Coastal Profile for Zanzibar 2014
Region Volume II

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
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
EximBank	China Export-Import Bank

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

FDD	Fisheries Development Division
FMP	Fisheries Management Plans
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 ImmunoDeficiency 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 will be 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 sea water 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, sea weed 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 study is financed by the World Bank (WB) 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 data base 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 proceeds in three phases:

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

  These results are 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 provides 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 contains 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 is presented in the form of a coastal profile for Tanzania with three volumes as further detailed below.

  The inception report will be finalised and distributed in soft copy after the workshops to incorporate feedback from stakeholders on the identified threats. A series of posters

will be displayed at the workshop presenting selected themes and providing a district level overview.

Objectives targeted to be fully achieved during this phase are: 1, 2, 3, 4, 8 and 10.

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

- **Prioritisation Study** through which the threats identified in the extended inception phase will be examined in more detail with the view of preparing a final list of threats for multi-criteria assessment which in turn in the process will also serve to examine adaptation measures addressing these threats.

  The final list of threats and adaptation measures will be reviewed against already existing or planned adaptation projects to ensure that overlapping and duplication is avoided 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 targeted to be fully achieved during this phase are 5, 6, 7, 9 and 11.

- **Reporting and Dissemination** will take place as the final activity under the study and will include a validation among major stakeholders through final workshops in Dar es Salaam and Stone Town. The final report from the study will describe the list of threats and adaptation measures, the method and results of the multi-criterion analysis, the investment prioritisation and propose 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 will reach 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 will be made to comply with the original scheduled completion of the study by September 2014 it is foreseen that completion may be delayed to end of 2014. Rescheduling will take place following the Inception Workshops in April 2014.

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 have been based on 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 is presented in three volumes:

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

Volume II: Coastal Regions, 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 region 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 regional presentations 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
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 follows:

[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.

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 36 of the threats to coastal communities and ecosystems identified in the regional coastal profile for Zanzibar have been prioritised. Out of these 2 were considered to constitute major problems, 13 very important problems, 7 important problems, 8 problems and 6 light problems. The district grouping of the problems are presented in Table 2 below and illustrated in **Error! Reference source not found.** also below.

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

Region	Threats as stated in the Regional Coastal Profile for Zanzibar	1	2	3	4	5	Grand Total
Pemba North	Beach erosion	1					1
	Beach pollution	1					1
	Diseases outbreaks		1				1
	Fisheries decline				1		1
	Loss of habitat and agricultural area			1			1
	Marine environmental pollution		1				1
Pemba North Total		**2**	**2**	**1**	**1**		**6**
Pemba South	Beach erosion			1			1
	Beach pollution			1			1
	Diseases outbreaks			1			1
	Fisheries decline				1		1
	Loss of habitat and agricultural area	1					1
	Marine environmental pollution				1		1
Pemba South Total		**1**		**3**	**2**		**6**
Unguja North	Beach erosion					1	1
	Beach pollution				1		1
	Diseases outbreaks		1				1
	Fisheries decline				1		1
	Land use conflicts				1		1
	Loss of coral cover			1			1
	Marine environmental pollution		1				1
	Sea water intrusion in underground aquifers				1		1
Unguja North Total			**2**	**1**	**4**	**1**	**8**
Unguja South	Beach erosion					1	1
	Beach pollution	1					1
	Diseases outbreaks	1					1
	Fisheries decline				1		1
	Land use conflicts		1				1
	Loss of coral cover		1				1
	Marine environmental pollution		1				1
	Sea water intrusion in underground aquifers	1					1
Unguja South Total		**3**	**3**		**1**	**1**	**8**
Unguja West and Urban	Beach erosion				1		1
	Beach pollution				1		1
	Diseases outbreaks		1				1
	Fisheries decline				1		1
	Land use conflicts				1		1

Region	Threats as stated in the Regional Coastal Profile for Zanzibar	1	2	3	4	5	Grand Total
	Loss of coral cover			1			1
	Marine environmental pollution				1		1
	Sea water intrusion in underground aquifers			1			1
Unguja West and Urban Total			**1**	**2**	**5**		**8**
Grand Total		**6**	**8**	**7**	**13**	**2**	**36**

The details of the ranking of threats within each region are presented in the region chapters under a separate CRIAM heading. A brief overview of threats within each problem class is tabulated in **Error! Reference source not found.** to **Error! Reference source not found.** and briefly commented below.

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
Unguja North	Beach erosion	Kiwengwa, Mnemba, Fukuchani, Nungwi	3	3	3	3	2	72	5					
Unguja South	Beach erosion	Rampant in many areas including Unguja Ujuu, Jambiani, Makunduchi, Uroa, Paje, Bwejuu and Michamvi	3	3	3	3	2	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
Unguja West and Urban	Beach erosion	Kilimani, Mazizini, Maruhubi, Mtoni, Mbweni	3	2	3	3	2	48	4					
Unguja North	Beach pollution	Nungwi, Matemwe, Tumbatu	3	3	3	2	2	63	4					
Unguja West and Urban	Beach pollution	All along the regional sea front	3	3	3	2	1	54	4					
Pemba North	Fisheries decline	Along shallow waters in the region	3	2	3	2	2	42	4					
Pemba South	Fisheries decline	Along shallow waters in the region	3	3	3	2	2	63	4					
Unguja North	Fisheries decline	All along shallow waters of the region	3	3	3	2	2	63	4					
Unguja South	Fisheries decline	All along the shallow water coastal areas	3	3	3	2	1	54	4					
Unguja West and Urban	Fisheries decline	All around the region	3	3	3	2	2	63	4					
Unguja North	Land use conflicts	Pwani Mchangani, Nungwi, Matemwe and Mangapwani. Mnemba Island and Matemwe	3	2	3	2	1	36	4					
Unguja West and Urban	Land use conflicts	In some spots along the coast, Southeast of region where it borders with Menai Bay	3	2	3	2	2	42	4					
Pemba South	Marine environmental pollution	Chake Chake and Mkoani towns and villages. Wesha, Mkoani Port	2	3	3	2	1	36	4					
Unguja West and Urban	Marine environmental pollution	Zanzibar municipalit, Zanzibar port, Maruhubi, Mtoni Deport, Kizingo	3	3	3	2	1	54	4					
Unguja North	Sea water intrusion in underground equifers	All along the coast	3	3	3	2	1	54	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
Pemba South	Beach erosion	Tandauwa, Wambaa, Mkoani, Kangani, etc.,	2	2	3	2	2	28	3					
Pemba South	Beach pollution	Mkoani and Chake Chake town and in some villages	2	2	3	2	1	24	3					
Pemba South	Diseases outbreaks	Chake Chake and Mkoani town, some villages in the region	2	2	3	2	2	28	3					
Unguja North	Loss of coral cover	All along the regional coast	2	2	3	2	2	28	3					
Unguja West and Urban	Loss of coral cover	Stone town reefs and other western coral reef areas	1	3	3	2	2	21	3					
Pemba North	Loss of habitat and agricultural area	Mtambwe, Wete bay, Micheweni	1	3	3	2	2	21	3					
Unguja West and Urban	Sea water intrusion in underground aquifers	Stone Town constituency, Kilimani, Kisiwandui	1	3	3	3	1	21	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
Pemba North	Diseases outbreaks	Micheweni town and villages	1	3	3	2	1	18	2					
Unguja North	Diseases outbreaks	Nungwi, Matemwe, Tumbatu, Pwani Mchangani, Kiwengwa	3	1	2	2	2	18	2					
Unguja West and Urban	Diseases outbreaks	Especially in Urban Distric	1	2	2	2	1	10	2					
Unguja South	Land use conflicts	Chwaka Bay	3	1	2	2	1	15	2					
Unguja South	Loss of coral cover	Jambiani, Bwejuu, Michamvi, Paje, Menai Bay	1	2	3	2	1	12	2					
Pemba North	Marine environmental pollution	Wete and Micheweni towns and villages. Wete port	1	2	3	2	1	12	2					
Unguja North	Marine environmental pollution	All along the north coast, especially Pwani Mchangani Kiwengwa on the east, and Muwanda – Makoba embayment on the west; Matemwe, Nungwi, Mkokotoni, Mangapwani	2	1	2	2	1	10	2					
Unguja South	Marine environmental pollution	All most the entire coast from Makunduchi to Michamvi through Jambiani, Paje and Bwejuu	2	1	2	2	1	10	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
Pemba North	Beach erosion	Ras Kigomasha, Wete, Mtambwe	1	1	3	3	2	8	1					
Pemba North	Beach pollution	Micheweni and Wete town and villages	1	1	2	3	1	6	1					
Unguja South	Beach pollution	All along the coast	1	1	3	2	1	6	1					
Unguja South	Diseases outbreaks	In every big village of the region	1	1	2	2	2	6	1					
Pemba South	Loss of habitat and agricultural area	Along the coastal front. Kisiwa Panza	1	1	3	3	2	8	1					
Unguja South	Sea water intrusion in underground equifers	Menai Bay	1	1	3	3	1	7	1					

2. Pemba North Region

Pemba North is one of two regions that comprise Pemba Island. It has a land area of around 552 km^2 and a coastline of 346 km.

Climate Profile

Temperature

The climate ranges from hot and humid in the coastal plains to temperate in the mountains. Average monthly temperature data, from Pemba weather station (Pemba Airport, from 1988 to 2012), show ranges from a low of around 22.0 ˚C during the coolest months of July to September when maximum temperatures are 28.0 ˚C and 28.9 ˚C for those months, to the highest monthly means of 31.5 ˚C to 32.1 ˚C during the hot season from December to March, when the temperatures drop to only 23.7 ˚C to 24.0 ˚C. Nights become slightly cooler inland, with increasing elevation towards the centre of the island. Relative humidity is 87 % in April, dropping to 76 % in November, with a minimum at 60 % during the dry season (July to September).

Precipitation

The average annual rainfall for the nearest weather station, at Pemba Airport, is 1,458 mm (ranging from 869 mm to 2,354 mm), over the period 1985 to 2012, with monthly rainfall peaks in April and May (main wet season) with 777 mm of rain during those two months, and October to December (short rains) with over 246 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern.

