

Gas exploration has been successful in Mtwara Rural, with significant discoveries around the Msimbati Peninsula (inside the Mnazi Bay-Ruvuma Estuary Marine Park, MBREMP), started by Artumas (Canada) in 2004 is presently conducted and expanded by Maurel & Prom (France). The gas has been piped to Mtwara town to the gas-fired power station and there are plans to export the gas further, to Dar es Salaam.

Description of the coast

Physical

Coastal features are the sand dunes at Msimbati's east coast (within MBREMP), over 15 m high, extending about 3 km along the coast. Such a formation is a rare feature along Tanzania's coastline and the dunes are the highest on the East Africa seaboard. The dunes and dune vegetation also attract specific communities of birds and insects that are unique to MBREMP (see Luke, 2004).

The coastline is fairly continuous with three main inlets, at Sudi Bay on the northern border with Lindi Rural at Mikindani Bay (leading into Mikindani Harbour and Mtwara Port and Harbour), and at Mnazi Bay. The southern border with Mozambique is the estuary of the Ruvuma River.

Coastal ecology

The coastline and inshore waters of support mangrove forests, intertidal rocky and sand expanses, with large areas of seagrass beds that extend to subtidal areas and coral reefs.

Coral reefs – To the north, a coral reef system begins off the southern end of Msimbati Peninsula, extending to Mtwara Port (Mtwara Urban District) and beyond to Sudi River mouth, the northernmost extend of the Mtwara Rural District. The fringing coral reef is interrupted by three passages Msimbati Channel, in the MBRMP, a small shallow mangrove creek south of Mtwara town, and into the Mikindani Inner Bay. The shoreline backing fringing reefs, extending for most of the district's coast, is fossil limestone coral. Small beaches are present in sheltered areas.

Mangroves – There are about 160 km^2 of mangrove forest in Mtwara Rural (including Mtwara Urban), with the bulk of the total present in the largest continuous mangrove forest in the district is located in the northern portion of the Ruvuma Estuary. Within this area, the densest stands are adjacent to the Ruvuma River, between the river's confluences with the Litokoto and Lidengo rivers. Here, the forest is comprised of mixed stands of healthy, mature trees, including *Heritiera littoralis* – a species that has suffered greatly in the Rufiji Delta forests. Mangrove forests are also present in a narrow band along many parts of the south and west shores of the district. The islands of Namponda and Membelwa have well-developed mangrove forests (URT, 2005).

Beach and rock shorelines – Rocky shores are found as pleistocene limestone cliffs at the Membelwa, Namponda, and Kisiwa Kidogo islands, and as intertidal flats on the western shores of these islands, punctuated by shallow tidal pools, and e.g. off Membelwa Island, extend about half a kilometre. Smaller patches are found around Namponda and Kiswa Kidogo.

Coastal waters

The southern boundary of Mtwara District (ca. 55 km long) is represented by the Ruvuma River - the border with Mozambique. Plumes of sediment extend offshore from the Ruvuma River mouth, especially between December and May when the chances of heavier rainfall in the catchment are greatest. The wide expanses of sand and mud flats adjacent to the mangrove creeks are important breeding and nursery areas for birds, fish and shellfish.

Marine species of importance

Coelecanth (*Latimera chalumnae*) - Listed as Critically Endangered, caught in 2007 off Msimbati Peninsula in shark-nets at depths of 250 m.

Whale shark– Reported from off Msimbati Peninsula and inside Mikindani Bay, though numbers and seasonality are not known.

Turtles – Green turtle nesting takes place in MBREMP (see Muir, 2003).

Cetaceans - Humpback whales are regularly reported within short distances of the coastline between June and November, especially at Msimbati Peninsula and inside Mikindani Bay.

Shorebirds - MBREMP is well-known for the large numbers of Palaearctic wading birds that visit during the months of November to March. A large population of crab plovers has led to the area being designated an Important Bird Area (IBA 28) (see Baker and Baker, 2002).

Natural resources

Coastal forests constitute an important fresh water catchment for the MREMP environment. These forests occur as small patches ranging from two to six hundred hectares,being remnants of the once continuous East African coastal forest that extended throughout the region. No natural forests are present (in either Mtwara Rural or Urban districts) though woodland covers 1,178 km^2 (31.5 %), bush

land 1,334 km² (35. 6 %) and grassland 89 km² (about 2 %). Over 70 % of the combined areas of the two Mtwara districts have natural vegetation, mainly woodland and bush land.

Settlements

The settlement and built-up portion of Mtwara Rural is slightly over 40 km² (both districts combined) and mostly located in Mtwara town. Other major settlements are on the Msangamku peninsula, along the Dar es Salaam trunk road running northwest, and along the road to Songea to the west, plus numerous minor villages scattered throughout the district.

Infrastructure

The district is connected to other districts in the region and other regions by a network of roads, the only tarmac being the trunk road to Lindi and Dar es Salaam (B2). There are very few tarmac roads in the district, as for the region as whole. A number of district roads connect through the region, with some only seasonal. Telecommunication is represented by a number of mobile network providers available in some areas but with poor coverage in others.

The Mtwara to Dar es Salaam gas pipeline in under construction and will pass through part of the district, from the gas field in Ruvula Peninsula (MBREMP), with expected completion in late 2014.

Major Threats

Table 50: Overview of threats to coastal communities in Mtwara Rural district.

Threat	Location	Cause
Beach pollution	All along the coastal populated areas such as Msimbati	Uncontrolled solid and liquid waste disposal, often in creeks.
Beach erosion	Lijombe, Ras Mivinjeni, Sinde Bay, Mnazi Village	Mangrove cutting, dynamite fishing, beach sand mining, unplanned construction along the coast.
Fisheries decline	All along the near shores of the district	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and beach seining and other poor fishing methods as well as coral mining for lime production
Diseases outbreaks	In many highly populated areas in the district	Inadequate liquid and solid waste product disposal and management system control, uncontrolled food vending.
Land use conflicts	All along the coast	Conflict between environmental conservation groups and resource users; conflicting interests between sectors e.g. Forestry (mangrove) and mining (salt pans), forestry (mangrove) and lands;
Habitat destruction	In many villages	Clearing of forest for agricultural use, deforestation, bush fires, coral mining, mangrove cutting, shifting cultivation, poverty, low level of education
River and estuary pollution	Ruvuma River	Mercury from gold mining upstream (TBC).

CRIAM Ranking of Threats to Local Communities in Mtwara Rural District

Table 51: Prioritisation of threats to local communities in Mtwara Rural District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	All along the near shores of the district	3	3	3	2	2	63	4					
Land use conflicts	All along the coast	3	2	3	2	1	36	4					
Habitat destruction	In many villages	2	2	3	2	1	24	3					
Beach pollution	All along the coastal populated areas such as Msimbati	2	1	3	2	2	14	2					
Beach erosion	Lijombe, Ras Mivinjeni, Sinde Bay, Mnazi Village	2	1	3	2	2	14	2					
River and estuary pollution	Ruvuma River	1	1	3	2	3	8	1					
Diseases outbreaks	In many highly populated areas in the district	1	1	2	2	3	7	1					

Major Opportunities

Opportunities available for coastal communities:

- Aquaculture – Mtwara Rural has high potential for mariculture.
- Tourism – continued high potential for ecotourism.
- Oil and gas industry

Climate Change Impacts

Table 52: Estimated area losses of sea level rise scenarios on overall area and on land uses in Mtwara Rural and Urban districts.

Mtwara Rural and Urban	Total	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
		ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation		844	0.21	1,155	0.29	1,368	0.34	1,822	0.46	2,560	0.64	36,130	9.10
Built-up area	40	0.00	0.00	1.68	0.04	3.24	0.08	4.08	0.10	8.08	0.20	97.58	2.47

Significant impacts from sea level rise are felt over the general land area for rise levels only above 10 m, since much of the Mtwara Rural and Urban districts is sufficiently raised to avoid inundation, despite about 9 % of the land area becoming inundated with such a rise. However, considering that most of the infrastructure is around Mtwara town and Mikindani town, a 10 m rise equivalent storm surge (inundating about 2.5 % of built-up areas), especially when coinciding with spring high tides

are likely to have more significant impact on infrastructure as well as further inland, along much of the length of the creeks with potential seawater penetration into agricultural land and shallow wells.

Projects and Plans

Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP) - Gazetted in 2001, with support from the French Government and the IUCN, with more specialized studies undertaken in the Park, including socio-economic studies (e.g. Malleret 2004), coral reefs (e.g. Obura, 2004), on mangrove forests of the Mnazi Bay and especially those of the Ruvuma Estuary (e.g. Wagner et al., 2004), of seagrass beds and other habitats (e.g. Richmond and Mohammed, 2005) and coastal plants (Luke, 2004). These further confirmed the uniqueness of the ecological systems in the Marine Park and their importance to the local economy and supported the designation of MBREMP (with Quirimbas Archipelago in northern Mozambique) as of Global Importance under the WWF Eastern Africa Marine Ecoregion programme.

Agriculture Research Council (ARC) - Naliendele, Mtwara - The ARC was established in 1990 through the Agricultural Research Act, 1990 (Act no. 86 of 1990). The Agricultural Research Council proved itself to be the principal agricultural research institution in South Africa. The primary mandate of the ARC is to promote agriculture and industry, to contribute to a better quality of life; and to facilitate and ensure resource conservation.

17. Mtwara Urban District

Mtwara Urban District (or Municipality) is in the Mtwara Region. It has a land area of around 193 km^2 and a coastline of 43 km.

