



The Economics of Climate Change in Zanzibar



Final Summary Report. July 2012



Executive Summary

This study - the '*Economics of Climate Change in Zanzibar*' - has assessed the current and potential future impacts of climate change on the islands, the potential adaptation options to address these impacts, and the opportunities for low carbon development. The key findings are set out below.

- Zanzibar's economy is very dependent on the climate: a large proportion of GDP, employment and livelihoods are associated with climate sensitive activities (in coastal, agriculture and tourism sectors).
- The climate of Zanzibar is changing and recent decades have seen rising temperatures, increased rainfall variability, higher wind speeds and high-tide levels, and an increase in extreme events (climate variability). The latter have led to droughts and floods which have had major economic costs in terms of GDP. It is clear that Zanzibar is not adequately adapted to the current climate, and there is an urgent need – as well as a large economic benefit – from addressing this existing adaptation deficit.
- Zanzibar is putting in place impressive development plans and the MKUZA II Implementation Plan (IP) will help to reduce current vulnerability through development. However, the IP does not currently take short-term trends in climate variability or future climate change into account, and it has not yet assessed how climate change might affect investments and planned outcomes. An initial screening of the IP has highlighted a number of high risk areas, where greater climate resilience could be included, as well as identifying a number of potential opportunities for low carbon and adaptation finance.
- In the medium to longer term, climate change will lead to potentially high economic impacts on the islands. There are potential threats from climate change on coastal and marine areas (including fisheries), tourism, agriculture, health, energy supply and demand, infrastructure, water resources and demand, and ecosystem services. Indeed, the combined effects of current climate vulnerability and future climate change could be large enough to prevent Zanzibar achieving key economic growth, development and poverty reduction targets, including the planned timetable for achieving middle income status.
- Adaptation can reduce these impacts and there is emerging international finance available for funding. A broad set of potential adaptation options has been identified in the study. These have been prioritised into a short-term priority plan, built around an adaptation pathway that maximises economic no regret opportunities, whilst building information to help decisions in the future, especially in the face of uncertainty. However, operationalizing adaptation and delivering such a plan will require significant funds, as well as institutional capacity. Building this capacity is an early key priority.
- The study has also considered the opportunities for Zanzibar to move towards a more sustainable, lower carbon pathway. The current use of energy on the islands is leading to economic, social and environmental impacts, and there are problems of load shedding and high back-up generation costs. The analysis has considered current energy use and emissions on the islands, and future trends with planned development. While emissions increases will be necessary for Zanzibar's growth, and there is no suggestion that future emissions should be constrained, the study has found an alternative growth strategy based around low carbon options would be more sustainable, provide wider economic and environmental benefits, and could provide sources of financing to help fund the transition, while also meeting underlying development and growth objectives. It is stressed that these opportunities exist for energy use in households and transport, in agriculture and in natural resource management, as well as in the electricity sector in the form of renewables.
- Finally, the study has set out the next steps. These focus around the development of a Zanzibar Climate Change Strategy, which includes consideration of climate resilience and low carbon development, prioritisation of options and mainstreaming, and routes to finance.

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This work was led by the Global Climate Adaptation Partnership (GCAP), working with local partners (SUZA, IMS), with funding from UK (DFID) Government. It has been commissioned under DEW Point, the DFID Resource Centre for Environment, Water and Sanitation which is managed by a consortium of companies led by Harewelle International Limited.

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The authors would like to thank the Revolutionary Government of Zanzibar: The First Vice President Office, Department of Environment, and the guidance of Dr Islam Salam, and the inputs of Dr Aboud Jumbe. We also would like to particularly thank Juma Baban VPO-E Pemba, for his input to the workshop and for arranging the Pemba site visit. We would also like to thank the team members at the State University of Zanzibar for their excellent organization of the stakeholder workshop events. We are particularly grateful for inputs on the provision of meteorological data from the Zanzibar office of the Tanzania meteorological agency (Khamis Ali Suleiman). The work also benefited significantly from comments from Emilia Holken (UNDP) and from Michael Juel (SMOLE). We would also like to thank the Climate Systems Analysis Group (CSAG), University of Cape Town, SA, for the data provided by their Climate Change Explorer. It is stressed that the discussion here – and any errors – are the responsibility of the authors.

The views expressed in this report are entirely those of the authors and do not necessarily represent the Revolutionary Government of Zanzibar or DFID's own views or policies.



Summary Report

Introduction

At the request of the Revolutionary Government of Zanzibar, the UK (DFID) Government has funded a study on the '*Economics of Climate Change in Zanzibar (Unguja, Pemba and other islands)*'. The work has been led by the Global Climate Adaptation Partnership, working with local partner organisations on the island (the State University of Zanzibar, SUZA, and the Institute of Marine Sciences, IMS).

The primary objective of this study has been to develop a comprehensive, participatory, and indigenously oriented climate change review study in Zanzibar, in order to address the required implementation formula in climate change adaptation and mitigation. Towards this, the study has assessed:

1. The current climate and the current costs of climate variability;
2. The impacts and economics costs of future climate change;
3. The costs and benefits of adaptation; and
4. The potential for low carbon growth.

A key theme has been to ensure that there is high level of Interaction and co-production between the research team and key Government stakeholders, while also engaging wider stakeholders through workshops on both islands.