Winds

Based on 26 years of data (1987 to 2012) from the Pemba Airport weather station (near Chake Chake), in the morning (9 am) winds are generally light (6-9 knots), with strongest morning mean wind speeds during the months of July to September. Slightly stronger afternoon (3 pm) wind speeds are experienced throughout the year (9-12 knots), with strongest mean speeds (around 11-12 knots) during the months January and February, and June and July 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 and Zanzibar as 20 knots, with peak speeds during July-August. Tanga and Zanzibar were considered areas of coastline influenced mostly by offshore winds, both with maximum wind speed showing a decreasing trend (Dubi, 2001).

Population

Population size: 211,732 with 108,510 females and 103,222 males. The region has experienced an average annual growth rate between 2002 and 2012 of 1.34 % leading to about 14.28 % increase of the population over the ten-year period. The population density in the region has grown to 448 persons/km^2 from 392 persons/km^2 of 2002.

The Wete and Micheweni districts of Pemba North are by far the poorest of Zanzibar, with a poverty headcount of 70.8 % and 74.2 %, respectively (vs. an overall poverty incidence in Zanzibar of 49 %; see Zanzibar HBS of 2004/05). The over 15 years of age literacy coverage was 82.8 % for men and 63.8 % of women; and under five years of age mortality for North

Pemba 136 (for every 1,000 live births), based on 2006 statistics (see http://knoema.com/TANPOP2006).

Economy

The economy of North Pemba Region is of mixed activities, including farming, fisheries, tourism, wholesale and retail trading as well as government employments. Fishing and farming are major economic activities in this Region. Agriculture and fisheries are the leading economic activities to majority of the households.

Agriculture

About 777 km^2 is agricultural land on the entire Pemba Island (approximately 77 % of the total island area), and about 32,672 households out of 39,706 in various levels are engaging in agriculture. The main food products are cassava (12,686 ha, 43,016 t), paddy (7,544 ha, 9,972 t), sweet potatoes (2,321 ha, 4,498 t), sorghum (1,175 ha, 1,183 t), maize (485 ha, 805 t), brush millet (931 ha, 763 t), banana and a varieties of vegetables and other crops. Main cash crops are cloves, coconut and seaweed.

Fisheries

Fisheries if one of the most important economic activities for communities living close to the coast, engaging 8,693 fishers, plus 1,738 foot fishers. Annual catch of fisheries products in North Pemba region in 2009 was 4,138 (ZNZ-SE, 2010). The region has about 1,577 fishing crafts of which big number is dugout canoe (1,115) and outrigger canoe (289) and only 26 outboard engines (MACEMP, 2009).

Seaweed farming

About 13 % of household in Micheweni district and 9.1 % in Wete involve in seaweed farming (MACEMP 2009). A total of 114 ha farmed seaweed and 258 t harvested in agricultural year 2007/8 (NSCA, 2012), from a workforce of 5,638 seaweed farmers in 2010, with about two thirds being women (DMFR, 2005 as quoted in MACEMP 2009). Although the amount of revenue obtained from seaweed farming is low compared to effort exerted, it remains attractive to take for many coastal women without alternative income generating activities.

Tourism

In general Pemba offers a particular type of cultural as well as ecological tourism although the high potential is not achieved. North Pemba Region is very famous for quality beaches (such as Mbuyuni Beach, Vuma Wimbi Beach and Panga ya Watoto Beach) and green sceneries, with a rich marine biodiversity. Tourism in Micheweni district involves about 6.3 % of the households while in Wete district it involves only 1.4% (MACEMP, 2009). Main tourism related activities include hotel employment, selling of products and tour guiding. Generally tourism is still underutilized, especially for cultural and ecotourism. Marine attractions include pristine coral reefs and game fishing.

Minerals

Some small scale sand and rock excavation supplies the building trade and salt pan area in Micheweni is 10.82 ha and in Wete 81.23 ha. On the west coast of Pemba Island there is a natural oil seep, at Tundaua, indicating geologic condition appropriate for oil formation, but no suggestion of the qualities. No viable reserves of oil or gas have been found on Pemba (with only a single well drilled in 1960s, Pemba-5, which recorded oil shows, but may have been missed the target depth) and exploration for oil and gas is about to commence with seismic surveys, for offshore waters to the east, by Shell International.

Description of the coast

Physical

Pemba North Region situated on the northern half of Pemba Island. It is surrounded by the Indian Ocean accept for the south side where it borders with South Pemba Region. The region has a number of islets, only two of them, Fundo and Njao, are inhabited.

There are two small rivers less than 6 km in length that drain from higher ground, flowing north. The shore is a mixture of hard substrates evidenced by the many headlands and cliffs, interspersed with mangrove creeks, with four creeks opening onto extensive intertidal sand and mud areas, some bedded with seagrass, extending into longer inlets, some several kilometres in length.

Sediments 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 coastal waters of North Pemba support coral reefs, mangroves, intertidal and sub-tidal flats with vast formations of sea grass beds and algal growth. In some areas there are rocky cliffs and intertidal rock flats while others have long and vast sandy beaches. The continental shelf is very narrow and deep water is quite close to the shore. Convolutions and undulations are numerous in this region, especially on the western side. These embayment and undulations are characterised by shallow water, numerous sand banks, sea grasses and healthy mangrove forests in many areas. Pemba Northern tip is characterised of comparatively wide intertidal with a vast seagrass and seaweed meadows. These characteristics resulted to high diversity of various coastal organisms.

Coral reefs - North Pemba region coast is surrounded by a fringing reef in almost all its coastal boundaries with some few interruptions in channels that enter Wete Bay such as between Mwata and Uvinje Island, Uvinje Islet and Fundo Island, Fundo Island and Njau and between Njau and Makangale on the eastern side. Reefs on the east coast has steep slope and characterised by low coral cover due to strong wave and current forces. Northern reef are wider compared to eastern reefs with a considerable formation of shallow back-reefs.. In general coral reef in Pemba show high diversity and cover range between 40 – 60% (PECCA 2005).

Mangroves – The total mangrove cover for the entire Pemba Island is 10,525 ha, with approximately half in each of the two regions. The mangrove forests are most luxuriant around the mouths of river inlets and creeks and in sheltered bays along the western, northern and eastern shores of Pemba North (around Micheweni and Tumbe) and the western creeks at Wete and embayment between Kijani and the main island.

Beach and rock shorelines – Most of the shoreline of Pemba 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

With few and minor rivers, coastal waters are little influenced by rainfall, expect during peak rains during April and 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

Coelacanth (*Latimera chalumnae*) - Listed as Critically Endangered, one specimen to date has been caught off Pemba in shark-nets at depths of 250 m.

Whale shark– A Vulnerable species by IUCN Red List (2002), occasional individuals are caught accidentally (there is no trade in the species) and some individual tagged in Seychelles found migrated to Zanzibar (Norman, 2005).

Turtles – Green turtles in this area are frequent, though nesting is uncertain, except for Misali (in Pemba South).

Cetaceans - Humpback whales are regularly reported within short distances of the coastline between June and November, especially off the western shores.

Shorebirds – Pemba Island, especially through the Ngezi Forest National Park is well-known for the bird uniqueness, with the nominated IBA 76 – Pemba Island, recording 132 species, with four endemic land or forest birds and numerous shorebirds (see Baker and Baker, 2002).

Natural resources

There are three forest areas in Pemba, these are Ngezi FR (1,440 ha), Msitu Kuu forest and Kiuyu forest. Ngezi FR lies on the north-western tip of Pemba Island and is a remnant of the forest that used to cover the western Pemba Island, and was reserved in 1959. The forest has a diverse of habitat type including estuarine, marine and coral rug forest. The biodiversity is high and it harbours some important bird species, such as three endemic subspecies of Pemba. About 56 km^2 is bushland on the entire Pemba Island

Settlements

The settlement and built-up portion of Pemba North is concentrated around the main town (Wete) as well as some of the larger villages (Michiweni, Kojani and Kangagani). The remainder of the villages are scattered across the region, with the far north-west with the lowest densities of inhabitants where land use is agricultural with smaller settlements.

Infrastructure

Pemba North region has good network of tarmac road that connects it to other regions and to the entire Pemba Island, with a good number of feeder roads. Most villages are accessible by road in all seasons, though some feeder roads are less passable during rainy season. All major mobile phone providers have network in this region. The region is directly connected through sea to Unguja Island and coastal East Africa through Wete Port, a harbour which can handle small to medium size cargo and passenger vessels.

Major Threats

Table 8: Overview of threats to coastal communities in Pemba North region.

Threat	Location	Cause
Beach pollution	Micheweni and Wete town and villages	Uncontrolled solid and liquid waste disposal
Beach erosion	Ras Kigomasha, Wete, Mtambwe	Mangrove cutting, beach sand mining, unplanned construction along the coast, currents and waves
Fisheries decline	Along shallow waters in the region	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods such as beach seine and kigumi
Diseases outbreaks	Micheweni town and villages	Inadequate sewerage control, poor solid waste management, use of beaches and bushes as toilets
Loss of habitat and agricultural area	Mtambwe, Wete bay, Micheweni	Mangrove cutting, Influx of sea water to agricultural land. Limestone brick cutting
Marine environmental pollution	Wete and Micheweni towns and villages. Wete port	Uncontrolled solid waste dump sites, as well as untreated sewage from domestic uses in the area. Influx of pesticides, nutrients and fertilizers from nearby firms, especially in the undulations and valleys where sea water near the agricultural areas. Possible oil leak during loading and offloading of petroleum from ships at Wete port.

CRIAM Ranking of Threats to Local Communities in Pemba North Region

Table 9: Prioritisation of threats to local communities in Pemba North Region. The assessment uses using 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 shallow waters in the region	3	2	3	2	2	42	4					
Loss of habitat and agricultural area	Mtambwe, Wete bay, Micheweni	1	3	3	2	2	21	3					
Diseases outbreaks	Micheweni town and villages	1	3	3	2	1	18	2					
Marine environmental pollution	Wete and Micheweni towns and villages. Wete port	1	2	3	2	1	12	2					
Beach erosion	Ras Kigomasha, Wete, Mtambwe	1	1	3	3	2	8	1					
Beach pollution	Micheweni and Wete town and villages	1	1	2	3	1	6	1					

Major Opportunities

Opportunities available for coastal communities include:

- Offshore fisheries
- Beekeeping
- Aquaculture, including fattening of crabs and lobsters
- High-tech horticulture to cater for hotels and resorts;
- Ecological as well as cultural tourism

Climate Change Impacts

Table 10: Estimated area losses of sea level rise scenarios on overall area and on land uses in Pemba Island.