Climate Profile

Temperature

The climate is hot and humid in the coastal plains of Mtwara. Average monthly temperature data from Mtwara Airport weather station, from 1987 to 2012, reveals ranges from a low of around 18.5 ˚C during the coolest months of July to September when maximum temperatures are under 31.0 ˚C; to the highest monthly means of 31.9 ˚C to 32.5 ˚C during the hot season from December to April. Relative humidity in Mtwara ranges from 69-72 % from June to October, increasing to 79 % by February and over 82 % during the wettest months of April.

Precipitation

The average annual rainfall for Mtwara Rural, based on the Mtwara Airport weather, is 1,044 mm (ranging from 515 mm to 1,589 mm), over the period 1987 to 2012. There is only one monthly rainfall peak, from December to April (the main wet season) with over 851 mm of rain during those five months. A uni-modal rainfall pattern is clear, with a five-month main wet season of scattered rains from December to April, usually with a significant monthly peak during March or April.

Winds

Based on 26 years of data (1987 to 2012) from the Mtwara Airport weather station, in the morning (9 am) winds are generally light to moderate (7-14 knots), with strongest morning mean wind speeds during the months of May to July. Stronger wind speeds (9-14 knots) are experienced in the afternoons (3 pm) throughout the year, with strongest mean speeds (13-14 knots) during the months of July to February and calmest during March and April (10 and 9 knots, respectively).

In a study by Dubi (2001) of maximum coastal wind speeds, from 1972 to 1996, the mode of the highest wind speeds reached in Mtwara was 30 knots, with peak speeds in July. Mtwara is considered an area of coastline that is more influenced by offshore winds rather than from coastal winds. Over the studied period, the maximum wind speed has followed a linear increase, reaching a peak of 35 knots (Dubi, 2001). The possibility of cyclones or strong winds exists, especially for the months of January to March during the main cyclone season off Madagascar and Comoros.

Population

Population size is 108,299 with 57,237 females and 51,062 males. The district has experienced an average annual growth rate between 2002 and 2012 of 1.65 % leading to around 18 % increase of the population over the ten-year period. The population density in the district has grown to 610 persons/km^2 in 2012 from 517 persons/km^2 of 2002.

Based on 2002 census data, the percentage of the population living below the poverty line was 38 %, the over 15 years of age literacy coverage was 73 % and under five years of age mortality was 146 per 1,000 live births.

Economy

As for the entire Mtwara Region, agriculture is the main economic activity in Mtwara Urban. Other activities include fisheries, wholesale and retail trading, transport, and to low extent tourism.

Agriculture

Agriculture occupies 1,898 km^2 (32 %) of the combined Mtwara Rural and Mtwara Urban districts, with the bulk in Mtwara Rural.

Fisheries

Mtwara Urban district has five landing sites, all of which are permanent and 27 BMUs with three FMPs and three fisheries bylaws (MLFD 2010). According to the 2009 frame survey data, there are 1,053 artisanal fishers of which 232 are foot fishers; the rest used different types of vessels. Of the 230 vessels used, 52 used sail for propulsion, 149 used paddles and 29 vessels use engines. Mtwara Urban's coastal waters supports seaweed farming, with 70 seaweed farmers reported (URT, 2010).

The inshore waters off Mtwara Urban, particularly Mikindani Bay, are relatively shallow and calm, protected by headlands to the north and south that create ideal conditions for the fishery for small pelagic fish species (sardines and anchovies). This fishery is the target of many of the 131 ring-nets, mostly operated by 29 motorised vessels noted above (URT 2010). The small pelagic fish are a significant component of the catch in Mtwara District, though data are not available.

Tourism

Tourism is underdeveloped and can be a significant source of employment and foreign exchange earnings. The district has the following attractions; it is close to two game reserves (Msanjesi and Lukwika), and the Ruvuma River, has a long coastline with sandy beaches and the historical Mikindani old town, rich tribal cultures (Makonde, Makua and Yao) and famous curvings. Tourism facilities exist in MBREMP and Mikindani, with new establishments under construction.

Minerals

The mining activities undertaken in Mtwara Urban include excavation of sand, gravel stone or boulders, aggregates and limestone. Solar salt works are present in the district, all located inshore of the mangrove creeks, especially east of Mtwara Harbour.

While no exploration drilling has taken place so far in Mtwara Urban, the district benefits from this sector through the supply of electricity and the Mtara Port and airport services.

Description of the coast

Physical

Mtwara Urban District is located in Mtwara Region, surrounded by all sides except the east by Mtwara Rural District. There are three major inlets, the Mtwara Harbour inlet to the east, the central inlet and the Mikindani Harbour. The district is penetrated by four small coastal rivers plus numerous seasonal streams, all less than 20 km in length. The shore is mostly limestone outcrop, with soft substratum in small sections. Sediment types vary greatly, from clay bound sands and gravel to more unconsolidated suite of recent times. Beach sands vary from silicilastic in river-dominated areas to carbonate sand around islands far from river influences.

Coastal ecology

The coastline and inshore waters of Mtwara District support coral reefs, intertidal rocky and sand expanses, with areas of seagrass beds that extend into the subtidal areas, and some mangrove forests.

Coral reefs – Coral reef systems begin off the southern end of Mtwara Urban District, extending to Mtwara Port and north to the northernmost extend of the Mtwara Urban District. The fringing coral reef is continuous although interrupted by a small shallow mangrove creek south of Mtwara town, and into Mikindani Inner Bay.

Mangroves – there are two major mangrove stands in Mtwara Urban District, a mangrove forest south of Mtwara Town and a Mikindani Harbour mangrove forest.

Beach and rock shorelines – The shoreline backing fringing reefs, extending for most of the district's coast, is fossil limestone coral. Small beaches are present in sheltered areas such as Msanga Mkuu.

Coastal waters

Marine species of importance

Whaleshark – Reported from off Msimbati Peninsula and inside Mikindani Bay, though numbers and seasonality are not known.

Seahorses - From shallower waters towards Mtwara Port, seahorses have been reported by divers from Mikindani. Some species of seahorse are endangered.

Cetaceans - Humpback whales and bottlenose dolphins are reported from within Mtwara Harbour and Mikindani Bay, with humpback whales during the June to November season.

Natural resources

There are no natural forests in Mtwara Urban as most of the area is either settled or farmed.

Settlements

The settlement and built-up portion of Mtwara urban is concentrated in the Mtwara city and Miknindani town, with linear development along the main arterial routes.

Infrastructure

The district is the main urban center of southeast Tanzania, connected to Lindi and Dar es Salaam by a tarmac road (B2) which in some parts is still under construction. Mtwara urban is also connected to interior districts by gravel roads. Mtwara Airport is designed to handle Boeing 747 jets and other large aircrafts. Since the start of the offshore oil and gas exploration there is also a dedicated helicopter hangar. Mtwara Port is active as an export facility for un-processed cashew nuts to India, and as a supply base for the offshore gas exploration activities that began in 2007.

A gas-fired power station exists close to Mtwara Port, supplying the town and other destinations as far as Lindi. Mtwara port and Mtwara airport connects the district to the entire Tanzania and abroad. All major mobile telephone providers have network in the district.

Major Threats

Table 53: Overview of threats to coastal communities in Mtwara Urban district.

Threat	Location	Cause
Beach pollution	At the passage to Mtwara Port, Mikindani	Uncontrolled solid and liquid waste disposal
Beach erosion	Mikindani and Mtwara towns	Mangrove cutting, dynamite fishing, beach sand mining, unplanned construction along the coast.
Fisheries decline	All along the nearshore seas	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods (beach seine) as well as coral mining for lime production
Heavy metal pollution	Within Mtwara Port waters, near shore waters	Ships and machineries produced wastes at the port and nearby upstream areas
Diseases outbreaks	Mtwara Town, Mikindani	Inadequate sewerage control, poor solid waste management, uncontrolled food vending.
Loss of habitat and agricultural area	Mtwara urban suburbs, near shores	Rapid urbanization, high increase of people immigration in the city. Beach seining, coral mining, dynamite fishing.

CRIAM Ranking of Threats to Local Communities in Mtwara Urban District

Table 54: Prioritisation of threats to local communities in Mtwara Urban District. The assessment uses the Coastal Rapid Impact Assessment Matrix (CRIAM) approach, described in detail in Annex 3.

Threat as stated in Coastal Profile	Location	A1 : Extent of issue	A2 : Seriousness of issue	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative character	Evaluation Score (ES)	Range Value (RV)	Light problem	Problem	Important problem	Very important problem	Major problem
Fisheries decline	All along the nearshore seas	3	3	3	2	2	63	4					
Beach pollution	At the passage to Mtwara Port, Mikindani	2	3	3	2	2	42	4					
Beach erosion	Mikindani and Mtwara towns	3	2	3	2	2	42	4					
Loss of habitat and agricultural area	Mtwara urban suburbs, near shores	3	2	3	2	2	42	4					
Diseases outbreaks	Mtwara Town, Mikindani	2	1	2	2	3	14	2					
Heavy metal pollution	Within Mtwara Port waters, near shore waters	1	1	2	2	1	5	1					

Major Opportunities

Opportunities available for coastal communities:

- Aquaculture – well planned and controlled aquaculture
- Tourism – Ecotourism
- Beekeeping

Climate Change Impacts

Table 55: Estimated area losses of sea level rise scenarios on overall area and on land uses in Mtwara Urban and Rural districts (combined).

Mtwara Rural and Urban	Total	1 m SLR		2 m SLR		3 m SLR		4 m SLR		5 m SLR		10 m SLR	
		ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Inundation		844	0.21	1,155	0.29	1,368	0.34	1,822	0.46	2,560	0.64	36,130	9.10
Built-up area	40	0.00	0.00	1.68	0.04	3.24	0.08	4.08	0.10	8.08	0.20	97.58	2.47

Significant impacts from sea level rise are felt over the general land area for rise levels only above 10 m, since much of the Mtwara Rural and Urban districts is sufficiently raised to avoid inundation, despite about 9 % of the land area becoming inundated with such a rise. However, considering that most of the infrastructure is around Mtwara town and Mikindani town, a 10 m rise equivalent storm surge (inundating about 2.5 % of built-up areas), especially when coinciding with spring high tides are likely to have more significant impact on infrastructure as well as further inland, along much of the length of the creeks with potential seawater penetration into agricultural land and shallow wells.