This document – the summary report from the study - reviews the existing evidence and presents findings from the project. A full set of technical reports are available on the project web-site <http://www.economics-of-cc-in-zanzibar.org/>

A separate Swahili translation of this summary is also available at the same site.

Methods and Approach: Impacts and Adaptation

There are an emerging number of national climate change studies that assess the economics of climate change, and start to move to analysis of the economics of climate resilient, low carbon development.

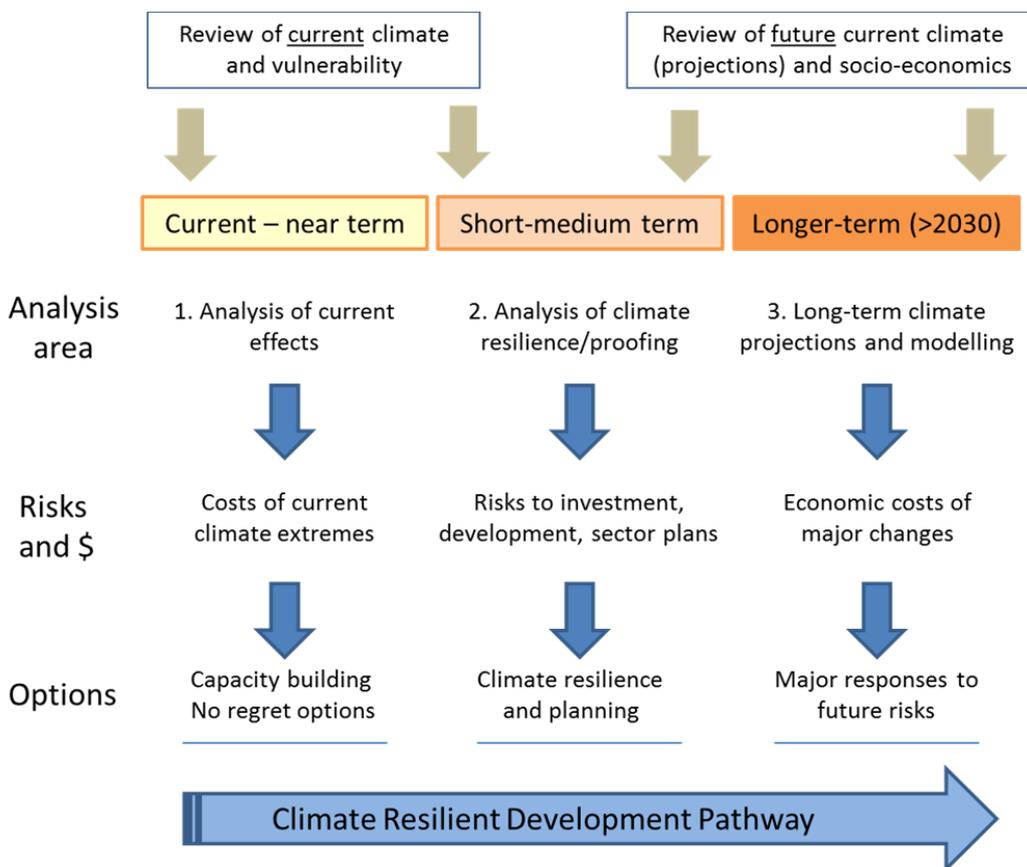
However, to date, many of these projects have focused on the medium-long term effects of climate change, considering technical adaptation options. While such studies provide valuable information, it is clear that on their own, they do not meet the objectives of the current study, as they have tended to have insufficient consideration of immediate and short term policy issues, the consideration of other drivers, and they do not take enough account of institutional issues, existing capacity and current policies.

As a result, more recent studies have adopted a new approach, used here. This has a more complex and dynamic view of climate change, bringing together a number of evidence lines over different time periods to form an overall view of the issues and appropriate responses. The key concepts behind this approach are:

- To start from the position of current climate variability, and look at the existing vulnerability and the economic costs of climate extremes. This is crucial to understanding current risks, and the current adaptation deficit. It also allows the identification of early quick wins (no regret options).
- To consider downscaled projections of future climate change, taking account of the wide range of scenarios and climate models, i.e. considering uncertainty.

- To consider other drivers of risks, and how these might change over the coming decades. This allows a study to ground the analysis in current policy, and consider non-climate drivers. It also allows the direct analysis of current Government policies, development and sector plans.
- To assess whether current development plans and policies are resilient to current and emerging climate change, or whether the plans need amending, i.e. to enhance climate resilience. This also starts the process of embedding (mainstreaming) climate change into current development. It also considers the opportunities for low carbon development.
- To assess the longer-term effects of future climate change, particularly focusing on areas that might require some early action now, i.e. for infrastructure (long life-times), for major effects, for adaptation actions that might be appropriate in the short-term, or in relation to information or data that might be required to address major issues in the future. .

The advantage of this approach is it starts with the current and looks to the future, and by considering sector plans, it aligns to the current development plans of the island. These elements are combined to provide an overall climate adaptation strategy or pathway (over time) for Zanzibar. The outline is shown below. The following sections report on the various steps of the method.



The Study Approach for Impacts to Adaptation

Current Climate Variability and the Economic Costs of Extreme Events

A large proportion of Zanzibar's GDP is associated with climate sensitivity activities, either directly such as with agriculture or tourism, or indirectly for example from the use of natural resources. The economy of the islands, and the livelihoods of the people, is therefore very dependent on the weather and the climate. The islands are also affected by the regional patterns of extreme weather, which lead to major events such as floods, droughts and storms.