Pemba Island (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	3,866	4.41	5,113	5.83	6,657	7.59	9,072	10.34	11,924	13.59	29,675	33.82

For projected rise levels of 1 m an inundation of 4.4 % is calculated across the entire island of Pemba, increasing to 13.6 % with a 5 m sea level rise. These inundated areas are likely to be in the creeks and bays that are typical of the west coast of the island, in both regions. Significant impacts from sea level rise are felt over the general land area for rise levels of 10 m, equivalent to storm surges, inundating almost 34 % of the island. When coinciding with spring high tides, such surges are likely to have even more 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 Pemba Island is part of the internationally-recognised "Pemba Island" area of eco-regional importance (WWF, 2004), based on the exceptional coral reef diversity and importance (including 200 km of fringing coral reefs, with islands, mangrove creeks, sand beaches and vast intertidal flats). Though no legislated conservation or formal protection measures are associated with the status of eco-regional importance, the recognition has drawn attention to the coastal habitats of Pemba which has in some locations resulted in improved management and increase conservation awareness. There are two main environmental and coastal management initiatives that are currently in place:

Pemba Channel Conservation Area (PECCA) – In September 2005 the Zanzibar Government declared the Pemba Channel Conservation Area (PECCA) through the Fishing Act. Management of PECCA falls under the Marine and Coastal Environmental Management Project. The Pemba Channel Conservation Area is positioned to the west of Pemba Island and it covers 42 nautical miles stretching from the southern tip to the northern one. It has a two-mile width stretching from Fundo Island. The no-take zone around Misali Island continues to exist and certain fishing gears are allowed in the reserve stretching along the rest of the western coast. The ultimate aim for PECCA is to have the area declared a UNESCO World Heritage Site to further protect both its marine habitats and its rich cultural heritage (Grimsditch et al. 2009).

Ngezi Forest Nature Reserve - Reserve established under the Forest Reserves Decree, Cap 120, under the Forest Resources Management and Conservation Act No 10 of 1996. Last patch of indigenous forest in Pemba, a mix of eastern Arc and Asian species with endemic species (e.g. Red Colubus Monkeys, Pemba White-eye (bird)), and a stretch of mangrove forest.

3. Pemba South Region

Pemba South is one of two regions that comprise Pemba Island. It has a land area of around 460 km^2 and a coastline of 341 km.

Climate Profile

Temperature

The climate ranges from hot and humid in the coastal plains to temperate in the mountains. Average monthly temperature data, from Pemba weather station (Pemba Airport, from 1988 to 2012), show ranges from a low of around 22.0 ˚C during the coolest months of July to September when maximum temperatures are 28.0 ˚C and 28.9 ˚C for those months, to the highest monthly means of 31.5 ˚C to 32.1 ˚C during the hot season from December to March, when the temperatures drop to only 23.7 ˚C to 24.0 ˚C. Nights become slightly cooler inland, with increasing elevation towards the centre of the island. Relative humidity is 87 % in April, dropping to 76 % in November, with a minimum at 60 % during the dry season (July to September).

Precipitation

The average annual rainfall for the nearest weather station, at Pemba Airport, is 1,458 mm (ranging from 869 mm to 2,354 mm), over the period 1985 to 2012, with monthly rainfall peaks in April and May (main wet season) with 777 mm of rain during those two months, and October to December (short rains) with over 246 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern.

Winds

Based on 26 years of data (1987 to 2012) from the Pemba Airport weather station (near Chake Chake), in the morning (9 am) winds are generally light (6-9 knots), with strongest morning mean wind speeds during the months of July to September. Slightly stronger afternoon (3 pm) wind speeds are experienced throughout the year (9-12 knots), with strongest mean speeds (around 11-12 knots) during the months of January and February, and June and July 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 and Zanzibar as 20 knots, with peak speeds during July-August. Tanga and Zanzibar were considered areas of coastline influenced mostly by offshore winds, both with maximum wind speed showing a decreasing trend (Dubi, 2001).

Population

Population size: 195,166 with 101,245 females and 93,871 males. The region has experienced an average annual growth rate between 2002 and 2012 of 1.06% leading to around 11% increase of the population over the ten year period. The population density in the region has grown to 482 persons/km^2 of 2012 from 434 persons/km^2 of 2002.

The Chake Chake and Mkoani districts of Pemba South have a poverty headcount of 56.8 % and 42.1 % respectively (vs. an overall poverty incidence in Zanzibar of 49%; see Zanzibar HBS of 2004/05). The over 15 years of age literacy coverage was 88.5 % for men and 74.1 % of women; and under five years of age mortality for South Pemba 104 (for every 1,000 live

births), based on 2006 statistics (see http://knoema.de/atlas/Vereinigte-Republik-Tansania/South-Pemba).

Economy

The economy of South Pemba Region is of mixed activities, including farming, fisheries, tourism, whole sale and retail trading as well as government employments. Fishing and farming are major economic activities in this Region.

Agriculture

Agriculture and fisheries are the two most important economic activities for South Pemba region's population. About 777 km^2 is agricultural land on the entire Unguja Island (approximately 77 % of the total island area), engaging about 29,950 households out of 35,884. Main food products are cassava (10,774 ha, 39,629 t), paddy (9,581 ha, 11,069 t), maize 302 ha, 355 t), sweet potatoes (162 ha, 229 t), brush millet (117 ha, 57 t), sorghum (58 ha, 51 t), plus banana and a varieties of vegetables and other crops. Main cash crops are including cloves, coconut, and seaweeds (102 ha).

Fisheries

The marine fisheries engage 4,161 fishers, plus 1,626 foot fishers. Annual catch of fisheries products in South Pemba region in 2009 was 4,773 (ZNZ-SE, 2010). The region has about 1,741 fishing crafts of which big number is dugout canoe (1,103) and outrigger canoe (572) and only 32 outboard engines (MACEMP, 2009).

Seaweed farming

About 6.3% of household in Mkoani district and 2.7% in Chake Chake are involved in seaweed farming (MACEMP 2009a). A total of 102 ha farmed seaweed and 245 t harvested in agricultural year 2007/8 (NSCA, 2012). There were 1,218 seaweed farmers in 2010, with the majority women.

Tourism

South Pemba Region is very famous for beautiful beaches and green sceneries, with a rich marine biodiversity. Tourism in Mkoani district involves only about 3.5% of the households while in Chake Chake district it involves only 3.2% (MACEMP, 2009). Main tourism related activities including hotel employment, selling of products and tour guiding. The region has very few tourist hotels although it harbours the best coral reef diving site in the entire East Africa at Misali Island.

Generally tourism is still underutilized, especially for cultural and ecotourism. The marine ecology of South Pemba, particularly Misali Island offers very spectacular shallow and deep water diving options.

Minerals

The mining activities undertaken in South Pemba region include excavation of sand, gravel stone or boulders, aggregates and limestone. Of special environmental concern is the excavation of limestone bricks in various areas including Kisiwa Panza. There are 87 ha of salt works in the region, all located inshore of the mangrove creeks.

On the west coast of Pemba Island there is a natural oil seep, at Tundaua, indicating geologic conditions appropriate for oil formation, but no suggestion of the qualities. No viable reserves of oil or gas have been found on Pemba (with only a single well drilled in 1960s, Pemba-5)

and exploration for oil and gas is about to commence with seismic surveys, for offshore waters to the east, by Shell International.

Description of the coast

Physical

South Pemba Region is situated on the southern half of Pemba Island. It is surrounded with Indian Ocean accept for north side where it borders with North Pemba Region. The region has a number of islets, including Kisiwa Panza and Makoongwe that are inhabited.

There are eight small rivers less than 6 km in length that drain from higher ground, flowing to the east or west of the region. The shore is a mixture of hard substrates evidenced by the many headlands and cliffs, interspersed with mangrove creeks, with four creeks opening onto extensive intertidal sand and mud areas, some bedded with seagrass, extending into longer inlets, some several kilometres in length, the longest leading to Chake Chake.

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 coastal waters of South Pemba Region support coral reefs, mangroves, intertidal and subtidal flats with vast formations of seagrass beds and algal growth. In some areas there are rocky cliffs while others have long and vast sandy beaches. The continental shelf is very narrow and deep water is quite close to the shore, especially in the south and southeastern side. Convolutions and undulations are numerous in this region as in other Pemba areas. These embayment and undulations are characterised by shallow water, numerous sand banks, sea grasses and healthy mangrove formations in many areas. These characteristics resulted in high diversity of various coastal organisms.

Coral reefs - Southern Pemba region is made up of fringing reefs on all shores, from northeast to southern end and towards southwest where it is interrupted with a wide area of shallow water with sandy substrate rich in sea grasses. The eastern side reef is continuous although interrupted in three areas. Eastern reefs are narrow, with low coral cover but large percentage of rocky substratum and fleshy algae on some parts. The area is directly exposed to strong waves and currents from the open ocean.

In the western part there are some reef formations including from Ras Wambaa southward. Misali Island, Utalimani reef and Ras Mkumbuu lie on the northwest of the region, an area characterized by rich coral reefs with magnificent coral formations, high cover and diversity. Misali offers both a shallow patchy reef (Mkwajuni area) and a complex, deep, almost pristine reef which extends to 64 m depth. There is minimum soft coral and fleshy algae cover in Misali. Mkwajuni reef is patchy coral outcrops interspersed with sand, rubble and seagrass beds. Utalimani has a vast area of shallow patchy reef (2-5 m) on the eastern side and steep sloped reef on the western side.

Mangroves – The total mangrove cover for the entire Pemba Island is 10,525 ha, with approximately half in each of the two regions. The mangrove forests are most luxuriant around the mouths of river inlets and creeks and in sheltered bays along the western and southern shores of Pemba South (around Panza and Tanuni) and the western creeks at Chake Chake and Mkombeni.

Beach and rock shorelines – Most of the shoreline of Pemba supports mangrove forests and have rocky outcrops and headlands, with 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

With few and minor rivers, coastal waters are little influenced by rainfall, except during peak rains during April and May where the influence of fresh water from the rivers is restricted to coastal waters tending to reduce water salinity and increase turbidity due to sediment inputs near the coast.

Marine species of importance

Coelacanth (*Latimera chalumnae*) - Listed as Critically Endangered, one specimen to date has been caught off Pemba in shark-nets at depths of 250 m.

Whale shark– A Vulnerable species by IUCN Red List (2002), occasional individuals are caught accidentally (there is no trade in the species) and some individual tagged in Seychelles found migrated to Zanzibar (Norman, 2005).