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Annex 1: List of Documents

Table 56: Document Database at SAMAKI compiled for the Prioritisation Study

Title	Source	Year
Feasibility Study for New Port Project in Zanzibar -Phase I	REVOLUTIONARY GOVERNMENT OF ZANZIBAR, TANZANIA	2014
Perceptions of Rule-Breaking Related to Marine Ecosystem Health	Matthew J. Slater1, Yunus D. Mgaya, Selina M. Stead	2014
Alleviating Poverty & Countering Environmentally Unsustainable Practices.	Smallholder Empowerment and Economic Growth through Agribusiness & Association Development (SEEGAAD)	2014
Shipping Traffic At major Ports	Annual Statistics 2012-2013 TPA	2013
Economic Impacts of Dynamic Fishing in Tanzania	Wilson and Associates	2013
Marine and Coastal Environment Management Project (MACEMP): Implementation Completion and Results Report	World Bank	2013
Zanzibar Climate Change Strategy	THE REVOLUTIONARY GOVERNMENT OF ZANZIBAR THE FIRST VICE PRESIDENT'S OFFICE	2013
Zanzibar Environmental Policy	Department of Environment Zanzibar	2013
Management Plan For the Tanzanian Artisanal Fishery for Small and Medium Pelagic Fish Species	Ministry Of Livestock and Fisheries Development.	2013
Tanzania Tuna Fishery Management Strategy		2013
The Proposed Transboundary Conservation Area (TCA)	UNEP	2013
Tanzania Economic Update How the ports of Dar es salaam can transform	www.Worldbank.org/tanzania/economicupdste	2013
$200 - $350 bn a year needed for Africa-UN	wwwnewsdaily.com	2013
2012 Population and Housing census	National Bureau of Statistics	2013
Coastal and Marine Ecosystems in Changing Climate.	Prof. Pius Z. Yanda	2013
The Earth Security Index	Alejandro Litovsky, Founder & CEO, Earth Security Initiative	2013
Future habitat suitability for coral reef ecosystems under global warming and ocean acidification	Elena Couce,Andy Rdgwell and Erica J Hend	2013
Distribution and Marketing Networks within Dynamite Fishing in Tanzania.	Winfried Venant Haule	2013
Tanzania: marching toward sustainable IDD elimination	Idd Newsletter	2013
Anthropogenic Impacts On Coral Reefs and Their Effect on Fishery of Kilwa District ,Tanzania	Mbije ,N.E and Rinkevich,B.	2013
The Economic Impacts Of Dynamite Fishing in Tanzania	MANCEMP	2013
National Gas policy Of Tanzania	URT	2013
Report urges modern farming	www.theeastafrican.co.ke	2013
Situation analysis for Mangroves for the Future: Understanding the resilience of coastal systems	Melita Samoilys, George Waweru Maina, Julie Church, Brigid Mibei, Marta Mo njane, Abdulla Shah, Doris Mutta and Mine Pabari	2013
Action on Nutrition in Tanzania	WHO & URT	2013
Tanzania Initiatives on Coastal Ecosystem Management in The Context of Adaptation and Mitigation	Zainabu Shabani	2013
The Deloitte Guide to Oil and Gas in East Africa	Deloitte	2013

Title	Source	Year
The Ecosystem, Livelihoods and Future Status of Mbegani	USAID/PWANI Project & http://www.crc.uri.edu	2013
The Description of Ecologically or Biologically significant of Marine Areas.	UNEP/CBD/RW/EBSA/SIO/1/4	2013
Agriculture Lab Tanzania Development Vision 2025	URT	2013
Education NKRALab Report Tanzania Development Vision 2025	URT	2013
EnergyLab Final Report Tanzania Development Vision 2025		2013
Resources mobilization(NKRA)Report Tanzania Development Vision 2025		2013
Transport Lab (NKRA)Report Tanzania Development Vision 2025		2013
National Key Result Area (NKRA) Water Tanzania Development Vision 2025		2013
Environmental factors influencing whale shark occurrence & movements at Mafia Island, Tanzania	Christoph A. Rohner & Simon J. Pierce ,Michael Berumen,Jesse Cochran3 & Fernando Cagua, Mathias Igulu& Baraka Kuguru Jason Rubens6	2013
Economics of Climate Change in Zanzibar - Vulnerability, Impacts and Adaptation	Global Climate Adaptation Partnership	2012
Marine Legacy Funds of Tanzania	Meyers, D.	2012
Socio-economic Impact Assessment of MACEMP Supported Subprojects	Health and Environmental Concerns (HEC) Limited	2012
People, Nature and Research in Chwaka Bay, Zanzibar, Tanzania	de la Torre-Castro M. and Lyimo T.J. (eds)	2012
National Marine Ecosystem Diagnostic Analysis. Tanzania. Contribution to the Agulhas and Somali Current Large Marine Ecosystems Project	ASCLME	2012
The Economics of Climate Change in Zanzibar	Global Climate Adaptation Partnership	2012
Marine and Coastal Environment Management Project (MACEMP): The Marine Legacy Funds of Tanzania	MACEMP	2012
Implementation of Concrete Adaptation Measures to Reduce Vulnerability of Livelihoods and Economy of Coastal Communities of Tanzania	UNEP	2012
Rising tides threaten Tanzania's coastal towns	Kizito Makoye	2012
A Study of Working Conditions in the Zanzibar Seaweed Farming Industry	Flower E. Msuya	2012
The Revolutionary Government of Zanzibar NATIONAL SAMPLE CENSUS OF AGRICULTURE 2007/2008		2012
Chumbe_Island__Coral_Park__Governance_Analysis	Lina M.Nordlund,Ulrike Kloiber,Eleanor Carter and Sibylle Riedmiller.	2012
Coastal and Marine Tourism Development Plan for the Menai Bay Conservation Area (MBCA), Mnemba Island Marine Conservation Area (MIMCA), and the Pemba Channel Conservation Area (PECCA).	Enviro-Fish Africa (Pty) Ltd	2012
Octopus Fishery Management Plan		2012
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National Marine Ecosystem Diagnostic Analysis	ASCLME	2012
Deep Sea Coral Research and Technology	NOAA	2012
NATIONAL SAMPLE CENSUS OF AGRICULTURE 2007/2008		2012
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Title	Source	Year
Legal and Institutional Framework for Effective Management of Marine Managed Areas in Tanzania	Mwita M. Mangora Mwanahija S. Shalli Bernice McLean	2012
Socio-Economic Profiles of Communities Adjacent to Tanga Marine Reserve Systems, Tanzania	Mwita M. Mangora and Mwanahija. S. Shalli Institute of Marine Sciences, University of Dar es Salaam, P.O. Box 668, Mizingani Rd., Zanzibar, Tanzania	2012
National Sample Census Of Agriculture 2007/2008 -Mtwara Region	URT	2012
Human induced changes, biodiversity loss, livelihood implications and management in the Western Indian Ocean	Lina Mtwana Nordlund	2012
Pwani Region Report	URT	2012
Sea Sense Annual report	www.seasense.org	2012
Tanzania Environmental Threats and Opportunities Assessment	USAID	2012
Tanzania Ports Authority	TPA	2012
Impact Assessment (SESIA) for the Oil & Natural Gas Subsector	NEMC	2012
Legal and Institutional Framework for Effective Management of Marine Managed Areas in Tanzania	EcoAfrica Environmental Consultants	2012
Water Perfromance Report	ewura	2011
Economics of Climate Change in Tanzania (mainland) - The Implications of Climate Change and Sea Level Rise in Tanzania	Global Climate Adaptation Partnership	2011
Community-based Vulnerability Assessment and Adaptation Options in Coastal Villages: Bgamoyo District, Tanzania	TCMP (Tanzania Coastal Management Partnership)	2011
The Tanzania Five Year Development Plan 2011/2012 - 2015/2016	GOT: President's Office. Planning Commission	2011
The Economics of Climate Change in the United Republic of Tanzania	Global Climate Adaptation Partnership and partners	2011
Developing Core Capacity to Address Adaptation to Climate Change in Productive Coastal Zones of Tanzania	UNEP	2011
Sea Level Rise and Impacts in Africa 2000 - 2100	Sally Brown, Abiy S. Kebede and Robert J. Nicholls School of Civil Engineering and the Environment University of Southampton Southampton SO17 1BJ, UK	2011
Population and Assets Exposure to Coastal Flooding in Dar es Salaam (Tanzania) Vulnerability to Climate Extremes	Abiy S. Kebede and Robert J. Nicholls University of Southampton School of Civil Engineering and the Environment and Tyndall Centre for Climate Change Research Southampton, Highfield, SO17 1BJ United Kingdom	2011
Preparation of a Zoning Plan for Tanga Coelacanth Marine Park	Christopher A. Muhando	2011
Proceeding Of The Tanga Coelacanth Marine Park Zoning Workshop,Veta Tanga,20th April 2011 and The TCMP Zoning Plan	Christopher A. Muhando	2011
Ministry of Livestock Development and Fisheries - Achievents and Lessons Learnt	MACEMP	2011
Environmental and Social Impact Statement for the proposed Fish Market and landing site at Tumbe, Micheweni District, Pemba	MK Business Consultants Ltd	2011
Poverty Eradication through Aquaculture	A Leverhulme Trust Research Grant Project	2011
Impacts Of Climate Change In Zanzibar	Care International	2011