The starting point for the study has been to assess the current climate of Zanzibar, and to look at the observational data to see how the climate has been changing over recent decades. The analysis has then assessed the impacts and economic costs of the extreme events (droughts, floods, storms, etc.) which periodically affect the islands, and the current adaptation deficit on the islands, identifying early no regret options that would address these immediate effects.

The findings are summarised below. A full write-up of the data and findings is included in a technical report (Report 1. Current Weather Data for Zanzibar and the Effects of Climate Variability and Extremes) which is available on the project web-site at <http://www.economics-of-cc-in-zanzibar.org/>.

The current climate

- Zanzibar currently has a tropical climate, with fairly constant average temperatures across the year. It has relatively high levels of average precipitation, and experiences strong rains in March to May, with shorter rains in November and December. The dry season lasts from June to October. However, there is variability across and between the two islands (Unguja and Pemba), and considerably variability across years.
- Zanzibar is also periodically affected by major East African climate extremes, associated with El Niño and La Niña years. These regional events lead to large climate variability, with heavy precipitation (floods) and dry spells (droughts). These extreme events have major economic costs on the islands, which are significant at the macro-economic level, as well as affecting livelihoods.

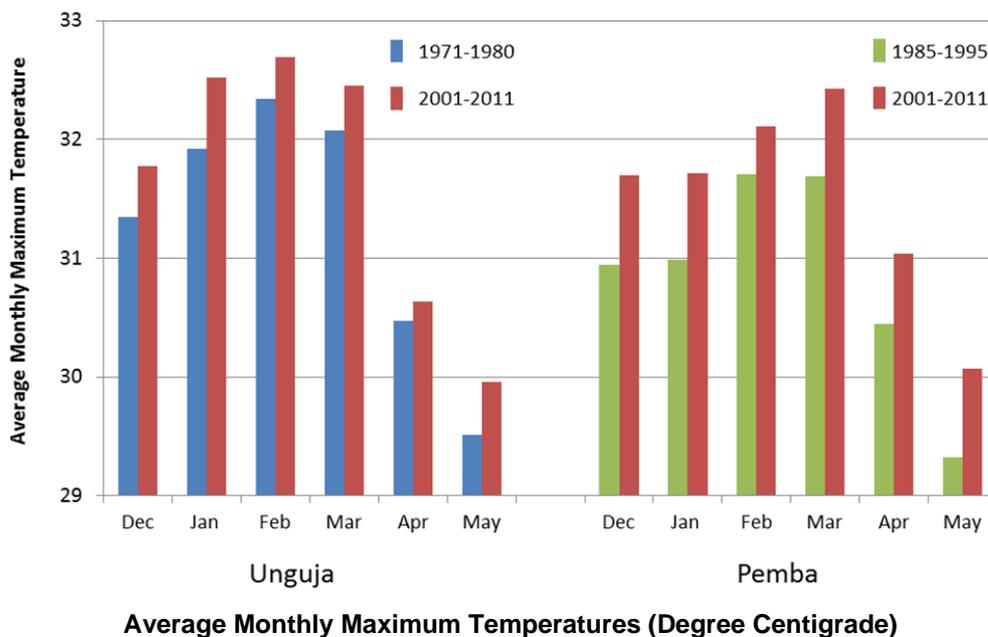
The climate of Zanzibar is changing

There is strong observational data to suggest that the climate of Zanzibar is changing. There is also strong evidence that extreme events are intensifying. Meteorological data from the islands show the following changing trends.

- Temperatures have been rising over the last thirty years on both islands, with a strong increase in average and maximum temperatures. The increases are highest in the months December to May (see box below) and the highest ever temperature recorded on the island was in 2007 (at over 39 degrees).
- The changes in rainfall are complex, and there does not appear to be a simple precipitation trend across the islands. However, there are indications of changes in rainfall variability, and there have been higher rainfall intensity events recorded in recent years.
- There are observational trends of increasing wind speeds on the islands over the last 20 years, with an increasing tendency of extreme wind events (see box below).
- There is some evidence that extreme events are intensifying. The most extreme cases of temperature, heavy rainfall and wind speeds on record on the islands have all occurred over the last ten years.

Temperature Trends

There are observational changes of increasing temperatures on both islands, with the strongest increases in the period December – May. The changes between recent decades are shown below (note the time series is shorter for Pemba). While some care must be taken in interpreting these trends, because of decadal variations and the relatively short time periods involved, they do show strong rising trends.



Unguja, average of 1971-2000 and 2001 – 2011. Pemba, average of 1985-1995 and 2001 – 2011. Source. TMA.