Turtles – Green turtles in this area are frequent, nesting on Misali Island and Makoongwe, the main sea turtle nesting ground of the entire Pemba Island (MACEMP, 2009a).

Cetaceans - Humpback whales are regularly reported within short distances of the coastline between June and November, especially off the western shores.

Shorebirds – Pemba Island, especially through the Ngezi Forest National Park is well-known for the bird uniqueness, with the nominated IBA 76 – Pemba Island, recording 132 species, with four endemic land or forest birds and numerous shorebirds (see Baker and Baker, 2002).

Natural resources

There is no forest reserve in South Pemba, a part from a small patch of forest within the Misali Island which due to MIMCA automatically falls under conservation. South Pemba region has a number of mangrove stands (see above) scattered on the east and the west of the Island. Remnants of old forest are found in very small scales and in very few areas. Most of the land in South Pemba region has been used for agricultural purposes, notably clove plantations.

Settlements

The settlement and built-up portion of Pemba South is concentrated around the two main towns (Chake Chake and Mkoani) as well as in some of the larger villages (Michenzani, Wesha, Wambaa and Chambani). The remainder of the villages are scattered across the region, with the lowest densities of inhabitants in the far northwest where land use is agricultural.

Infrastructure

The region has a good network of tarmac roads that connects it to the northern region and to the entire Pemba Island. Almost all villages are accessible by road in all season with varied level of accessibility during rainy seasons. All major mobile phone providers have network in this region. The region is directly connected via sea to Unguja Island and coastal East Africa through Mkoani Sea Port, a very active harbour which can serve small to medium size cargo and passenger vessels, with regular sailings to Zanzibar, Dar es Salaam and sometimes Tanga.

Pemba Airport, at Chake Chake, is in good condition and it can serve for small and medium aircrafts, also with regular scheduled flights to Zanzibar, Tanga and Dar es Salaam.

Major Threats

Table 11: Overview of threats to coastal communities in Pemba South region.

Threat	Location	Cause
Beach pollution	Mkoani and Chake Chake town and in some villages	Uncontrolled solid and liquid waste disposal
Beach erosion	Tandauwa, Wambaa, Mkoani, Kangani, etc.,	Mangrove cutting, beach sand mining, unplanned construction along the coast, currents and waves
Fisheries decline	Along shallow waters in the region	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods such as beach seine and kigumi
Diseases outbreaks	Chake Chake and Mkoani town, some villages in the region	Inadequate sewerage control, poor solid waste management, use of beaches and bushes as toilets
Loss of habitat and agricultural area	Along the coastal front Kisiwa Panza	Mangrove cutting, Influx of sea water to agricultural land. Limestone brick cutting
Marine environmental pollution	Chake Chake and Mkoani towns and villages. Wesha, Mkoani Port	Uncontrolled solid waste dump sites, as well as untreated sewage from domestic uses in the area. Influx of pesticides, nutrients and fertilizers from nearby firms, especially in the undulations and valleys where sea water near the agricultural areas. Possible oil leak during loading and offloading of petroleum from ships at Wesha depot and Mkoani Port.

CRIAM Ranking of Threats to Local Communities in Pemba South Region

Table 12: Prioritisation of threats to local communities in Pemba South Region. The assessment uses using 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 shallow waters in the region	3	3	3	2	2	63	4					
Marine environmental pollution	Chake Chake and Mkoani towns and villages. Wesha, Mkoani Port	2	3	3	2	1	36	4					
Beach erosion	Tandauwa, Wambaa, Mkoani, Kangani, etc.,	2	2	3	2	2	28	3					
Diseases outbreaks	Chake Chake and Mkoani town, some villages in the region	2	2	3	2	2	28	3					
Beach pollution	Mkoani and Chake Chake town and in some villages	2	2	3	2	1	24	3					
Loss of habitat and agricultural area	Along the coastal front. Kisiwa Panza	1	1	3	3	2	8	1					

Major Opportunities

Opportunities available for coastal communities:

- Offshore fisheries
- Cultural and ecological tourism
- Beekeeping
- Aquaculture, including fattening of crabs and lobsters
- High-tech agriculture to cater for hotels and resorts

Climate Change Impacts

Significant impacts from sea level rise are felt over the general land area, even for rise levels of 1 m, particularly in the shallow embayments around Chake Chake and Mkoani (see Table 10, above).

Projects and Plans

The entire Pemba Island is part of the internationally-recognised "Pemba Island" area of eco-regional importance (WWF, 2004), based on the exceptional coral reef diversity and importance (including 200 km of fringing coral reefs, with islands, mangrove creeks, sand beaches and vast intertidal flats). Though no legislated conservation or formal protection measures are associated with the status of eco-regional importance, the recognition has drawn attention to the coastal habitats of Pemba which has in some locations resulted in improved management and increased conservation awareness. There are two main environmental and coastal management initiatives that are currently in place:

Misali Island Marine Conservation Area (MIMCA) - In August 1997 the Government of Zanzibar established the boundaries of the MIMCA. About 1,640 fishers from 29 communities use the MIMCA area and both extractive use and no-take zones exist. The Misali Island Conservation Association (MICA), a local fisher's association, is charged with assisting communities to protect the island and enhance livelihoods. Since 1998, the project has been funded by CARE International. There is an interpretive centre on the island and six full time rangers. MIMCA is considered a successful example of co-management. Illegal and destructive fishing has largely been stopped (see Campson, et al. 2010). MIMCA is considered a core area with the newly established PeCCA.

Pemba Channel Conservation Area (PeCCA) – Includes the entire west coast (see full description in Pemba North, Chapter 2, above).

4. Unguja North Region

Unguja North is one of three regions that comprise Unguja Island. It has a land area of around 450 km^2 and a coastline of 103 km.

Climate Profile

Temperature

The climate ranges from hot and humid in the coastal plains to temperate in the mountains. Average monthly temperature data, from Zanzibar weather station (Zanzibar Airport, from 1986 to 2012), show ranges from a low of around 20.5 ˚C during the coolest months of August and September when maximum temperatures are 29.1 ˚C and 30.3 ˚C for those months, to the highest monthly means of 31.6 ˚C to 33.0 ˚C during the hot season from December to March, when the temperatures drop to only 23.5 ˚C to 24.1 ˚C. Relative humidity is 87 % in April, dropping to 76 % in November, with a minimum at 60 % during the dry season (July to September).

Precipitation

The average annual rainfall for the nearest weather station, at Zanzibar Airport, is 1,583 mm (ranging from 704 mm to 2,459 mm), over the period 1987 to 2012, with monthly rainfall peaks in April and May (main wet season) with 641 mm of rain during those two months, and November to December (short rains) with over 375 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern.

Winds

Based on 26 years of data (1987 to 2012) from the Zanzibar Airport weather station, in the morning (9 am) winds are generally light (6-9 knots), with strongest morning mean wind speeds during the months of January and February. Stronger afternoon (3 pm) wind speeds are experienced throughout the year (7-13 knots), with strongest mean speeds (around 12-13 knots) during the months of July and August, with occasional January strong wind events, 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 Zanzibar as 20 knots, with peak speeds during July-August. Zanzibar was considered an area of coastline influenced mostly by offshore winds, with maximum wind speed showing a decreasing trend (Dubi, 2001).

Population

Population size: 187,455 with 95,341 females and 92,114 males. The region has experienced a high average annual growth rate between 2002 and 2012 of 3.17 % leading to more than 37.37% increase of the population over the ten-year period. The population density in the region has grown to 397 persons/km^2 of 2012 from 289 persons/km^2 of 2002.

Unguja North A and B have a poverty headcount of 53.3 % and 48.3 %, respectively (vs. an overall poverty incidence in Zanzibar of 49%; see Zanzibar HBS of 2004/05). The over 15 years of age literacy coverage was 77.8 % for men and 72.4 % of women; and under five years of age mortality for Unguja North was 124 (for every 1,000 live births), based on 2006 statistics (http://knoema.com/TANPOP2006).

Economy

The population in Unguja North Region are engaged in more than one economic activity, with the major economic activities being farming, fisheries, tourism, seaweed farming, and retail trading as well as government employment. Fishing and farming are the leading economic activities in this Region, employing 27 % and about 24 % of the working force, respectively. Seaweed farming engages 12.3 %, tourism 7.4 % and other activities together employ 29.15 % (MACEMP, 2009a).

Agriculture

About 528 km^2 is agricultural land on the entire Unguja Island (about 34 % of the entire island), with some 20,000 ha cultivated in the region with main food products being cassava (7,262 ha), paddy (5,589 ha), maize (2,235 ha), sweet potatoes (1,393 ha), sorghum, and banana (2,653 ha) and a varieties of vegetables and other crops. Main cash crops are including coconut (1,911 ha) (TASS, 2012), cloves (456 ha), and seaweed (309 ha).

Fisheries

About 13.5 % and 8.5 % of households in the North-A and North-B districts in Unguja North are engaged directly in fisheries, totalling 6,524 fishers, plus 1,562 foot fishers. Annual catch of fisheries products in Unguja North region in 2009 was 3,666 t (ZNZ-SE, 2010).

Seaweed farming

About 18 % of households in North-A region and 2.1 % in North-B involve in seaweed farming (MACEMP 2009a) over 42 ha, with a 2007/8 harvest of 56 t (NSCA, 2012). There were 10,222 seaweed farmers in 2010 in North Region, with about 80 % being women (DMFR, 2005 as quoted in MACEMP 2009a).

Tourism

North Region is popular for beaches and hotels of various standards. Tourism in North-A region involves about 13.3 % of the households while in North-B region it involves only 3.9 %. Main tourism-related activities include hotel employment, supply of products, handcraft making and selling and tour guiding. The male workforce generally dominates employment in the industry, while females dominate handcrafting and some hotel employment, especially housekeeping.

Minerals

Other than sand and rock excavation, there is little mineral exploration or economy in the North Unguja region. No viable reserves of oil or gas have been found on Unguja (with only a single well drilled in the 1960s) and exploration for oil and gas is about to commence with seismic surveys, for offshore waters to the east, by Shell International.

Description of the coast

Physical

Unguja North Region is situated on the northern half of Unguja Island, and is bordered to the south by the regions of Unguja South (to the east) and Town and Urban on the west. The east coast is predominantly sand beach interspersed with fossil limestone outcrops, more predominant around the northern extreme. On the western shores, the isle of Tumbatu is a distinctive feature, with the main villages of Jongowe and Gomani, while the remainder of the western shores of the region is either farmed of settled, more so closer to Unguja Urban.