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Local Economic Development Plan Kilwa Kisiwani, Kilwa, Tanzania	Eco Africa	2011
To connect or not to connect? Floods, fisheries and livelihoods in the Lower Rufiji floodplain lakes, Tanzania	http://www.tandfonline.com/loi/thsj20	2011
International Social and Environmental Performance Standards	BG Group Workshop Dar esSalaam, Tanzania 14 September 2011	2011
Integrated Industrial Development Strategy	URT	2011
State of Knowledge of Coastal and Marine Biodiversity of Indian Ocean Countries	Mohideen Wafar, Krishnamurthy Venkataraman, Baban Ingole, Syed Ajmal Khan, Ponnapakkam LokaBharathi	2011
The Formation and Establishment of the Jozani-Chwaka Bay National Park, Zanzibar, Tanzania	Fred Saunders School of Life Sciences, Södertörn University, Huddinge, Sweden	2011
Health Sector and Social Wlfare public Private Partnerships Policy Guidelines	Ministry of Health and Social Walfare	2011
The organisation Structure of the Ministry of Lands ,Housing and Human Settlements Development		2011
Tanzanian Food and Water Security Outlook	Aida Mliga	2011
Tourism Guide for the Tanga Region, Tanzania 2nd edition	Tanga City Council	2011
2011 TanSEA layers delivered	TanSea	2011
National Nutrition Strategy	URT	2011
WIOMSA Annual Report	WIOMSA	2011
Preparation of an Adaptation Programme of Action for Zanzibar (Zanzibar NAPA)	SMOLE	2010
The Implications of Climate Change and Sea-Level Rise in Tanzania – The Coastal Zones	Kebede, Brown, and Nicholls. University of Southampton School of Civil Engineering and the Environment and Tyndall Centre for Climate Change Research Southampton, Highfield, SO17 1BJ United Kingdom	2010
News of the Coast no 14	RECOMAP (Regional Programme for the Sustainable Management of the Coastal Zones of the Indian Ocean Countries)	2010
Annexes to Zanzibar NAPA	SMOLE	2010
Mapping of Mangroves in Jasini, Ndumbani, Mahandakini, Moa, Boma Kichakamiba and Boma Subutuni villages, Mkinga District, Tanga	Christopher A. Muhando	2010
Intergrated Social and Ecological Report For Non - Node and Node Sites	T. Campson R. Pomeroy C. Dahlgren S. Gopal L. Kaufman H. Patel B. Shank J.F. Bertrand	2010
Sustainable Management of Land and Environment II	Mr. Lars Møller	2010
Calibration of Community-based Coral Reef Monitoring Protocols	Christopher A Muhando	2010
Mapping of Mangroves in Jasini, Ndumbani, Mahandakini, Moa, Boma Kichakamiba and Boma Subutuni villages, Mkinga District, Tanga	Dr. Christopher A. Muhando	2010
SMOLE II - Environmental Impact Assessment	KRISTINE KARPF, EIA Advisor, Environmental consultant with NIRAS	2010
SMOLE II - Final Report from International IT and Database Advisor		2010
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Policy misfits,climate change and cross scale vulnerability in Coastal Africa;How development projects undermine resilience	Matthew Brunce,Katrina Brown and Sergio Rosendo	2010

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Ecosystem-based Adaptation in Tanzania	Tahia Devisscher	2010
Marine Fisheries Frame Survey Result.doc	URT,MACEMP & WWF	2010
Mnemba Island-Chwaka Bay Marine Conservation Area (MIMCA)	SMZ & MACEMP	2010
Zanzibar Strategy for Growth and Reduction of Poverty 2010-2015 (MKUZA II)	RGoZ	2010
Strengthening Co-Management (SccaFcoM) in Rufiji,Mafia,and Kilwa Districts	Dr Robert M. Otsyina Monitoring and Evaluation Expert Team Leader Development Associates Ltd Dr Benaiah L. Benno Expert in Fisheries Management University of Dar es Salaam Dr Jumanne M. Abdallah Socio-economist & Community Based Management Sokoine University of Agriculture	2010
An update on research on migratory routes and feeding destinations of Southwest Atlantic humpback whales	Alexandre N.Zerbini,Artur Andriolo,Daniel Danilewicz,Mads Peter Heide-Jorgensen,Nick Gales and Phillip J Clapham.	2010
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Habitats and Ecological Zone in Kicamp Area	Christopher A. Muhando, Mwanahija S. Shalli, Rukia A. Kitula ,Mwita M. Mangora	2009
Coral Reef Baseline Survey in Tumbatu Conservation Area	Christopher A. Muhando	2009
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The Status of Zanzibar Coastal Resources	Department of Environment through support from Marine and Coastal Enviromental Project (MACEMP)	2009
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Improved Salt Iodation Methods for Small scale Salt produces in Law resource setting in Tanzania.	www.biomedcentral.com/1471-2458/9/187	2009
Documenting the global impacts of beach sand mining	R. Young and A. Griffith	2009
The Extractive Resource Industry in Tanzania	Society for International Development Regional Office for Eastern Africa P O Box 2404 – 00100 Nairobi Kenya Telephone: +254 - 20 - 2737991 Fax: +254 - 20 - 273 7992 Email: sidea@sidint.org Website: http://www.sidint.org	2009
Tanzania Ports Master Plan	TPA	2009
Consultancy Study On The Needs assessment For Implementation Of The Prevention Of Marine Pollution From Ships (MARPOL 73/78) and Oil Spill Response Contingency Plan For The United Republic Of Tanzania.	Gorton Consultancy	2009

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Institutional Analysis of Nutrition in Tanzania	Valerie Leach and Blandina Kilama	2009
Tanzanian water policy reforms between principles and practical applications	Haakon Lein and Mattias Tagseth	2009
Country Wildlife Response Profiles	Sea Alarm	2009
Integrated Coastal Management Action Plan Bagamoyo District Council	The District Executive Director P.O. BOX 59 BAGAMOYO	2009
Integrated Coastal Management Action Plan ilala District Council	www.ilalamunicipal-tz.org	2009
Mpango Kazi wa Usimamizi Kamilifu wa Mazingira ya Pwani Kilwa Masoko	Mkurugenzi Mtendaji wa Wilaya P. O. Box 160 Simu Na. Nukushi. Kilwa Masoko	2009
Integrated Coastal Management Action Plan Kinondoni District Council		2009
Mpangokazi wa Usimamizi Kamilifu wa Mazingira ya Pwani Wilaya ya Lindi.	Mkurugenzi Mtendaji Halmashauri ya Wilaya ya Lindi S.L.P. 328 LINDI Simu : 023-2202325/2261 Nukushi: 023-2202472 Baruapepe: dedlindi@yahoo.co.uk	2009
Integrated Coastal Management Action Plan Lindi District Council	Town Director Lindi Town Council P.O. Box 1070 LINDI Tel. 023 – 2202164 Fax: 023 – 2202116 E-mail: linditc@pmoralg.go.tz	2009
Integrated Coastal Management Action Plan Mkuranga District Council	District Executive Director Mkuranga District Council P.O. Box 10 Mkuranga Coastal Region	2009
2009 Integrated Coastal Management Action Plan Mtwara District Council	Municipal Director Mtwara-Mikindani Municipal Council P.O. Box 92, Mtwara. Te:+255 23 3333941 Fax: + 255 23 2334256 E-mail: Mtwaramikindani@yaoo.com	2009
2009 Mtwara District Council ICM Action Plan	District Executive Director Mtwara District Council P.O Box 528 MTWARA. Tel: 023-2333928 Fax: 023-2333293 Email: Mtwara rural@gmail.com	2009
2009 Integrated Coastal Management Action Plan Muheza District Council	District Executive Director Muheza District Council P.O.Box 20 Muheza TANGA	2009
Integrated Coastal Management Action Plan Pangani District Council.	District Executive Director Pangani District Council P.O. Box 89 Pangani Tanga Tel: 0272630058 Fax: 0272630315	2009
Mpango kazi wa Usimamizi Kamilifu wa Mazingira ya Pwani (ICM) Halmashauri jiji la Tanga	Mkurugenzi Halmashauri ya Jiji la Tanga S.L.P 178 TANGA Simu: 0272644530 Barua pepe: tmc@kaributanga.com	2009
Mpango kazi wa Usimamizi Kamilifu wa Mazingira ya Pwani Halmashauri ya Jiji la Temeke	HALMASHAURI YA MANISPAA YATEMEKE S.L.P. 46343, FAX NO. 2850640 SIMU: 2851054 TEMEKE DAR ES SALAAM	2009
Integrated Coastal Management Action Plan Mkinga District Council		2009
Tanzania Coral Reefs Status Report	Muhando, C.A. and Mwaipopo, R.	2008
The Social Dimensions of Marine Protected Areas: A Case Study of the Mafi a Island Marine Park in Tanzania	Rosemarie Nyigulila Mwaipopo	2008
Distribution and Status of Coastal Habitats and Resources in Tanzania	Dr. Christopher A. Muhando, Institute of Marine Sciences and Mr. Chikambi K. Rumisha Ministry of Natural Resources and Tourism	2008
Local community perceptions, Tanga Coastal Resources Centre and Socio-economics considerations for Coelacanth MPA: An overview	Dr. Christopher A. Muhando & Hassan W.J. Kalombo	2008