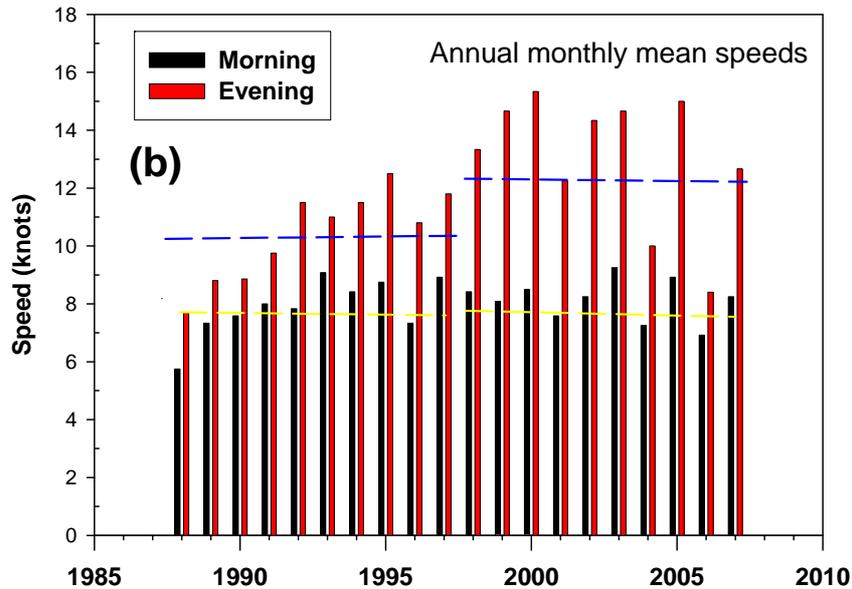
Zanzibar's economy is also strongly dependent on the marine and coastal environment. Again, observational data shows changes are occurring, with the following trends.

- Data of sea surface temperature shows a rising trend over the past twenty years. These increases are probably a factor in the decline in shallow water seaweed harvesting on Zanzibar. There has also been more extreme warming associated with some recent ENSO (El Niño Southern Oscillation, i.e. El Niño/La Niña) years, which have led to coral bleaching.
- Tide gauge data for Zanzibar shows some large inter-decadal trends, with variations (both decreases and increases) over time. However, alongside increasing wind speeds on the islands, there have been increases in wave (sea surface) heights and high water levels (see below). This would suggest that the wave climate regime may be changing, and increasing wave activity could be a factor in enhanced coastal erosion, especially in shores which lack natural protection.

There are recent recorded examples of coastal erosion and saltwater intrusion on the islands, which are possibly linked to some of the trends above. However, these effects are also likely to be associated with socio-economic drivers (loss of mangroves, over abstraction of water) and care must be taken in attributing all or even most of these recent trends only to climate change.

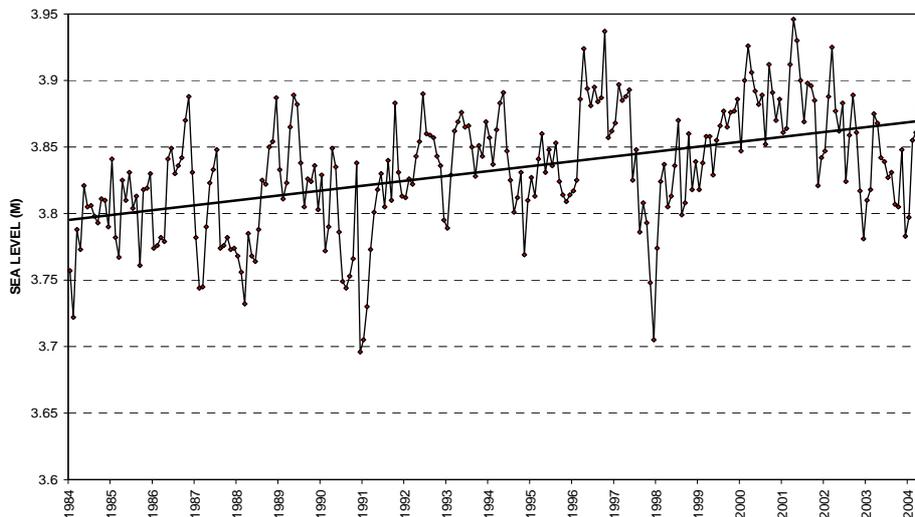
Wind speed and High Water Level Trends

Data are shown below on the changes in annual monthly mean speeds and monthly high water levels over the past twenty or so years. This shows strong increases, reflecting changes that are highly relevant to coastal impacts.



Annual monthly mean wind speeds for Zanzibar

Key. The dotted blue lines and the dotted yellow lines in (b) indicates the ten years monthly mean averages for the evenings and mornings wind speeds, respectively.



Monthly Mean High Water Level for Zanzibar for the period 1984 – 2004. Source of data: Tanzania Meteorological Agency, Zanzibar Station; Shaghude and Dubi (2008).

Extreme events – changing signals and economic costs

The increased intensity of extreme events is leading to impacts with high economic costs.

- The highest ever recorded precipitation event on the island was recorded in 2005, with a flood that seriously damaged at least 1,000 homes and displaced 10,000 people. The immediate relief and disaster response costs associated with this individual event were \$100,000, but from an analysis of the event, we conclude the full economic cost was probably at least \$1 million, equivalent to 0.2% of Zanzibar's GDP, with a high estimate (including the full direct and indirect costs of the event) that could be as high as 1% of GDP. Heavy rainfall events in 2011 also led to major impacts, including the damage of road infrastructure on Pemba.
- Low and erratic rainfall in 2006/7 on the islands led to a major crop failure. The contribution of agricultural crops to GDP on the islands was significantly lower in 2007, and was a strong factor in reducing GDP (by several %). The crop failures in 2007 also led to a large-scale hunger crisis in 2008, which affected over 20% of the population (300,000 people). The health costs of this failure (using prevention costs as a proxy) have been estimated at \$5 – 7 million, equal to 1% of Zanzibar GDP.
- There is evidence of strengthening wind speeds on the islands associated with the monsoons. This has led to increased impacts from storms (and storm surges). Major wind storm events occurred in 2009 (leading to widespread building damage) and in 2011, leading to injuries (and a fatality).