There are four small, mainly seasonal rivers that drain the north region, all flowing to the west, the largest emptying at Makoba mangrove creek. The shore is a mixture of hard substrates giving rise to headlands, interspersed with sand beach bays and the main mangrove creek at Makoba. Sediment types vary greatly, from clay bound sands and gravel to more unconsolidated suite of recent times. Beach sands are mainly of carbonate, biogenic origin.

Coastal ecology

The coastal waters of Unguja North Region support coral reefs, mangroves, intertidal and subtidal flats with vast formations of seagrass beds and algal growth.

Coral reefs - The region is characterised by a long stretch of fringing reef which runs from the southeast end to the northwest end. There is also a very long and wide intertidal and subtidal stretch, which in some places, stretches a few kilometres from the shore to the fringing reef, mostly with a shallow lagoon and patchy reefs. Off the northeastern end there is Mnemba Island with 21 km of fringing reefs on its north and eastern side while on the western side there is a series of shallow patch reefs. In the western side of North Region there are shallow patch reefs scattered on the sandy platform (Mohammed, 2002). A deep (10–20 m) patch reef (Shearwater Patches) is situated about 7-10 km off the main coast and south of Tumbatu Island.

Tumbatu Island is fringed with coral reef on its northern and western sides with a series of shallow patch reefs scattered off the western shores. Around Mnemba Atoll, live coral cover reaches 65 %, while in Kendawi, algal cover only accounts for 39 %. Hard coral cover is generally low in the eastern exposed sites, e.g. Kichwani had only 2 % coral cover (Bergam & Ohman, 1999), with northwest Mnemba live coral cover was 16 % while that of southwest Mnemba was 10 % live coral cover. Massive and submassive corals dominated exposed areas and foliose corals can be found in sheltered reefs such as Mnemba southwest (Mbije et al., 2002).

Mangroves – Total area covered by mangrove for the whole of Unguja Island is 4,934 ha, though most of that is present in the South Unguja Region. North Unguja mangroves are restricted to a few hectares at Muwanda and Makoba.

Beach and rock shorelines – The forests are most luxuriant around the mouths of large river mouths and in sheltered bays along the mainland coast and on Pemba Island

Coastal waters

With few and minor rivers, coastal waters are little influenced by rainfall, expect during peak rains during April and May when 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.

Marine species of importance

Coelacanth (*Latimera chalumnae*) - Listed as Critically Endangered, one specimen to date has been caught off Pemba in shark-nets at depths of 250 m.

Whaleshark– A Vulnerable species by IUCN Red List (2002), occasional individuals are caught accidentally (there is no trade in the species) and some individual tagged in Seychelles found migrated to Zanzibar (Norman, 2005).

Seahorses - *Hippocampus kelloggi* which is reported from lagoons off the northeast of Unguja, in the North region. This is a vulnerable species according to IUCN 2002 (Wiswedel, 2012).

Turtles – Green turtles in this area are frequent, nesting on Mnemba, Matemwe and Nungwi (Khatib and Jiddawi, 2005) although shores in Nungwi are almost completely used for tourism developments. Hotel construction threats the nesting in the area (MACEMP, 2009a). Mnemba Island is the only protected nesting area in Unguja, with an average of 35-40 nests a year, typically between the months of February and September. Mnemba Island staff in conjunction with the Department of Fisheries/Forestry and Sea Sense monitor the nests and provide statistics regarding size, nesting habits, clutch sizes, success rates, etc.

Cetaceans - Humpback whales are regularly reported within short distances of the coastline between June and November, especially off the eastern shores, with bottlenose dolphins commonly encountered around Mnemba.

Natural resources

There are 756 km^2 of woodland on the entire Unguja Island (representing about 49 % of the island), plus 42 km^2 of natural forest (about 3 %). Kiwengwa Controlled Area includes protected forest (about 17.5 km^2), located in the Urban West region, on the east coast.

Settlements

The settlement and built-up portion of Unguja North is concentrated along the two main routes (main road to Nungwi past Mahonda from Stone Town, and the eastern coast road from Matemwe to Chwaka Bay). The remainder of the villages are scattered across the region, with the far northeast having the lowest densities of inhabitants as coral rag offers few agricultural options other than grazing and firewood.

Infrastructure

The region has a good network of tarmac roads that connects it to other regions and to the entire Unguja Island. Almost all villages are accessible by road all year with varied level of accessibility during rainy seasons for those more remote. All major mobile phone providers have network coverage. The region is directly connected to Pemba Island and mainland Tanzania through Mkokotoni Port, a small harbour which can serve small, normally traditional, cargo vessels.

Major Threats

Table 13: Overview of threats to coastal communities in Unguja North region.

Threat	Location	Cause
Beach pollution	Nungwi, Matemwe, Tumbatu	Uncontrolled solid and liquid waste disposal
Beach erosion	Kiwengwa, Mnemba, Fukuchani, Nungwi	Beach sand mining, unplanned construction along the coast, currents and waves, clearing coastal vegetation.
Fisheries decline	All along shallow waters of the region	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods such as beach seine and kigumi
Diseases outbreaks	Nungwi, Matemwe, Tumbatu, Pwani Mchangani, Kiwengwa	Inadequate sewerage control, poor solid waste management, use of beaches and bushes as toilets
Marine environmental pollution	All along the north coast, especially Pwani Mchangani Kiwengwa on the east, and Muwanda – Makoba embayment on the west; Matemwe, Nungwi, Mkokotoni, Mangapwani	Uncontrolled solid waste dump sites, as well as untreated sewage from domestic uses and tourist hotels in the area. Influx of pesticides, nutrients and fertilizers from nearby farms, especially in valleys with agricultural areas close to the shore. Possible oil leak during loading/unloading fuels in landing sites and small local harbours
Land use conflicts	Pwani Mchangani, Nungwi, Matemwe and Mangapwani Mnemba Island and Matemwe	Use of space, especially beaches and intertidals, between hoteliers and local community – seaweed farmers and fishers. Use of space and resources between fishers and Mnemba Island CA
Loss of coral cover	All along the regional coast	Crown of Thorn outbreak; over exploitation of habitat by fishers, gleaners and tourists
Sea water intrusion in underground aquifers	All along the coast	Overuse of ground water by tourist hotel and increased population related to tourism (Gössling, 2001).

CRIAM Ranking of Threats to Local Communities in Unguja North Region

Table 14: Prioritisation of threats to local communities in Unguja North Region. The assessment uses using 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	Kiwengwa, Mnemba, Fukuchani, Nungwi	3	3	3	3	2	72	5					
Beach pollution	Nungwi, Matemwe, Tumbatu	3	3	3	2	2	63	4					
Fisheries decline	All along shallow waters of the region	3	3	3	2	2	63	4					
Sea water intrusion in underground aquifers	All along the coast	3	3	3	2	1	54	4					
Land use conflicts	Pwani Mchangani, Nungwi, Matemwe and Mangapwani. Mnemba Island and Matemwe	3	2	3	2	1	36	4					
Loss of coral cover	All along the regional coast	2	2	3	2	2	28	3					
Diseases outbreaks	Nungwi, Matemwe, Tumbatu, Pwani Mchangani, Kiwengwa	3	1	2	2	2	18	2					
Marine environmental pollution	All along the north coast, especially Pwani Mchangani Kiwengwa on the east, and Muwanda – Makoba embayment on the west; Matemwe, Nungwi, Mkokotoni, Mangapwani	2	1	2	2	1	10	2					

Major Opportunities

Opportunities available for coastal communities:

- Offshore fisheries
- Beekeeping
- Aquaculture, including fattening of crabs and lobsters
- High-tech agriculture to cater for hotels and resorts
- Employments in tourism industry

Climate Change Impacts

Table 15: Estimated area losses of sea level rise scenarios on overall area and on land uses in North Unguja region.

Unguja	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 (km^2)	594	0.79	1,456	1.95	2,432	3.25	3,836	5.13	5,207	6.97	21,780	29.14

For projected rise levels of 4 m an inundation of 5.3 % is calculated across the entire island of Unguja, increasing to almost 7 % with a 5 m sea level rise. These inundated areas are likely to be in the creeks and bays that are typical of the northwest coast of the region, around Mkokotoni. Significant impacts from sea level rise are felt over the general land area for rise levels of 10 m, equivalent to extreme storm surges, inundating over 29 % of the island. When coinciding with spring high tides, such surges are likely to have even more 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

Mnemba Island Marine Conservation Area (MIMCA) - Established in 2002 to protect natural systems around Mnemba Island, it has an area of approximately 150 ha and houses Mnemba Island Lodge, a high-end luxury resort. The island is managed by Conservation Corporation Africa (CCA), a South African Company founded in 1990. Mnemba is surrounded by an extensive coral reef and it is an important nesting ground for sea turtles. There is a no-fishing protected area zone that extends 200 m offshore surrounding the island. Mnemba Island Lodge and protected area was established in 1992 and in 2002 the area was officially gazetted as marine conservation area.

Kiwengwa Controlled Area – Gazetted in 2000, the site includes protected forest (about 17.5 km^2), traditional fishing grounds, fringing coral reefs, seagrass beds, algal beds, and once a productive fishery. There are three villages involved: Kiwengwa, Mwani Mchangani and Pongwe, all located in the Urban West region, on the east coast of Unguja Island.

5. Unguja West and Urban Region

Unguja West and Urban is the smallest of the three regions that comprise Unguja Island. It has a land area of around 232 km^2 and a coastline of 64 km.

Climate Profile

Temperature

The climate ranges from hot and humid in the coastal plains to temperate in the mountains. Average monthly temperature data, from Zanzibar weather station (Zanzibar Airport, from 1986 to 2012), show ranges from a low of around 20.5 ˚C during the coolest months of August and September when maximum temperatures are 29.1 ˚C and 30.3 ˚C for those months, to the highest monthly means of 31.6 ˚C to 33.0 ˚C during the hot season from December to March, when the temperatures drop to only 23.5 ˚C to 24.1 ˚C. Relative humidity is 87 % in April, dropping to 76 % in November, with a minimum at 60 % during the dry season (July to September).

Precipitation

The average annual rainfall for the nearest weather station, at Zanzibar Airport, is 1,583 mm (ranging from 704 mm to 2,459 mm), over the period 1987 to 2012, with monthly rainfall peaks in April and May (main wet season) with 641 mm of rain during those two months, and November to December (short rains) with over 375 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern.