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Distribution and Status of Coastal Habitats And Resources in Tanzania	Christopher A. Muhando and Chikambi K. Rumisha	2008
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Mapping research systems in developing countries	http://www.state.gov/r/pa/ei/bgn/2843.htm	2008
Ecological Effects of the Crown-of-Thorns Starfish Removal Programme on Chumbe Island Coral Park, Zanzibar, Tanzania	C.A. Muhando and F. Lanshammar	2008
Preparation Of Surveying and Mapping Policy for Tanzania	Topo-Carto Consultants Limited, Consultant	2008
Approaches to Coral Reef Monitoring in Tanzania	Christopher A. Muhando	2008
Interactive Governance Approach in Mariculture Activities In Tanzania	Mutatina Alieth	2008
A study of perceptions and impacts from different types of tourism in Mafia Island Marine Park, Tanzania.	Noragric Department of International Environment and Development Studies Norwegian University of Life Science (UMB) P.O. Box 5003 N-1432 Ås Norway Tel.: +47 64 96 52 00 Fax: +47 64 96 52 01 Internet: http://www.umb.no/noragric	2008
Natural resource dependence, livelihoods and development Perceptions from Tanga, Tanzania	Melita A. Samoilys and Nyaga W. Kanyange	2008
Method for calculating brine evaporation rates during salt production	D. Glen Arkridge	2008
Microfinance and environmental sustainability at selected sites in Tanzania and Kenya	Robert Wild, Altemius Millinga and James Robinson	2008
National and Regional Networks of Marine Protected Areas	UNEP World Conservation Monitoring Centre	2008
The Social Dimensions of Marine Protected Areas	Rosemarie Nyigulila Mwaipopo	2008
SongoSongo Social Services and Economic Survey.	Dr. Oswald Mashindano Deus Kibamba Prosper Charle Festo Maro	2008
Optimisation of Production and Quality of Solar Salt from New and Existing Solar Saltfields using Brine Mass Balance Computer Modelling.	Roland Mottershead: CGV Pty. Ltd. Perth, Western Australia & Kevin Wellisch: K F Wellisch & Associates Pty. Ltd. Perth, Western Australia.	2008
Status of Coral reefs in East Africa : Kenya , Tanzania , Mozambique and South Africa	Nyawira Muthiga , Alice Costa , Helena Motta , Christopher Mu H ando , Rose Mwaipopo and Michael Scheleyer	2008
Tanga Regional Socio -Economic Profile.	NBS and Tanga Regional Commissioner's office	2008
Coast Region Socio-economic Profile	National Bureau of Statistics	2007
Tanzania National Adaptation Program for Action (NAPA)	VPO-Division of Environment	2007
East Africa Exploration Map		2007
National Report of the United Republic of Tanzania on Sea Level Measurements	Ignatious K. Nhnyete TANZANIA PORTS AUTHORITY and Shigalla B. Mahongo TANZANIA FISHERIES RESEARCH INSTITUTE	2007
Development of a Geographic Information System for Tanga; supporting expedition planning for the Tanga Coast, Tanzania		2007
Coast Region Socio-Economic Survey	URT	2007
The Status Report On The Impact Of Dynamite Fishing In KICAMP Localities	Chikambi K. Rumisha and Christopher A. Muhando	2007
Effects Of Climate and Seawaters Variation on Coral Bleaching and Mortality.	TIMOTHY R. MCCLANAHAN,1,2,5 MEBRAHTU ATEWEBERHAN,2 CHRISTOPHER A. MUHANDO,3 JOSEPH MAINA,2 AND MOHAMMED S. MOHAMMED4	2007
Zanzibar Fisheries Frame Survey	Department of Fisheries and Marine Resources,Ministry of Agriculture,Livestock and environment,Zanzibar Institute of Marine Sciences ,University of Dar es salaam	2007

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Sustainable universal salt iodization in low-income countries – time to re-think strategies?	VD Assey S Peterson and T Greiner	2007
Coast Region Socio Economic Profile	National Bureau of Statistics and Coast Regional Commissioner's Office	2007
Land Suitability Mapping Lindi Rural	Steve Ball & Anne-Marie Gregory	2007
National Sample Census Of Agriculture 2002/2003	URT	2007
Report on Eviction And Resettlement Of Pastoralist From Ihefu and Usangu Mbarali District To Kilwa and Lindi Districts	PINGOs Forum, Hakiardhi, HIMWA, LHRC, ITV and Majira	2007
Mtwara Region Socio - Economic Profile	The Planning Commission Dar es salaam and Regional Commissioner's Office Mtwara	2007
Tanga Region Agriculture Sample Census Report	URT	2007
National Adaptation Programme Of Action (NAPA)	URT,UNEP & GEF	2007
Mpango Kazi wa Usimamizi Kamilifu wa Mazingira ya Pwani Wilaya ya Rufiji	Mkurugenzi Mtendaji wa Wilaya, P.O Box 28 Tel. 0232010304 Fax. no.0232010317 Utete/Rufiji	2007
Zanzibar Ecotourism Study	ZHTI	2006
Ecological Monitory of Coral reefs in Marine No -Take and Fished zones off Bagamoyo Coast	Christopher A. Muhando	2006
Trends in Reef Benthos in Mafia Island Marine Park, Tanzania: 1999-2005 coral reef monitoring results	Muhando, C.A.	2006
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Zanzibar Ecotourism Study	Study initiated as part of NUFFIC Support program to ZHTI and facilitated by MMA Ltd	2006
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Marine and Coastal Environment Management Project (MACEMP): Environmental and Social Assessment	Jacques Whitford Environment Limited 3 Spectacle Lake Drive Dartmouth, NS B3B 1W8 CANADA	2005
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Assessment of marine biodiversity, ecosystem health and resource status of intertidal (non-mangrove) and sub-tidal (non-coral) habitats in MBREMP	M. D. Richmond and A. Mohamed	2005
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City Profile for Dar es salaam	Document Prepared By Dar es Salaam City Council,City Director Dar es Salaam City Council Morogoro/Sokoine Drive P.O. Box 9084 DAR ES SALAAM TEL.:255-22-2123551/6 FAX: 255-22-2125589 E-mail: cd@dcc.go.tz Website: www.dcc.go.tz	2004
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2003 Intitial National Communication Under The United Nations Framework convetion on climate change	United Republic of Tanzania(URT),Vice President's office	2003
Coral and fish distribution patterns in Mafia Island Marine Park, Tanzania: fish–habitat interactions	Kajsa C. Garpe & Marcus C. Öhman Department of Zoology, Stockholm University, 10691 Stockholm, Sweden Tel: +46 8164002. Fax: +46 8167715. E-mail: kajsa.garpe@zoologi.su.se	2003
Mangroves Of East Africa	Michelle Taylor, Corinna Ravilious, Edmund P. Green	2003
National Trade Policy	URT	2003
Local Governance in Zanzibar	(Edited Version of chapter by Per Tidemand in "Zanzibar Good Governance Strategy" A Report by the Consultants Prof. Othman, Prof Mukandala, Robert Makaramba and Per Tidemand, for Revolutionary Government of Zanzibar	2003
Managing Tanzania's Coast through Integrated Planning - Reflections upon the first five years of District ICM Action Planning	TCMP (Tanzania Coastal Management Partnership)	2002
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The Economics of Climate Change in the United Republic of Tanzania	URT & UKAid	2001
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Nutrition Improvement Projects in Tanzania	Zentrum für Entwicklungsforschung (ZEF) Center for Development Research Walter-Flex-Strasse 3 D – 53113 Bonn Germany Phone: +49-228-73-1861 Fax: +49-228-73-1869 E-Mail: zef@uni-bonn.de http://www.zef.de	1999
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Advances in Marine Science in Eastern Africa: Application of Scientific Knowledge in Marine and Coastal Resources Management.	WIOMSA (Ngoile, M.A.K., Farancis, J. and Mtolera, M.)	1997
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Physical Alteration and Destruction of Habitats in the Eastern African Region	Christopher A. Muhando, Harrison Ong'anda and Lieven Bydekeke	
Menai Bay Governance	Elin Torell, Aviti Mmochi, and Karen Palmigiano	
Marine Fisheries in Tanzania	Narriman S. Jiddawi and Marcus C. Ohman	
Seawater Temperature on Shallow Reefs Off Zanzibar Town, Tanzania	Christopher A. Muhando	
Coral Reefs in Chwaka Bay and Adjacent Areas	Christopher A. Muhando and Mohammed S. Mohammed	
Coastal Tanzania ,A New Home To The Living Coelacanth An Oceanographic Analysis	N. Nyandwi Institute of Marine Sciences, University of Dar es Salaam P.O. Box 668 Zanzibar, Dar es Salaam, Tanzania	
Water Use Standard - Offshore Aqueous Discharges		
Sustaining the Marine Environment in Mainland Tanzania and Zanzibar	www.worldbank.org	
Survey of the extent of human-induced beach erosion problems in Tanzania	N. NyandwiInstitute of Marine Sciences, University of Dar es Salaam P.O. Box 668 Zanzibar, Dar es Salaam, Tanzania	
Draft National Land Surveying and Mapping Policy.		
Frequency and long-term distribution of coastal winds of Tanzania	A.M. Dubi	
A review of Climate Dynamics and Climate Variability in Eastern Africa.	S.E Nicholson,Department of Meteorology, Florida State University.	
Extending the Coastal Forest Protected Area Subsystem in Tanzania	United Nations Development Programme	
Botanical Assessment Of Ngezi Forest ,Pemba	H.J. Beentje	
Mangrove diversity Maps	NA	

Title	Source	Year
Information Outline for Tanzania Coastal and Marine Atlas.		
Marine Science country profiles Tanzania	Julius Fransis/IOCINCWIO-IV/Inf. 8	
Implications for sustainable coastal management	Huruma Sigalla,Richard Sambaiga, Godwin A. Lema, Emmanuel Shemaghembe, Vendelin Simon, Richard Abila, Jacob Ochiewo, Andrew Wamukota	
Mangrove diversity Maps		

Annex 2: Coastal Rapid Impact Assessment Matrix (CRIAM)

Introduction

Background

The coastal zone in Tanzania is under development pressure induced by population growth and economic activities and the area is experiencing a range of management problems giving rise to increased concern, including ecosystem encroachment, pollution, salinisation of soils, estuaries and aquifers, degradation of resources, shoreline erosion and conflicts of interest among stakeholders depending on the coast for their livelihood. Climate change will further aggravate this situation due to sea level rise and more frequent extreme weather.