These changes in extremes are economically important, and affect the livelihoods of many people on the islands.

The study has also considered the existing policy environment and the areas to address the trends of increasing extremes.

Existing Disaster Risk Management

In recognition of the events above, progress has been made on disaster risk management on the islands. There is a newly established Disaster Management Policy for Zanzibar, a Disaster Management Commission/Department, and an Emergency Preparedness and Response Plan. Nonetheless, further strengthening and implementation would be beneficial to enable these policies and disaster risk reduction plans to work more effectively, and there is an issue whether the current strategy is taking account of the changing patterns of trends and extremes.

Zanzibar's adaptation deficit

The impacts of current climate variability (discussed above) provides strong evidence that that Zanzibar has an existing adaptation deficit associated with current climate extremes, particularly due to the recent increases in the intensification of these events.

Addressing this deficit is a priority for early adaptation, because it leads to immediate benefits by reducing current economic losses (from current variability) as well as providing greater resilience to future climate change. Such measures are often termed no-regret measure (i.e. due to their net positive present value). However, taking advantage of many of such measures requires better capacity and institutional strengthening.

A number of possible early priorities have been identified that could help address the issues of current climate variability (and emerging climate change signals) and the adaptation deficit, particularly in relation to current disasters.

- There is an urgent need to enhance the capability and resources of the Zanzibar meteorological agency, the marine institute, and other related institutes looking at meteorological data (both terrestrial and marine), and a key priority is to improve data collection and interpretation. This is likely to require additional meteorological stations, tide gauges and sea temperature loggers, as well as institutional capacity, support and training. These systems need to be put in place now, to allow sufficient baseline data collection, and to provide a time series of observational changes of climate change over coming years. This evidence base is critical to allow effective responses in future years.
- There is the potential for advances in Disaster Risk Management and Reduction. While the existing policy sets out the architecture and responsibilities, further strengthening would be beneficial (in capacity, governance, infrastructure, etc.) to enable the systems to be fully effective. There is still an inadequate warning system in Zanzibar (particularly in Pemba) and not all stakeholders are effectively involved in disaster management activities. Warning systems could also be further developed and tested to make them more effective.
- One of the critical areas is the potential for improving the effectiveness of early warning information. This could be advanced by strengthening the TMA and extending the current system to ensure the communication and dissemination of information is effective and reliable, so that early warning information reaches (and is understood by) the range of potential users (fishermen, communities at risk, farmers, etc.), many of which do not currently receive or act on this information. The potential for community based early warning systems is also highlighted.
- There would be benefits from gathering disaster and risk data in a more systematic way, to improve the system of reporting. This is important as it will provide baseline information to allow analysis of the current likelihood and probabilities of different type of hazards.
- There is also the potential to strengthen the existing institutional and legal framework (though progress in this area is being taken forward), with capacity building within Ministries and Departments across Government in the areas of agriculture, health, and emergency services. There is also the potential to improve the collection, analyse and dissemination of DRR information (using risk maps for example), and for capacity building and training for responses, for local and district level.
- There are a number of areas where sectoral plans and policy could factor in these current and emerging risks. A particularly important area is for land-use, spatial planning and major/critical infrastructure siting, where risk mapping would allow the reduction of current and future exposure to extreme events (e.g. from flooding).
- Finally, the current disaster and emergency response plans do not yet plan for the effects of climate change (because of the lack of evidence to date). There is a need to start planning for the potential increases in extreme events that may arise, i.e. the changes in likelihood and magnitude of events, and to mainstream climate change into DRM.

Note these recommendations also need to be seen alongside the sectoral discussion (later) which provides additional early actions for agriculture, coastal areas, etc.

Projections of Climate Change and Sea Level Rise for Zanzibar

The study has provided projections of future climate change and sea level rise for Zanzibar, the former using island-specific downscaling. The findings are summarised below.

A full write-up of the analysis is included in a technical report (Report 2 - Projections of Climate Change and Sea Level Rise for Zanzibar) which is available on the project web-site at <http://www.economics-of-cc-in-zanzibar.org/>.

Projections of Temperature and Precipitation

For this study, future climate projections for the medium-long (2040-2060) and long-term (2080-2100) have been reported, using statistically downscaled global modelling for Zanzibar, i.e. using local meteorological data from the islands. Some notes and caveats on the interpretation of these data are given in the box below. The key findings are:

- ***Temperature.*** The climate models project significant increases in average temperature for Zanzibar, with increases in maximum monthly temperature of 1.5 to 2°C by the 2050s (2045-2065) and 2 to 4°C by the 2090s (2081-2100), with a fairly similar increase across the months of the year. These increases far exceed the rates of changes seen over the past 50 years and would significantly shift the climate of the islands. A summary is included in the box below.
- ***Rainfall.*** The changes in precipitation are more complex. All the climate models show that the rainfall regime will change but the projections vary across the models and seasons. Nonetheless, there are consistent trends projected of increasing rainfall during the Mar-May wet season, as well as an increase in January and February. There is also a trend of decreasing rainfall during the dry season (June – October). These changes would exacerbate existing trends (i.e. increased rainfall during the rainy season, lower rainfall during the dry seasons). A summary is included in the box below.
- ***Extreme events.*** The information on extreme events (floods and droughts) is also complex, though again, some clear trends emerge. Nearly all the models indicate an intensification of heavy rainfall, especially during the rainy season, and thus greater flood risks. The models also indicate an increasing intensity of dry spells during the dry season. However, while these trends suggest possible increases in numbers and/or intensification of extreme events, the effects of climate change on the regional climate, and particularly on El Niño and La Niña events, is not yet well understood.