Winds

Based on 26 years of data (1987 to 2012) from the Zanzibar Airport weather station, in the morning (9 am) winds are generally light (6-9 knots), with strongest morning mean wind speeds during the months of January and February. Stronger afternoon (3 pm) wind speeds are experienced throughout the year (7-13 knots), with strongest mean speeds (around 12-13 knots) during the months of July and August, with occasional January strong wind events, 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 Zanzibar as 20 knots, with peak speeds during July-August. Zanzibar was considered an area of coastline influenced mostly by offshore winds, with maximum wind speed showing a decreasing trend (Dubi, 2001).

Population

Population size: 593,678 with 310,088 females and 283,590 males. The region has experienced a high average annual growth rate between 2002 and 2012 of 4.80 % leading to more than 61.64% increase of the population over the ten-year period, and documenting a high level of net in-migration. The population density in the region has grown to 2,158 persons/km^2 in 2012 from 1,335 persons/km^2 in 2002.

Urban District has a poverty headcount of 37.6 % while West Distruct recorded 38.6 % (vs. an overall poverty incidence in Zanzibar of 49%; see Zanzibar HBS of 2004/05). The over 15 years of age literacy coverage was 96.8 % for men and 93.6 % for women; and under five years of age mortality for Urban West was 101 (for every 1,000 live births), based on 2006 statistics (http://knoema.com/TANPOP2006).

Economy

Main economic activities taking place in Unguja West/Urban Region are retail and wholesale businesses (including small and medium shops, hotels, bars and restaurants), transportation services (including Zanzibar Port, clearing and forwarding, medical businesses, handcraft businesses, banking businesses, construction business), tourism, agriculture (especially in the west district). The region's historical and natural resources e.g. islands, sandy beaches, clear seawater, rich soils as well as coral rag play important role in income generation to local population and offer attractions for tourism as well as other sector investments.

Agriculture

About 528 km^2 is agricultural land on the entire Unguja Island (about 34 % of the entire island), with a small proportion of that within the Town and Urban region, where small production of a few food products takes places, namely of cassava, maize, sweet potatoes and banana, plus a varieties of vegetables.

Fisheries

Fisheries is a very important economic activity in West Urban region, with 4,449 fishers plus 777 foot fishers in this region engaged directly in fisheries. Annual catch of fisheries products in the region in 2009 was 9,406 t of which 8,063 t weighed in Urban district and 1,406 t from West district (ZNZ-SE, 2010). Total number of fishing crafts is 1,300, of various types including dingy, dugout canoe, outrigger canoe, boats and dhows, with about 263 outboard engines (MACEMP, 2009). There were 403 seaweed farmers in the region, principally due to the absence of ideal shore conditions for this activity.

Tourism

Nearly all tourism that takes place in other regions of the island contributes to Zanzibar West Urban region. For instance large number of tour operators resides in this region and a large percentage of excursions are organised in Zanzibar Stone Town and trips start there. Tourist transport within the islands and between Zanzibar and Mainland Tanzania as well as abroad are mainly organised from Zanzibar Town. The town has many historical sites, such as House of Wonders, Old Portuguese Fort, old churches, slave markets, old Persian baths, nearshore islands and sand banks, numerous guest houses and tourist hotels, and narrow streets with magnificent history – the World Heritage Site status of the Stone Town and numerous others.

Minerals

The mining activities undertaken in Unguja West region include excavation of sand, gravel stone or boulders, aggregates and limestone. Of special environmental concern is the excavation of gravel, stones (kifusi) and sand in many areas for the purpose of road construction. Such areas include Chukwani and Mwanakwerekwe. This causes large open pits with no special environmental concern to rehabilitate them. There is no salt works in the region.

No viable reserves of oil or gas have been found on Unguja (with only a single well drilled in the 1960s) and exploration for oil and gas is about to commence with seismic surveys, for offshore waters to the east, by Shell International.

Description of the coast

Physical

The region is located on the western side of the Unguja Island, to the north and northeast side bordered by Unguja North Region, while to the south and southeast it borders with Unguja South Region.

The coast is predominantly sand beach interspersed with fossil limestone outcrops. There are four small, mainly season rivers that drain westward into the Zanzibar Channel, hence the shore is a mixture of hard substrates giving rise to headlands, interspersed with sand beach bays with sediment types varying from clay bound sands and gravel to more unconsolidated suite of recent times.

Coastal ecology

Coastal waters of this region support coral reefs, intertidal and subtidal zones of various types of substrates, various forms of beaches and intertidal, seagrass beds and mangroves. The region's ocean area is of shallow water and is a continuation of continental shelf from mainland Tanzania, hence the marine environment is sheltered from the prevailing oceanic.

Coral reefs – Unguja West Urban coral reefs formed within the relatively sheltered areas. Coral reefs are associated with a number of islets and sand banks. Formation of the coral reefs is of two major types; namely fringing reefs mainly on the western side of the islands and back patch reefs on the more sheltered sides. The reefs are including Chapwani Island, Bawe Island, Chumbe Island, Pungume Island, Mwambabawe, Pange and Murogo. Generally live coral cover is high in western reefs yet diversity is low. Pange, Changuu, Bawe, Murogo, Mwambabawe, Komonda and Kwale the average live coral cover exceeds 60% (see Mbije et al., 2002). Kwale had a highest percentage of dead corals.

Mangroves – Total area covered by mangrove for the whole of Unguja Island is 4,934 ha, though most of that is present in the South Unguja Region. Unguja West Urban mangroves are restricted to a few hectares around Fumba Peninsula and Mbweni.

Beach and rock shorelines - Almost large part of the western coast the shoreline is sandy with a considerable amount of erosion in many areas such as Mtoni. The southern part is mixture of rocky and sandy shores.

Coastal waters

With few and minor rivers, coastal waters are little influenced by rainfall, expect during peak rains during April and May when 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. This is particularly evident around the Stone Town when run-off from the town and infrastructure is directed into the sea.

Marine species of importance

Turtles – Green and hawksbill turtles are recorded from the various patch reefs and islands off the Stone Town (Bawe, Prison, Chapwani), though no nesting in the region is documented.

Cetaceans - Humpback whales are regularly reported within short distances of the coastline between June and November, in the Zanzibar Channel, and bottlenose and humpback dolphins are commonly encountered around the Zanzibar Channel reefs.

Natural resources

There are 756 km² of woodland on the entire Unguja Island (representing about 49 % of the island), plus 42 km² of natural forest (about 3 %). There are no protected or significant forests in the Urban West region.

Settlements

The settlement and built-up portion of Unguja West Urban amounts to 34 km², concentrated in the Stone Town and suburbs, with villages and businesses stretching along the four main arterial routes from the town (to Mtoni and Bububu northwards, east past Amani to Chwaka, southeast past Mwanakwerekwe to the south and east, and directly south past the airport and on to Fumba). The eastern portion of the region has the lowest densities of inhabitants where coral rag presents few agricultural options other than grazing and firewood.

Natural resources

There are 756 km² of woodland on the entire Unguja Island (representing about 49 % of the island), plus 42 km² of natural forest (about 3 %). There are no protected or significant forests in the Urban West region other that the small Forest Reserve on Chumbe Island (22 ha).

Infrastructure

Unguja Urban West Region is the hub of Zanzibar infrastructure. All major roads either start in this region or are easily accessed from the Stone Town, with most roads is good condition. The region includes the Zanzibar International Airport (A. A. Karume International Airport) which connects the island with regional as well as international destinations. All major Tanzania landline as well as mobile phone operators are easily accessible in the region. Zanzibar Port, also a hub of cargo and passenger sea movement, is located within the Stone Town centre of the region.

Major Threats

Table 16: Overview of threats to coastal communities in Unguja West Urban region.

Threat	Location	Cause
Beach pollution	All along the regional sea front	Uncontrolled solid and liquid waste disposal, lack of toilets in public gatherings
Beach erosion	Kilimani, Mazizini, Maruhubi, Mtoni, Mbweni	Beach sand mining, unplanned construction along the coast, currents and waves, clearing coastal vegetation.
Fisheries decline	All around the region	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods such as beach seine and kigumi
Diseases outbreaks	Especially in Urban Distric	Inadequate sewerage control, poor solid waste management, use of beaches and bushes as toilets
Marine environmental pollution	Zanzibar municipalit, Zanzibar port, Maruhubi, Mtoni Deport, Kizingo	Uncontrolled solid waste dump sites, as well as untreated sewage from domestic uses and tourist hotels in the area. Possible oil leak during loading and offloading of fuels in landing sites and small local harbors
Land use conflicts	In some spots along the coast, Southeast of region where it borders with Menai Bay	Use of space, especially beaches and intertidals, between hoteliers and local community. Use of space and resources between fishers and Menai Bay Conservation Authority
Loss of coral cover	Stone town reefs and other western coral reef areas	Crown of Thorn outbreak. Over exploitation of habitat by fishers, gleaners and tourists
Sea water intrusion in underground aquifers	Stone Town constituency, Kilimani, Kisiwandui	Overuse of ground water by tourist hotel and increased population related to tourism (Gössling, 2001).

CRIAM Ranking of Threats to Local Communities in Unguja West and Urban Region

Table 17: Prioritisation of threats to local communities in Unguja West and Urban Region. The assessment uses using 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 around the region	3	3	3	2	2	63	4					
Beach pollution	All along the regional sea front	3	3	3	2	1	54	4					
Marine environmental pollution	Zanzibar municipalit, Zanzibar port, Maruhubi, Mtoni Deport, Kizingo	3	3	3	2	1	54	4					
Beach erosion	Kilimani, Mazizini, Maruhubi, Mtoni, Mbweni	3	2	3	3	2	48	4					
Land use conflicts	In some spots along the coast, Southeast of region where it borders with Menai Bay	3	2	3	2	2	42	4					
Loss of coral cover	Stone town reefs and other western coral reef areas	1	3	3	2	2	21	3					
Sea water intrusion in underground aquifers	Stone Town constituency, Kilimani, Kisiwandui	1	3	3	3	1	21	3					
Diseases outbreaks	Especially in Urban Distric	1	2	2	2	1	10	2					

Major Opportunities

Opportunities available for coastal communities:

- Offshore fisheries are considered under-exploited although have a potential for large fish resources such as yellow fin tuna (MACEMP, 2009)
- Beekeeping could benefit a number of villagers in Urban West Region if trained.
- Aquaculture such as oyster farming as well as finfish culturing in mangrove areas, and fattening of crabs and lobsters
- High-tech agriculture particularly greenhouse and irrigation horticulture
- Employments in tourism industry

Climate Change Impacts

Significant impacts from sea level rise are felt over the general land area, even for rise levels of 1 m, particularly in the shallow embayments inshore of Fumba Peninsula, Mbewni creek and sections of the Stone Town seafront (see Table 15 above).