In order to address these management challenges the Government of Tanzania with World Bank assistance has through the project "Investment Prioritisation for Resilient Livelihoods and Ecosystems in Coastal Zones of Tanzania" embarked on identifying and prioritising threats with the view of developing fundable adaptation measures to address the most pertinent threats.

The complex situation in the coastal area requires a holistic approach to managing development addressing amongst others the problems linked to insufficient coordination between sectors and integration of knowledge, experience and resources in the management processes. For this purpose a rapid but comprehensive coastal profile has been produced based on as recent information as readily available. The profile has been organised to describe threats to coastal communities and ecosystems thematically (sector and other themes as presented in this Volume I of the coastal profile) and geographically by coastal district (as presented in Volume II of the coastal profile) and there is a need to analyse these threats in a coordinated manner to identify linkages and overlaps prior to embarking on developing recommendations for adaptation measures.

Given the extent of the area under concern and the multitude and complexity of activities therein the study as a first step adopts a bird's eye approach to identifying and ranking the most pertinent areas of concern and impacting issues and to relating these to the main development sectors. This approach does not initially produce detailed recommendations for specific locations of individual development projects and activities but rather offers directions to where efforts should be focused to alleviate the main pressures on the coast.

To accomplish the bird's eye overview we are suggesting a matrix approach allowing for a structured consideration of the main impact areas of concern along the coast of Tanzania, the impacting issues and the sectors involved (thematic origin).

The matrix approach apart from offering a tool for structured consideration of conditions in a complex management environment also provides means of transparently communicating the basis for the assessment. The Excel application described further in this appendix can therefore be used in validating the assessment at various levels of management.

This technical annex describes the methodology proposed.

Coastal Rapid Impact Assessment Matrix

The matrix presented in detail below is intended to systematically and in a structured way examine impact areas of concern in the coastal zone and the impacting issues. While the analysis also targets to establish an overview of which main economic and other sectors are concerned it is important to differentiate between the physical situation in the coastal areas

and the management arrangements that are available to plan and control the development on the ground. The matrix approach serves to establish an understanding and overview of the situation as it is on the ground. The result of the matrix analyses can identify deficiencies and shortcomings in the current management arrangements the most pertinent of which may be addressed in the subsequent phase of the study through identification of fundable actions. Management arrangements in this contexts cover policy, legal and institutional aspects, and management tools such as information and communication framework, institutional and human resources and financial aspects.

The Coastal Rapid Impact Assessment Matrix Method

The Coastal Rapid Impact Assessment Matrix method[3] is proposed to allow the attribution of reasonably qualified quantitative values to more or less subjective judgments[4], thus, offering at the same time an evaluation of a given impact and a recordable figure, which can be used later, either for re-evaluation or for comparison with other impacts.

The method is based on a standard definition of the important assessment criteria as well as the means by which semi-quantitative values for each of these criteria can be assigned, with the aim to give a precise and independent score to each condition relevant to areas of concern in the coastal zone.

The impacts of issues considered are evaluated against the various components of the studied problem and, for each component, a score (using the defined criteria) is determined giving a measurement of the impact or importance for the component considered.

The assessment criteria fall into two groups:

A: Criteria that are of importance to the condition, and which can individually change the score obtained considerably;

B: Criteria that are of value to the given situation, but individually have a little effect on the score obtained.

For group A, the overall scoring system is based on multiplying the scores allocated each criterion. The principle of the multiplication is important since it assures that the weight of each criterion intervenes directly, whereas a sum of the scores could give identical results for groups of different scores.

For group B, the scoring system consists in summing up the scores allotted to each criterion. This ensures that an individual score cannot influence the overall result disproportionally. On the other hand, the sum assures that the combined importance of all values in group B is taken into account.

The scoring system is simple as there are only two criteria in group A (A_1 and A_2) and three criteria in group B (B_1, B_2 and B_3).

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[3] The method proposed for Tanzania has been adapted from the WRIAM method (Water Resources Impact Assessment Matrix) which again was derived from the RIAM (Rapid Impact Assessment Matrix) method used for complex project impact assessments.

[4] A comprehensive and detailed description of the situation in the coastal areas of Tanzania based on acquired information is difficult to make in a uniform manner as the level of documentation varies significantly in terms of resolution, accuracy, detail and updatedness. The matrix assessment method described in this technical note offers an opportunity to establish a rapid and uniform assessment of the situation at bird's eye level which again can guide in-depths efforts to address key problems at local and project level.

Calculation of the overall score for a given condition is also simple.

A_1 and A_2 represent individual criteria scores for group A;

B_1, B_2 and B_3 represent individual criteria scores for group B;

For each condition the following calculation is done:

$$A_T = A_1 \times A_2$$

$$B_T = B_1 + B_2 + B_3$$

$$ES = A_T \times B_T$$

where:

A_T is the result of multiplication of all A scores

B_T is the result of summation of all B scores

ES is the overall score of importance for the condition considered.

For a traditional environmental impact assessment, the criteria of group A can be determined by using scales that pass from negative to positive values through zero, thus reflecting both positive and negative impacts. However, in the present situation, the target is to quantify and compare negative impacts by only applying a one-way scale (from 0-4 and 0-3 for A_1 and A_2, respectively)[5]. In group B it has to be ensured that the sum of values cannot become zero as this in all cases would lead to an overall score of zero, which is against the required goal. For this reason the values of the criteria in group B is 1, 2 or 3, where 1 represents a neutral situation.

Compared to the RIAM method, the WRIAM method introduced a scoring system for the level of documentation as well as scores for the evolutionary character of each identified impact.

In the Coastal Rapid Impact Assessment Matrix (CRIAM) for Tanzania we have kept these scorings and in addition added three fields allowing for:

- Comments important for additional qualification related to the scoring which should be given only if required.
- Reference to the documentation database compiled by the project. This information may be useful for decision makers and managers in subsequent steps to address the areas of concern highlighted in the matrix.
- Reference to resources that are considered relevant for addressing the area of concern in more detail in later steps.

These three fields are not part of the structured impact assessment. The capture of documentation and competent resources at this point can however be useful for subsequent in-depth and localised analyses.

[5] This impact assessment for the coastal zone of Tanzania is a first step macro analysis of the threats identified to coastal communities and ecosystems. It is intended to assess the degree of impact from various issues in these areas of concern, while at the same time providing an indication of impacting sector or sectors if more are involved. Following such a "bird's eye" ranking decision makers and managers can prioritise efforts in addressing these areas of concern through individual and local interventions applying more detailed assessments that would allow a balanced capture of both positive and negative project impacts.

Assessment criteria for the coastal rapid impact assessment matrix method

The criteria should be defined for the two groups A and B, and should be based on fundamental conditions that may be affected by change introduced by the activities considered. It is theoretically possible to define a number of criteria, but those should always satisfy two principles:

- The universality and importance of the criterion;
- The nature of the criterion, which determines whether it should be treated as a group A or B condition.

For the purpose of ranking the coastal impacts of concern in Tanzania the method operates with 5 criteria in this first phase of the impact analysis (2 in group A and 3 in group B). These 5 criteria represent the most important fundamental assessment conditions and comply with the principles stated above.

These criteria, and their scales of scores, are defined in the following:

Group A criteria

Criterion A_1 - Importance of condition

A measure of the importance of the condition, which is assessed against the spatial boundaries or human interests it will affect:

A1 = 4: Important to national/international interests

A1 = 3: Important to regional/national interests

A1 = 2: Important to areas immediately outside local condition

A1 = 1: Important only to local condition

A1 = 0: No importance

Criterion A_2 - Magnitude of change / effect

Magnitude is defined as a measure of the scale of benefit / dis-benefit of an impact or a condition:

A2 = 0: No change / status quo

A2 = 1: Negative change to status quo

A2 = 2: Significant negative dis-benefit or change

A2 = 3: Major dis-benefit or change

Group B criteria

Criterion B_1 - Permanence

This criterion defines whether a condition is temporary or permanent:

B1 = 1: No change / not applicable

B1 = 2: Temporary

B1 = 3: Permanent

Criterion B_1 - Reversibility

This criterion defines whether the condition can be changed and is a measure of the control over the effect of the condition:

B2 = 1: No change / not applicable

B2 = 2: Reversible

B2 = 3: Irreversible

Criterion B_1 – Cumulative character

This criterion is a measure whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions:

B3 = 1: No change / not applicable

B3 = 2: Non-cumulative / single

B3 = 3: Cumulative / synergistic

The overall evaluation score (ES) may reach values ranging from 0 to 108. The achieved score is translated into 5 levels describing the problem using range bands as shown in Table 57.

Table 57: Translation of ES into Range Values and their significance.

Score (ES)	Range value (RV)	Description
0	0	No importance / Not applicable
1 to 9	1	Importance / slight negative impact
10 to 18	2	Importance / negative impact
19 to 35	3	Importance / moderate negative impact
36 to 71	4	Importance / significant negative impact
72 to 108	5	Importance / major negative impacts

To substantiate the assessment and support further analyses the matrix includes a field where the level of documentation relevant to the assessed condition can be indicated using a score between 0 and 3 as shown in Table 58 below.