Projections of Future Sea Level Rise and Other Coastal Effects

As a small island, a critical issue for Zanzibar is the rise in sea level from climate change.

- ***Sea level rise.*** Rising temperatures, associated with ocean expansion and ice melt, will lead to sea level rise. The IPCC (2007) projected global average increases of between 0.2metre and 0.6 metres of sea level rise over the next century, but more recent studies have reported the upper estimates could be as much as 1 metre or even more. These projections need to be compared against other factors (natural land up lift or subsistence) to give relative sea level rise, but currently there is not sufficient data on these other trends for the islands. Investigating these other factors is therefore a priority. Nonetheless, there is a strong projected trend of increasing sea level which will have potential effects for many areas of the islands.
- ***Sea temperature and ocean acidification.*** Alongside sea level rise, there are a number of other trends projected from climate change. These include rising sea temperatures and ocean acidification, the latter arising from the absorption of atmospheric CO₂ levels and decreasing seawater pH. These will lead to impacts on marine ecosystems, particularly corals.

A key conclusion is that the climate of the islands will shift considerably and this will have major potential impacts (especially in the absence of adaptation).

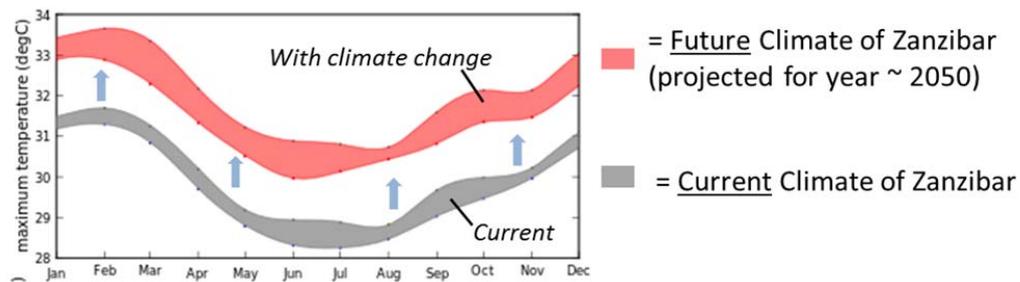
The range of model results highlights there is some uncertainty in the exact projections of the future effects, especially in relation to scenarios of future rainfall, floods and droughts. However, it is essential to recognise this uncertainty, not to ignore it, and to plan robust strategies to prepare for uncertain futures, rather than using uncertainty as a reason for inaction.

A Summary of the Climate Projections for Zanzibar

TEMPERATURE. All the climate projections show increasing temperatures (average and extremes) for Zanzibar, though the level of increase varies slightly across the models. The figure below shows the changes for the 2040 – 2060 time period.

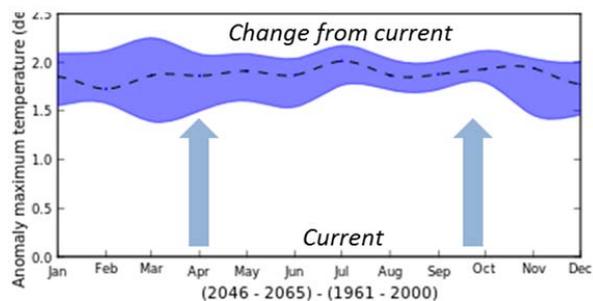
The top box shows the absolute modelled temperatures, with the current climate shown in grey, and the future climate with climate change shown in pink. The bottom box shows the increase from the current (modelled) climate in blue. In both cases the width of the lines represents the range across the different models.