Projects and Plans

Chumbe Island Conservation Program (CHICOP) – CHICOP was gazetted in December 1994, and includes a Reef Sanctuary of 33 ha, a Forest Reserve of 22 ha and a seaward boundary of 1 km of fringing coral reef. Features include a coral rag island approximately 1.1 km long and 300 m at its widest point, with pristine fringe reef running NW to SW of the Island with high biodiversity of fish and corals. Pristine coral rag forest contains IUCN data deficient coconut crab population and IUCN critically endangered individuals of Ader's Duiker (ex-Jozani).

Menai Bay Conservation Area (MBCA) – MBCA was gazetted in August 1997, with a total area presently of 470 km^2. Features include traditional fishing ground, coral reef, sea grass beds, six small islands (Vindwe, Miwi, Uzi, Pungume and Ukanga) and mangrove forests. It includes a multiple use marine conservation area (MCA) and a community mangrove conservation area.

Zanzibar Airport expansion project – Completion is expected in 2015, with significant improvements for passenger movement and comfort, with likely increasing volumes of both.

New Zanzibar Port - There is a plan to build a large hub port that will start at Mpigaduri northward to Maruhubi. The project is estimated to cost USD 400 million and if implemented will have considerable impact on movement of goods in and out of Zanzibar, as well as potential negative impacts on mangroves and coral reefs off Zanzibar Town and vicinity.

6. Unguja South Region

Unguja South is one of three regions that comprise Unguja Island. It has a land area of around 852 km^2 and a coastline of 199 km.

Climate Profile

Temperature

The climate ranges from hot and humid in the coastal plains to temperate in the mountains. Average monthly temperature data, from Zanzibar weather station (Zanzibar Airport, from 1986 to 2012), show ranges from a low of around 20.5 ˚C during the coolest months of August and September when maximum temperatures are 29.1 ˚C and 30.3 ˚C for those months, to the highest monthly means of 31.6 ˚C to 33.0 ˚C during the hot season from December to March, when the temperatures drop to only 23.5 ˚C to 24.1 ˚C. Relative humidity is 87 % in April, dropping to 76 % in November, with a minimum at 60 % during the dry season (July to September).

Precipitation

The average annual rainfall for the nearest weather station, at Zanzibar Airport, is 1,583 mm (ranging from 704 mm to 2,459 mm), over the period 1987 to 2012, with monthly rainfall peaks in April and May (main wet season) with 641 mm of rain during those two months, and November to December (short rains) with over 375 mm of rain, reflecting a clear predominantly bi-modal rainfall pattern.

Winds

Based on 26 years of data (1987 to 2012) from the Zanzibar Airport weather station, in the morning (9 am) winds are generally light (6-9 knots), with strongest morning mean wind speeds during the months of January and February. Stronger afternoon (3 pm) wind speeds are experienced throughout the year (7-13 knots), with strongest mean speeds (around 12-13 knots) during the months of July and August, with occasional January strong wind events, 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 Zanzibar as 20 knots, with peak speeds during July-August. Zanzibar was considered an area of coastline influenced mostly by offshore winds, with maximum wind speed showing a decreasing trend (Dubi, 2001).

Population

Population size: 115,588 with 57,708 females and 57,880 males. The region has experienced an average annual growth rate between 2002 and 2012 of 2.33 % leading to more than 26% increase of the population over the ten-year period. The population density in the region has grown to 131 persons/km^2 in 2012 from 104 persons/km^2 of 2002.

Unguja South has a poverty headcount 53.8 % (vs. an overall poverty incidence in Zanzibar of 49%; see Zanzibar HBS of 2004/05). The over 15 years of age literacy coverage was 94.7% for men and 90.3 % of women; and under five years of age mortality for Unguja South was 114 (for every 1,000 live births), based on 2006 statistics (http://knoema.com/TANPOP2006).

Economy

The population in Unguja South Region engages in more than one economic activity, with major economic activities including farming, fisheries, tourism, seaweed farming, retail trading as well as government employment. Fishing and farming are major economic activities in this region and employ over 26 % and 23 % of working force respectively. Seaweed farming engages 24.5 %, tourism 14.5 % and other activities pulled together employ 10.3 (data modified from MACEMP, 2009a).

Agriculture

About 528 km^2 is agricultural land on the entire Unguja Island (about 34 % of the entire island). In Unguja South region, the main crops planted according to 2007/8 agricultural census are coconut, cloves, maize (678 ha), paddy (1813 ha), sorghum (228 ha), seaweed (142 ha), sweet potatoes (1955 ha), yams (789 ha), cocoyam (358 ha) and cassava (4,248 ha) and tomatoes (264 ha) (NSCA, 2012). Other crops cultivated inlcude cowpeas, green peas, and various types of vegetables including okra, cabbage, bitter aubergine and radish.

Livestock rearing is also important agricultural activity, with the Unguja South region having about 33,003 cattle, 20,915 goats, 155,063 chicken, 3,900 ducks, and small quantities of other types of livestock (NSCA 2012).

Fisheries

Fisheries is a very important economic activity in South Unguja Region, second to agriculture and tourism, with 3,360 fishers, plus 1,681 foot fishers engaged directly in fisheries. Annual catch of fisheries products in South region in 2009 was 3,331 t of which 1,535 t was harvested in Central district and 1796 t from south district (ZNZ-SE, 2010). Total number of fishing crafts is 1,386 of various types including dingy, dugout canoe, outrigger canoe, boats and dhow. There are 222 outboard engines (modified from MACEMP, 2009).

Seaweed farming

Seaweed farming occupies 4,488 people in the Unguja South region, mostly on the coastal villages of the eastern shores of South District, centered on the villages around Chwaka Bay, and south to Paje and Jambiani.

Tourism

South Unguja Region is also very famous for beaches and hotels of various classes and standard. About 13.3 % of households in South Unguja Region are involved in tourism, in activities such as direct hotel employment, selling of products, dolphin tourism (at Kizimkazi), handcraft making and selling and tour guiding. The industry is generally dominated by males, although handcrafting and some hotel employment, especially housekeeping, are dominated by females.

Minerals

The mining activities undertaken in South Unguja region include excavation of sand, gravel stone or boulders, aggregates and limestone. Of special environmental concern is the excavation of gravel and stones (kifusi) in many areas for the purpose of road construction. Such areas include Mgeni Haji and Jumbi, resulting in large open pits with no special environmental concern to rehabilitate them. There is no salt works in the region.

No viable reserves of oil or gas have been found on Unguja (with only a single well drilled in the 1960s) and exploration for oil and gas is about to commence with seismic surveys, for offshore waters to the east, by Shell International.

Description of the coast

Physical

The region located on the south and eastern side of Unguja Island. To the north it borders with Unguja North Region, while to the west lies Unguja Urban West Region. There are few rivers, though Chwaka Bay is fed by three main freshwater creeks, fringed by mangrove forest, extending onto vast areas of seagrass and calcareous *Halimeda* beds. The Chwaka Bay is important as nursery grounds as well as feeding areas for various marine life forms, particularly fish and crustaceans (Gullstrom *et al.,* 2012). Sediments types are in general dominated by biogenic and recent limestone origins, with a few clay-bound sands and gravel close to river-dominated areas**.**

Coastal ecology

The coastal waters of Unguja South Region support coral reefs, mangroves, intertidal and subtidal flats with vast formations of seagrass beds and algal growth. In some areas are rocky cliffs and rocky intertidal while others have long and vast sandy beaches. The underlying structure of large part of this region is rocky formations of various geological times. Interior Chwaka Bay has geological formation different to the exposed coast of the region. This is the only place in this region where large area of mangrove forest can be found.

Coral reefs - The region is characterised by a long stretch of fringing reef which runs from the north end of the region, where it borders with Unguja North, southward to southwest of the Island where the region boarders with West Region. These reefs are limited in extent and consist mainly of a reef flat and a reef slope. Landward of this fringing reef, in the lagoon, are weak and small patch reefs in a few areas. Exception is in the western side of the region, within the Menai Bay, where there is a series of small islands and sand banks in which various formations of fringing reefs around the islands, especially the sides which are exposed to high seas, and many patch reefs in the sheltered side. These reefs include Pungume, Mianembe, Komunda and Miwi Islets.

Mangroves – Total area covered by mangrove for the whole of Unguja Island is 4,934 ha, with most of that present in the South Unguja Region, in particular the Uzi Island complex in the south, and the Chwaka Bay forest to the northeast.

Beach and rock shorelines - Almost large parts of the southern and southeastern coasts the shoreline is sandy interspersed with rocky headlands and rocky intertidal flats, with fringing lagoon along the eastern coast.

Coastal waters

With few and minor rivers, coastal waters are little influenced by rainfall, expect during peak rains during April and May when 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. This is particularly evident around the Stone Town when run-off from the town and infrastructure is directed into the sea.

Marine species of importance

Turtles – Green and hawksbill turtles are recorded from the various patch reefs and islands in the Menai Bay area, though no nesting in the region is documented.

Cetaceans - Humpback whales are regularly reported within short distances of the coastline between June and November, in the Zanzibar Channel, and bottlenose and humpback dolphins are commonly encountered around the Zanzibar Channel reefs. Over 250 bottlenose dolphins are resident off Kizimkazi and contribute to an important tourism attraction for the region.

Shorebirds – Unguja South Region includes various important bird areas, notably Chwaka Bay (IBA 45), Jozani forest (IBA 57) and Latham Island (IBA 27) which is well known for breeding masked boobies (Baker and Baker 2002).

Terrestrial mammals - Red colubus monkey, Zanzibar duiker (and Zanzibar leopard, possibly), are occupants of the Jozani Forest Nature Reserve (which has been expanded to include Chwaka Bay).

Natural resources

There are 756 km² of woodland on the entire Unguja Island (representing about 49 % of the island), plus 42 km² of natural forest (about 3 %). Most of the protected woodland and forests of Unguja are located in the South region, in Jozani-Chwaka Bay (see Figure 1).