Table 58: Scoring the level of documentation relevant to the assessed condition

Documentation Score (DS)	Description
0	No information / documentation
1	Slight actual information / documentation
2	Existing information / documentation, but insufficient
3	Good documentation / information

The speed with which the condition is developing is not captured in the EV and we have the matrix therefore also includes a field where the evolutionary character of the condition can be assessed using a score between 0 and 3 as shown in Table 59 below. The sensitivity to climate change may have implications on the speed with which the condition is developing. Such a sensitivity assessment however will be pursued after the CRIAM has prioritised impacts.

Table 59: Scoring the speed of development of the condition

Evolutionary Score (ES)	Description
0	No evolutionary character
1	Light evolutionary character
2	Moderate evolutionary character
3	Strong evolutionary character

The scores for level of documentation and development speed of the condition at present do not enter into the calculation of the EV, but serves rather to assist at the subsequent decision making process.

Excel application to support the matrix analysis

To support the matrix analysis of impacts in the coastal zone of Tanzania we have developed an Excel application, which allows for structured input into the matrix, while providing the basis for semi-automatic queries.

The matrix itself is a database with the following fields (Figure 4):

Districts to specify which of the Tanzania's coastal districts are considered, thus determining the bird's eye scope of the analysis. Districts should not be keyed into the matrix itself but are selectable from drop down menus. When the impacts are derived from a thematic threat (Volume II of the Coastal Profile), and therefore lack in geographical reference the matrix provides under Districts for selecting MAINLAND for mainland Tanzania or ZANZIBAR for Zanzibar.

Impact area of concern to specify which physical area or physical resource of concern is considered for the conditional assessment. Examples could be a habitat, an ecosystem or another physical feature a water body or resource, a shoreline, an area vulnerable to flooding, etc. Impact areas of concern should not be keyed into the matrix itself but are selectable from drop down menus. This drop down list can be expanded should new impact areas emerge.

Nature of issue which serves to specify which impact issue is being considered. Examples could be pollution, encroachment, erosion, flooding, degradation, biodiversity degradation, etc. If there are several issues relevant to a problem area of concern these would emerge in separate records in the matrix. Nature of issues should not be keyed into the matrix itself but are selectable from drop down menus. This drop down list can be expanded should new natures of issue emerge.

Theme, which serves to specify which main development sector, can be identified as contributing to the impacting issue. Examples of main development sectors could be agriculture, fisheries, forestry, industry, infrastructure etc. If there are several sectors contributing these would emerge in separate records in the matrix. Theme should not be keyed into the matrix itself but are selectable from drop down menus, which initially contain the themes covered in Volume I of the Coastal Profile. Should new themes emerge from the drop down menu can be expanded.

Sub-sector, allowing for a finer level consideration of sector contribution to the impacting issue if this is required. Examples of sub-sectors could be transportation, water supply, sanitation, etc. under infrastructure, and aquaculture, processing and coastal fisheries under fisheries. If there are several sub-sectors contributing these would emerge in separate records in the matrix. Sub-sector should not be keyed into the matrix itself but are selectable from drop down menus.

Criteria fields: These are fields for each of the five assessment criteria A_1, A_2, B_1, B_2 and B_3. The assessment consists of inputting values for these criteria for each of the conditions examined for a given area of concern. The values can be entered directly from the keyboard or using drop down menus. Values outside the respective ranges for these criteria are not allowed and will be rejected by the application.

EV field containing the evaluation score based on the values allocated to the criteria. The field will automatically calculate the EV based on the criteria input.

RV field which contains the range value corresponding to the EV. The field will automatically calculate and display the RV value based on the calculated EV.

Speed of evolution field, where the speed of the condition's development can be entered as a value between 0 and 3.

Documentation level, where the availability of documentation considered relevant for the condition can be entered as a value between 0 and 3.

Degree of problem field which provide a graphical display of the severity of the problem area of concern. These will appear as a bar display automatically generated based on the EV and RV.

Documentation (DOCBase) field, where references can be made to the database of documents compiled through the study.

Resources (Government, NGO, Academia, Individuals), allows references to be entered that may be useful in subsequent work, including the development of adaptation measures.

Comment field. Providing for any brief comment on the assessment made for the condition if relevant.

In the presentation above it was explained that selection of entries for a number of fields should be made using drop down menus. If a choice is not displayed in the dropdown menu, a separate spreadsheet in the Excel application provides for adding additional choices.

At the present state of development, the application includes the following choices, which serve as examples:

Districts

Only the 26 coastal districts are relevant for the present analysis. The application however could be used for assessments in other regions and districts, addressing concerns that go beyond the coastal zone.

Table 60: Table of administrative areas considered in the CRIAM, including Districts, Regions, Mainland Tanzania (MAINLAND) and Zanzibar (ZANZIBAR).

Districts	Super-Region	Region
Bagamoyo	Mainland	Pwani
Ilala	Mainland	Dar es Salaam
Kilwa	Mainland	Lindi
Kinondoni	Mainland	Dar es Salaam
Lindi Rural	Mainland	Lindi
Lindi Urban	Mainland	Lindi
Mafia	Mainland	Pwani
MAINLAND	**MAINLAND**	**MAINLAND**
Mkinga	Mainland	Tanga
Mkuranga	Mainland	Pwani
Mtwara Rural	Mainland	Mtwara
Mtwara Urban	Mainland	Mtwara
Muheza	Mainland	Tanga
Pangani	Mainland	Tanga

Districts	Super-Region	Region
Rujifi	Mainland	Pwani
Tanga	Mainland	Tanga
Temeke	Mainland	Dar es Salaam
Chakechake	Zanzibar	Kusini Pemba
Kaskazini A	Zanzibar	Kaskazini Unguja
Kaskazini B	Zanzibar	Kaskazini Unguja
Kati	Zanzibar	Kusini Unguja
Kusini	Zanzibar	Kusini Unguja
Magharibi	Zanzibar	Mjini Mhagaribi
Micheweni	Zanzibar	Kaskazini Pemba
Mjini	Zanzibar	Mjini Mhagaribi
Mkoani	Zanzibar	Kusini Pemba
Wete	Zanzibar	Kaskazini Pemba
ZANZIBAR	**ZANZIBAR**	**ZANZIBAR**

Impact area of concern

Table 61: Drop down list of Impact Areas of Concern emerging from the updated Coastal Profile

Impact Area of Concern
Bird Sanctuary
Coastal Vegetation
Coastal Villages
Coastal Zone
Coral Reefs
Estuaries/Backwater
Fishing Grounds
Islands
Lagoons
Mangroves
Mussel/Oyster Beds
Pearl Banks
Ponds and Lakes
Ramsar Sites
Rivers
Rocky Shores
Salt Marsh
Sand Bar/Dunes
Sandy Beach
Sea Grass Beds
Shoreline
Tidal Flats
Wetlands
Wildlife Sanctuary

The drop down list of impact areas of concern has been based on impact areas identified through the preparation of the updated Coastal Profile.

In discussions with stakeholders, this list can be considered the point of departure based on the rapidly collected information contained in the coastal profiles, but should be expanded as and if these discussions identify additional areas of concern.

Nature of Issue

Nature of Issues
Accretion
Biodiversity Degradation
Conflict
Destructive Fisheries
Encroachment
Erosion
Flooding
Over Exploitation
Physical Degradation
Pollution
Sedimentation

Here again the discussions in the assessment group of experts will determine which main issues are relevant to take into account affecting the problem area of concern. Any new main impacts should be added to this list.

Theme

Themes
Agriculture
Climate Change
Coastal Communities
Coastal Information Management
Fisheries
Forestry
Freshwater Resources
Hydrocarbons
Industry
Infrastructure
Management Framework for CZM
Natural Resources
Non-renewable Extractive Industry
Ports and Harbours
Salt Production
Shoreline Management
Tourism
Urbanisation

The main development sectors presently considered in the intersector impact assessment study are listed here.

It is not expected at present that additional sectors will be included but should it be required the list can be expanded.

Source of Concern

Source of Concern
Catchment Management
Fisheries Resources Management
Fishing Practices
Mangrove Management
Mining
Waste Management

A list of possible subsectors for consideration. The list is an example there are many more sub-sectors under the different sectors that may be included in the analysis. At this level of analysis however, care should be taken not to differentiate too much.

COASTAL THREATS IMPACT ASSESSMENT — Tanzania Coast

IMPACT RANKING — TABLE FOR CALCULATIONS

Super Region	Region	District	Themes	Source of Concern	Problem Area of Concern	Issue	A1 : Extent of issue	A2 : Seriousness of	B1 : Permanence	B2 : Irreversibility	B3 : Cumulative	ES	RV	Speed of evolution	Level of	Light problem	Problem	Important problem	Very important	Major problem	Documentation (DOCBase)	Resources (Government, NGO, Academia, Individuals)	Remarks
MAINLAND	MAINLAND	MAINLAND	Fisheries	Fishing Practices	Coastal Villages	Conflict	2	1	3	2	3	16	2										
MAINLAND	MAINLAND	MAINLAND	Fisheries	Fisheries Resources Management	Fishing Grounds	Conflict	4	3	3	3	3	108	5										
MAINLAND	MAINLAND	MAINLAND	Fisheries	Fishing Practices	Coral Reefs	Destructive Fisheries						0	0										
MAINLAND	MAINLAND	MAINLAND	Fisheries	Fishing Practices	Sea Grass Beds	Destructive Fisheries						0	0										
MAINLAND	MAINLAND	MAINLAND	Fisheries	Fishing Practices	Fishing Grounds	Destructive Fisheries						0	0										
MAINLAND	MAINLAND	MAINLAND	Fisheries	Fisheries Resources Management		Conflict						0	0										

Figure 4: Coastal Rapid Impact Assessment Matrix for Tanzania

Additional steps

Constraint analysis

In a later step, constraints analyses may be performed on the identified and ranked coastal zone issues in order to specify the types of constraints related to a specific coastal zone issue. The constraints used in the analysis could be divided into issues of technical, institutional, economic, sociological and legal character. The constraint analyses would involve an evaluation and identification of the existing technical level, responsible institutions, existing legal framework, sociological structure and the economic situation with respect to each coastal zone issue. Examples of different types of constraints are given below.