TEMPERATURE



Change from current

- Higher temperatures across the year
- Around 2 degrees warmer by 2050s

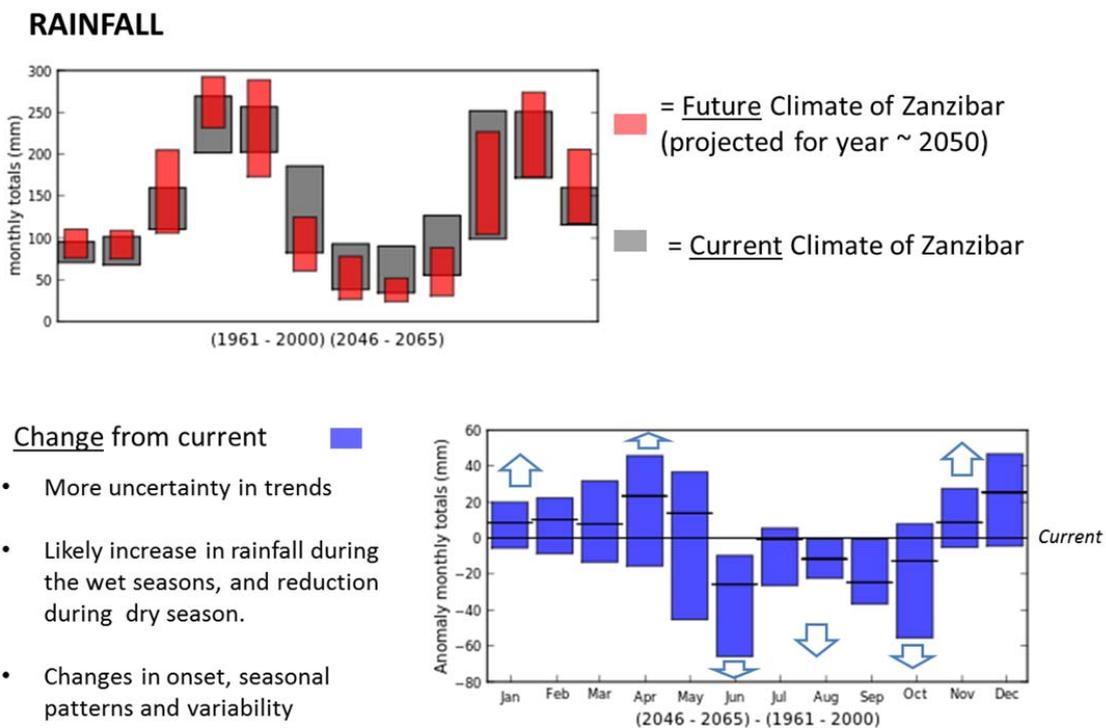


Future Monthly Daily Maximum Temperature for 2040- 2060 for Zanzibar

Source of data: Climate Systems Analysis Group (CSAG), University of Cape Town, SA

RAINFALL. The projections of future rainfall are more complex. The projections show changes in rainfall (average and extremes) for Zanzibar, though the changes vary across the models. The figure below shows the changes for the 2040 – 2060 time period.

The top box shows the absolute modelled precipitation, with the current climate shown in grey, and the future climate with climate change shown in red. The bottom box shows the change from the current (modelled) climate in blue. In the top graph, the width of the lines represents the range across the different models. In the bottom graph, the height of the columns represents the span of the different models (with the average line also plotted).



Future Monthly Rainfall for 2040- 2060 for Zanzibar

Source of data: Climate Systems Analysis Group (CSAG), University of Cape Town, SA

The rainfall projections do show clear trends – as seen in the bottom figure. There are projections of increasing precipitation in the early months of the year (shown by the blue columns, which show increases above the current line in the period December to April), and decreasing precipitation in the drier period (represented by the columns decreasing below the current line in June to October). However, the exact size of the change varies considerably across the models, represented by the height of the column, and in some months (notably May) there is a wide variation (above and below the line) highlighting that changes in this month are more uncertain.

See technical report 2 for full notes and caveats.

Socio-Economic Projections and Climate Screening of Development

In considering future vulnerability to climate change, a critical step is to consider how socio-economic development might change Zanzibar over future decades. This includes the underlying drivers, such as population trends and economic development, but it also includes the proposed policies and development plans of Zanzibar, as these will also influence the future baselines for both climate resilience and low carbon growth.

This part of the study has compiled socio-economic projections, using these subsequently in the analysis of impacts and low carbon development. This also allows the study to ground the analysis in current (local) policy, and consider non-climate drivers.

The study has also assessed whether the Zanzibar development plans themselves are at risk from current and emerging climate change, and looked at potential actions which could enhance climate resilience, and the potential opportunities from low carbon finance. This also starts the process of mainstreaming climate change into the development trajectory of the islands.

A full write-up of the analysis is included in a technical report (Report 3 - Socio-Economic Data and Climate Screening of Programmes and Development Plans) which is available on the project web-site at <http://www.economics-of-cc-in-zanzibar.org/>.

Socio-economic scenarios

Future socio-economic development needs to be considered alongside the future impacts of climate, because these changes – such as population growth, the size of the economy, land-use development - will affect the potential size of future climate impacts (e.g. the number of people potentially affected, the number of people living in flood zones, etc.). The same socio-economic changes also influence other pressures on the islands, for example, by increasing demand for water or for natural resources.

The study has reviewed existing socio-economic data for Zanzibar and built up future socio-economic projections, which have subsequently been used to inform the impacts and adaptation analysis, and the projections for the low carbon analysis. A number of key areas are highlighted below.

- ***Population.*** The current population of Zanzibar is around 1.2 million people, and population growth rates are around 3%, which implies a population of over 2 million by 2030. There are also likely to be high urbanisation trends. There are similar growth rates on mainland Tanzania, particularly in Dar es Salaam, which is projected to become a mega city (>10 million people) by 2040, and these mainland changes will affect Zanzibar in terms of population flows and pressures on natural resources (such as fisheries and fuel wood imports). Population growth on the islands is likely to increase future vulnerability, partly because it increases the number of people at risk, and also because it tends to lead to development into new areas which are often more marginal or have higher risks (e.g. low lying areas are risk of flooding). These effects will be compounded if development and urbanisation is informal. Population increases are also likely to increase pressures on all the sectors below, e.g. through greater natural resource use, water abstraction, land-use pressures, etc.
- ***Economic development.*** The current economy of the island is very reliant on natural resources and ecosystems. The Vision sets out the future planned direction, with high growth rates, a strong growth in tourism, and a move into modern sectors. These changes will increase per capita income and will have beneficial effects (in increasing some aspects of adaptive capacity). However, the changes will also affect the future vulnerability of the islands, as it will introduce new pressures which climate change will act upon. The planned projections for tourism are highlighted as an example, where sector growth is likely to increase water and energy use significantly.