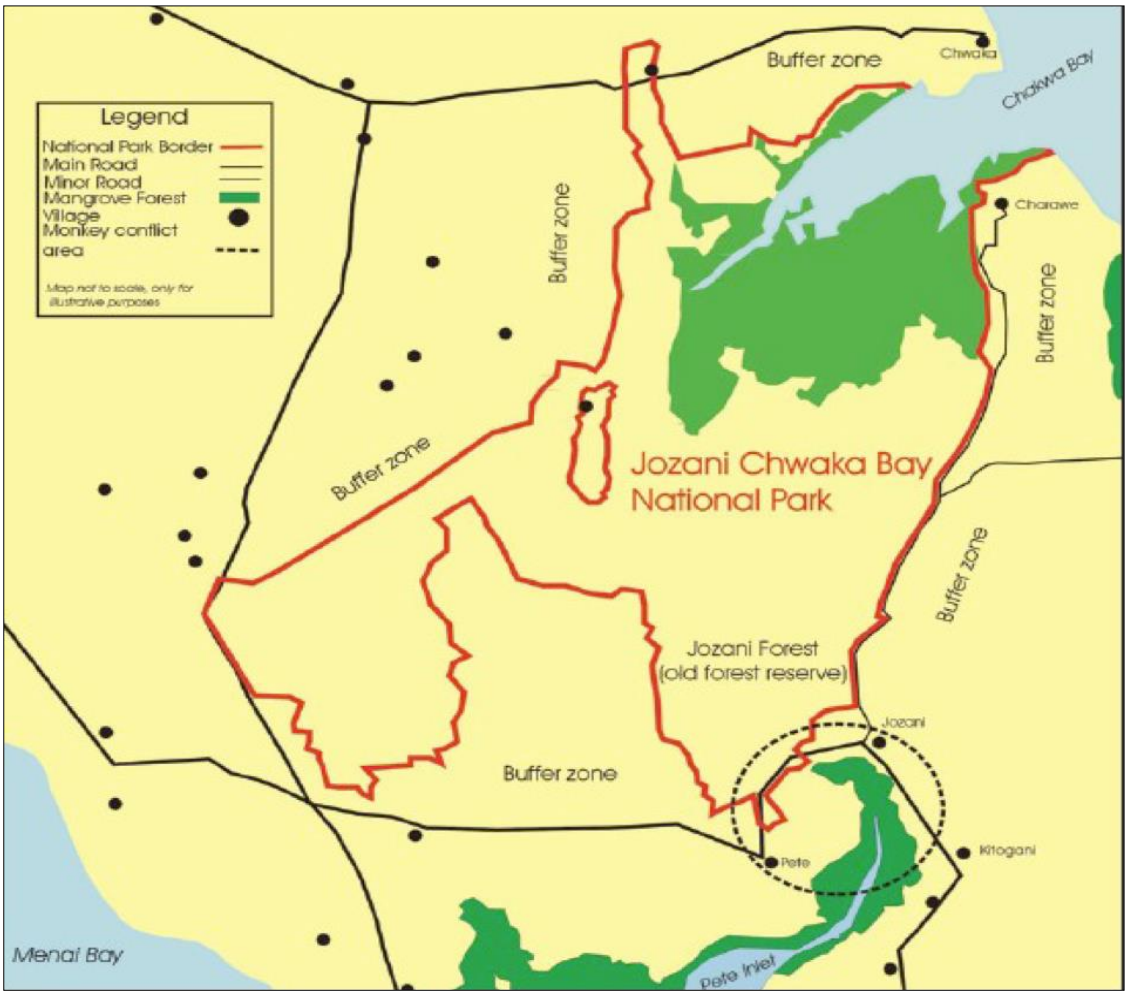

Figure 1: Jozani-Chwaka Bay National Park. (Source: Saunders, 2011).

The settlement and built-up portion of Unguja South Region is concentrated in small to medium-sized villages such as those along the three main arterial routes from the town (from west to east at Chwaka Bay and north to Pongwe, south to Kizimkazi, past Pete and Jozani,

and southeast to Page and then both directions along the shore). The south central portion of the region has the lowest densities of inhabitants where coral rag presents few agricultural options other than grazing and firewood.

Infrastructure

The region has good network of tarmac road that connects it to other regions and to the entire Unguja Island. There are a number of feeder roads. Almost all villages are accessible by road in all season with varied level of accessibility. Few feeder roads are difficult to manoeuvre during rainy seasons. All major mobile phone providers have network in this region and a number of telephone towers erected hence the coverage is sufficient.

Major Threats

Table 18: Overview of threats to coastal communities in Unguja South region.

Threat	Location	Cause
Beach pollution	All along the coast	Uncontrolled solid and liquid waste disposal
Beach erosion	Rampant in many areas including Unguja Ujuu, Jambiani, Makunduchi, Uroa, Paje, Bwejuu and Michamvi	Beach sand mining, unplanned construction along the coast, currents and waves, clearing coastal vegetation.
Fisheries decline	All along the shallow water coastal areas	Destruction of fish nurseries such as mangrove cutting, illegal fishing such as dynamite fishing and other poor fishing methods such as beach seine and kigumi
Diseases outbreaks	In every big village of the region	Inadequate sewerage control, poor solid waste management, use of beaches and bushes as toilets
Marine environmental pollution	All most the entire coast from Makunduchi to Michamvi through Jambiani, Paje and Bwejuu Chwaka Bay	Uncontrolled solid waste dump sites, as well as untreated sewage from domestic uses and tourist hotels in the area. Possible oil leak during loading and offloading of fuels in landing sites and small local harbours
Land use conflicts	Jambiani, Bwejuu, Michamvi, Paje, Menai Bay	Use of space, especially beaches and intertidal, between hoteliers and local community – seaweed farmers and fishers. Use of space and resources between fishers and MBCA
Loss of coral cover	Menai Bay	Crown of Thorn outbreak. Over exploitation of habitat by fishers, gleaners and tourists
Sea water intrusion in underground equifers	All along the coast	Overuse of ground water by tourist hotel and increased population related to tourism (Gössling, 2001).

CRIAM Ranking of Threats to Local Communities in Unguja South Region

Table 19: Prioritisation of threats to local communities in Unguja South Region. The assessment uses using 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	Rampant in many areas including Unguja Ujuu, Jambiani, Makunduchi, Uroa, Paje, Bwejuu and Michamvi	3	3	3	3	2	72	5					
Fisheries decline	All along the shallow water coastal areas	3	3	3	2	1	54	4					
Land use conflicts	Chwaka Bay	3	1	2	2	1	15	2					
Loss of coral cover	Jambiani, Bwejuu, Michamvi, Paje, Menai Bay	1	2	3	2	1	12	2					
Marine environmental pollution	All most the entire coast from Makunduchi to Michamvi through Jambiani, Paje and Bwejuu	2	1	2	2	1	10	2					
Sea water intrusion in underground equifers	Menai Bay	1	1	3	3	1	7	1					
Beach pollution	All along the coast	1	1	3	2	1	6	1					
Diseases outbreaks	In every big village of the region	1	1	2	2	2	6	1					

Major Opportunities

Opportunities available for coastal communities:

- Offshore fisheries are considered underexploited with potential for large fish resources such as yellow fin tuna (MACEMP, 2009)
- Beekeeping at Jozani Beekeeping Project, and Bwejuu Beekeeping Project
- Aquaculture, including fattening of crabs and lobsters
- High-tech agriculture to cater for hotels and resorts
- Employments in tourism industry

Climate Change Impacts

Significant impacts from sea level rise are felt over the general land area, even for rise levels of 1 m, particularly in the shallow embayments such as Chwaka Bay and around Uzi Island (see Table 15 above).

Projects and Plans

Menai Bay Conservation Area - Most of the MBCA is within the South Region, though a small part overlaps with Unguja West Urban (see Chapter 5).

Jozani-Chwaka Bay National Park - Jozani Forest, previously protected under the Forest Reserve Decree, Cap. 120, under the Forest Resources that covered 50 km^2 was more recently combined with Chwaka Bay and enlarged to 116 km^2. Features include rain forest and mangrove forest containing globally important biological diversity, and a range of endemics (e.g. Red Colobus).

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Annex 1: List of Documents

Table 20: 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
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

Title	Source	Year
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
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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
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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
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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
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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
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Sustainable Industries Development Policy	URT	1996
Integrated Coastal Zone Management in Tanzania	World Bank Land Water and Natural Habitats Division, Environment Department	1995
Salt Iodization for the Elimination of Iodine Deficiency	M. G. Venkatesh Mannar and John T. Dunn	1994
Land Use Planning and Resource Assessment in Tanzania	A.S.Kauzeni, I.S.Kikula, S.A.Mohamed & & J.G.Lyimo andD.B.Dalal-Clayton	1993
National Enviromental Policy For Zanzibar.	Commission For Lands and Environment.Ministry of Water,Construction,Energy,Lands and Environment Zanzibar.	1992
DSM Small Pegalic Fishery Paper	L.B Nhwani & E.D Makwaia,Tanzania Fisheries Research Institute.	1986
Design And Layout of Solar Salt Works	M.J Mehta	1981
The Elopoid and Clupeoid Fishes of East African Coastal Waters.	G.F Losse	1968
The Status Of Coral Reefs In Dar es salaam Marine Reserves System and The State of Reefs in Other Marine Protected Areas of Tanzania	Christopher A. Muhando and J. Francis	
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	
Information Outline for Tanzania Coastal and Marine Atlas.		
Marine Science country profiles Tanzania	Julius Fransis/IOCINCWIO-IV/Inf. 8	

Title	Source	Year
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 3: 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 **Error! Reference source not found. Error! Reference source not found.**.

Table 21: 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 22 below.

Table 22: 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 23 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 23: 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 (**Error! Reference source not found.**, **Error! Reference source not found.**):

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 spread sheet 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 24: 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

Districts	Super-Region	Region
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
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 25: 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

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.

Wetlands
Wildlife Sanctuary

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 impacting on 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 2: 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 4: Inception Workshops – Participants

Dar es Salaam 8 April 2014

Table 26: 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 3: Inception Workshop groups sessions examining threats from thematic sectors and considering prioritization and mitigation alternatives, Dar es Salaam, 8 April 2014

Figure 4: Dar es Salaam Inception Workshop participants, 8th April 2014

Zanzibar 10 April 2014

Table 27: 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 5: 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 6: Zanzibar Inception Workshop participants, 10 April 2014

Annex 5: Members of Working Groups

Tanzania Mainland Working Group

Table 28: 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 29: 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