Constraints

Examples of technical constraints connected to a given coastal zone issue are lack of information/monitoring programs concerning pollution, encroachment, degradation and erosion, limited availability of water, technical difficulties in mobilising the water resources, constraints with rehabilitation of an ecosystem, a habitat, an aquifer or a reservoir, insufficient laboratory capacity/quality, few or no adequate sites for various desired development.

Institutional constraints can typically include subjects as lack of or dispersed co-operation and co-ordination between involved institutions, insufficient human resources, lack of capacity/expertise regarding a given issue, no clear operational framework between the involved parties, e.g. clear guidelines regarding responsibilities etc.

Types of economic constraints includes inadequate economic resources to; carry out monitoring of the quality and quantity of the resource, mobilise the resource, water purification treatment, establishment of reservoirs and hydropower installations, purchase of equipment etc.

Sociological constraints could be that the population ignores the risks connected to a given issue, lack of awareness and/or education concerning imposing issues.

Legal constraints could be that the existing legal framework is not fully covering a specific issue, that there are enforcement problems with respect to the existing legal framework, lacking or insufficient regulations and absence of required policies.

Management level

In a further step of the analysis, each of the listed constraints can be evaluated with respect to the management level. In this context, whether the management level can be characterised as international, national, regional, and local or a combination of these levels and both considering the government, non-government and civil society dimensions.

Identification of the responsible institutions

Furthermore, an identification of the existing public and private institutions such as authorities, laboratories and industries involved with the types of constraints are conducted.

Policy option analysis

At this point relevant facts and the importance of a given coastal zone issue are established forming the first part of a Policy Option Analysis. The elements in a Policy Option Analysis can be summaries as:

- Observation and Description. Description of the key facts about the issue, process issues and policy context.

- Analysis. Identification of major issues, interests, costs and benefits.
- Option Identification. Identification of the most optimal solutions.
- Advice. Succinct and clear advice to the decision maker providing the basis for the policy choice.

Action plans. Finally detailed action plans addressing high-prioritised coastal zone issues can be prepared and implemented.

Annex 3: Inception Workshops – Participants

Dar es Salaam 8 April 2014

Table 62: List of Participants – Inception Workshop 8 April 2014, Dar es Salaam

Name	Organisation	Name	Organisation
Benaih Benno	UDSM-DASF	Shadrack Stephen	National Land Use Planning
Mathias Igulu	TAFIRI	Philbert Luhunga	TMA
Bupe. E. Mwansasu	Kinondoni	Magdalena Banasiall	DFID
Upendo Hamidu	MLFD (head quarter)	Jason Rubens	Sound Ocean Ltd
Mwanaidi R. Mlolwa	MLFD-FDD	J. M Daffa	WWF
Matthew Richmond	Samaki Consoltants Ltd	Doyi Mzenzele	IUCN TZ
Kimasa Bugomba	MLFD	Titus Mwisomba	NBS
Baraka S. M. Mngulwi	MLFD	Violaine Lepoosez	French Embassy
Magese . E. Bulayi	MLFD	Hannes Potgietel	SEE BREEZE MARINE
Dr. E. J. Mosha	MLFD	Alexander Riefer	SEA BREEZE MARINE
Jovice Mkuchu	MLFD	Ambakisye Simtoe	Fisheries Education Training
Ezra E. Mutagwaba	MLFD	Ramadhani H. Mwigah	UWAWADA-Katibu mkuu
Dr. Simon J. Kangwe	TAFIRI	Abdulkarim Salum	UWAWADA-Mwenyekiti
Flora Akwilapo	NEMC	Christopher Muhando	IMS
Theddy P. Chuwa	Temeke Municipal Council	Rosemarie N. Mwaipopo	UDSM
Juma Msangi	Ilala Municipal Council	Gorm Jeppesen	DHI
Rashidi Tamatamah	UDSM	B.E Mapunda	DAFIE
Rikard Liden	World Bank	Fadhila Ruzika	MLFD-AQUACULTURE DEPT
Jairos Mahenge	Marine Parks	Abdallah Mohamed	Samaki Consultants Ltd

Figure 5: Inception Workshop groups sessions examining threats from thematic sectors and considering prioritization and mitigation alternatives, Dar es Salaam, 8 April 2014.

Figure 6: Dar es Salaam Inception Workshop participants, 8th April 2014.

Zanzibar 10 April 2014

Table 63: List of Participants – Inception Workshop 10 April 2014, Zanzibar

Name	Organization	Name	Organization
Hamad S. Khatib	MLF-Department of Marine	Ali Kassim Mohamed	PECCA
Ali Ameir Ali	MLF-Fisheries Department	Saleh K. Kina	SMOLE
Othman Maulid	ZIPA	Miza S. Khamis	DFNR
Ali S. Mchenga	Mkoa Kusini (U)	Thani R. Said	SUZA
Dr. Mabau A. Usa	Mkoa Kaskazini (U)	Tammy Holter	SCUBA DO/ZATI/Ocean
Saleh Mohamed Juma	MANR	Rikard Liden	World Bank
Martin McDonald	Chumbe	Tamriri Ali Said	Forestry Zanzibar
Matthew Richmond	Samaki Consultants Ltd	Dr. N.S.Jiddawi	IMS
Gorm Jeppesen DHI	DHI	Amas M Othman	MBCA
Ramla Talik Omar	SWIOFish Coordinator	Omar Hakim Foum	MCU
Salum Rehan	Urban West Region	Ali S. Mkarafuu	DFD
Mohamed. M. Nur	Samaki Consultants	Makame Khamis Makame	Rc's Office Pemba North
Rosemarie Mwaipopo	Samaki Consultants	Sheha Mjaja Juma	DOE- FVPO
Rukia Kitula	Institute of Marine Science	Mwalim KH.Mwalim	DOE- FVPO Pemba
Omar Mohamed Ali	Kojani Fishermen Dev. Organization	Masoud S. Said	Zari-Kizimbani
Juvinaries M. Nyandoto	Deep Sea Fishing Authority	Othman Mohamed	Director KATI-Kizimbani
Asma Othman	Ministry of Livestock and Fisheries	Casper Loursen	Smole Project
Ummi Molid	SWIOFish	Makame Salum	C-Weed Corp Ltd
Amour Mlenge	Ministry of Livestock and Fisheries	Ramla Fadhil	Aquaculture
Abdulrahman Ali	ACRA-ZNZ	Batuli M. Yahaya	C-Weed section
Mohammed Chum	Department of Fisheries	Jadidi Abdulla	Zanea Seewed Co Ltd
Hussein M. Mohamed	ZFSE	Arif Mazrui	Zanqur Aqua Farms Ltd
Jaala Sumba	Department of Fisheries	Christian Mchloll	ZATI-Scuba Do Zanzibar
Mohamed Habib	Dept of Urban and Rural Planning	Issa Yussup	Daily News
Thani R. Said	SUZA	Hinja Haji	ZBC Radio
Hashim Runehielun	GIM SEA CO .Ltd	Salama Mohamed	Mwandishi Wizara
Amour Kassim	Dept of land and Registration	Madina Issa	Zanzibar Leo
Sihaba H. Vuai	Dept of Environment	Beatrice George	ZBZ Tv
Munira A. Arahman	Dept of Fisheries	Makame Ame Ussi	ZBZ Tv
Semeni Mohamed Salum	Dept of Fisheries	Chalid Abdallah	Ministry of Livestock and
Hamad Masoud	DPPR-MLF	Ngwali M. Haji	Forestry Department
Khatib Juma	ZARI	Dr. Ahmada H. Panda	ZCT
Lars Moller	SMOLE	Daud H. Pandu	DFA
Mwadidni Haji	DPF	Maryam Ali Mohamed	Fisheries
Radhiya R. Haroub	PORASD	Bahati Ameiri Khamis	Fisheries
Khamis Khalfan	CHICOP LTD		

Figure 7: Inception Workshop participants attending a presentation by Dr. Rosemarie Mwaipopo on the preliminary social and economic assessment of the coast as it relates to threats to livelihoods and the environment, prior to groups work considering prioritization and mitigation alternatives of thematic threats identified thus far, Zanzibar, 10 April 2014

Figure 8: Zanzibar Inception Workshop participants, 10 April 2014

Annex 4: Members of Working Groups

Tanzania Mainland Working Group

Table 64: Members of the Working Group for Mainland Tanzania

Name	Institution
Dr. Rashid Tamatamah	University of Dar es Salaam (USDM)
Jeremiah Daffa	Tanzania Coastal Zone Management Project (TCZMP) – National Environmental Management Council (NEMC)
Magese E. Bulayi	Ministry of Livestock and Fisheries Development MLFD
Shadrack Stephen	National Land Use Planning Commission
Deogratius Paul	Vice President's Office (VPO), Division of Environment
Abdallh Said Shah	International Union for Conservation of Nature (IUCN)
Lewis Nzali	National Environmental Management Council (NEMC)

Zanzibar Working Group

Table 65: Members of the Working Group for Zanzibar

Name	Institution
Sihaba Vuai	Department of Environment
Hamad Khatibu	Ministry of Livestock and Fisheries (MLF) -Department of Marine Resources
Rune Hashim	GIM SEA CO .Ltd
Daudi Pandu	DFA
Christian Zati	SCUBA DO/ZATI/Ocean watch
Bakari Asseid	Deputy PS, Ministry Natural Resources
Makame Kitwana	Institute of Marine Sciences, UDSM
Nariman Jiddawi	Institute of Marine Sciences, UDSM