- Land-use information. A key further driver of vulnerability is future land-use change. There has been considerable progress in land-use mapping on the islands, and there is an opportunity to use this information in advancing current vulnerability and hazard mapping on the islands (linked to the discussion earlier). This would help provide baseline information to allow analysis of the current likelihood and probabilities for different type of hazards, which would have additional benefits in relation to the disaster risk reduction measures.

Climate Screening MKUZA II

When considering future climate change, it is also necessary to factor in current and planned development, because this also affects the vulnerability to future climate change. In many cases, future development will reduce vulnerability (and thus impacts), but it can also increase it.

Furthermore, the impacts of future climate change will be influenced by development strategies chosen in the next five to ten years, particularly those that affect land-use planning and major investment. As a result, a recent focus in climate change assessment has been to screen or assess future development plans and investment, to investigate whether these should be adjusted to cope with the future climate, often termed '*climate-proofing*'. This considers how climate resilient existing plans are, identifies any changes that are needed, and can assess whether existing plans are taking advantage of the potential opportunities for low carbon or adaptation finance.

The study has undertaken a rapid climate screening of the key development plans for Zanzibar, focusing on the Mkakati wa Kukuza Uchumi na Kupunguza Umasikini (MKUZA) II Implementation Plan (IP). The aim has been to rapidly assess the potential vulnerability of planned investments to current climate variability and future climate change, and to highlight possible high risk areas (effectively a form of due diligence). Similarly, the study has undertaken a rapid screening to look at the potential for low carbon or adaptation within the plan, including areas that might be eligible for emerging international carbon finance. In terms of the high level screening, the key conclusions on risks / opportunities are summarised below.

Climate Risks

The review has identified a large number of Implementation Plan projects and programmes that could have potentially high risks to current climate variability and/or future climate change. These include different types of risks:

- Major infrastructure projects and assets that could be at risk from climate variability and future climate change (e.g. major new port developments which might be at risk from enhanced storm surge and future sea level rise; critical infrastructure such as hospitals that might be affected by increasing flood risks, etc.).
- It also includes the consideration of how changing climate variability and future climate change could affect the achievement of the objectives of the projects and programmes (e.g. the increase in clove productivity on Zanzibar might be affected by higher storm threats, the health programmes might need to be enhanced to address emerging climate risks, and even sectoral policy on for example tourism, would benefit from building in climate considerations).
- Climate change may affect the operational costs of the implementation of the plans and programmes, for example, e.g. by increasing air conditioning costs due to future warmer temperatures, by affecting the delivery of health or social outcomes, etc.. While these sit outside the investment plans, there may be potential to address these during procurement or during the operational design of projects.

While some projects and programmes will get a climate risk screening from other processes (e.g. AfDB projects would be subject to AfDB screening), there will be many projects (open tender) where this is not

the case. It would therefore be useful for the Government to develop some form of climate risk screening itself, framed around internal procedures. It is also recommended that a more comprehensive analysis is undertaken on the higher risk projects and plans.

Opportunities

The review also identified a large number of projects where there might be opportunities in relation to low carbon or adaptation and possible emerging climate finance.

- **Adaptation.** Many of the projects and programmes in the IP are consistent with early adaptation actions (e.g. integrated water and coastal management projects, agricultural strengthening, disaster risk management). There may therefore be opportunities for these projects and programmes to access international climate finance, providing funding streams or reducing costs (by leveraging off these funds).
- **Low Carbon.** Similarly, there are opportunities for low carbon (mitigation) financing, not just in renewables but across energy more broadly (household, transport), and for land use, agriculture and natural resources management, as in many cases activities align with low carbon objectives (e.g. agroforestry, climate smart agriculture).

Finally, there may also be opportunities by bringing an enhanced climate dimension to extend new activities, or to reframe existing activities from a stronger climate perspective, to allow potential carbon finance streams to be accessed.

Again, this is an area that is highlighted as a priority going forward, with further work to investigate the identified opportunities.

Next steps

While the MKUZA II Implementation Plan already has activities / programmes on climate change, including goals and objectives, these are centred in Environment (Vice President's Office), recognising this is the main lead for this area. However, it might be useful to extend climate responsibility and activities to the Zanzibar Planning Commission (within the President's Office Finance, Economy and Development Planning – POFEDP) and the Ministry of Finance and Economic Affairs (MOFEA), in relation to climate screening and climate finance.

This will require capacity building to fulfil the operational roles and responsibilities (i.e. to fully take account of climate risks and finance opportunities), and this is recommended as a priority area to take forward. It is noted that UNDP (UNDAP) has committed funds to both ZVPO and to ZPC, and there are plans for World Bank Technical Assistance as well, and these would provide a source of funding for these activities.

It would also be useful to undertake a more comprehensive analysis of those areas in the Implementation Plan that have been identified as potentially high risk (i.e. at risk from current climate variability and future climate change) and to possibly build climate screening capability within the Government (built around existing processes and procedures).

Similarly, many of the projects and programmes in the Implementation Plan involve areas that might fit with emerging opportunities for low carbon (mitigation) or adaptation financing. Again, it is recommended that a more comprehensive analysis of the opportunities identified in the Implementation Plan are considered, and a capacity building programme is introduced to improve knowledge on climate finance.

Impacts of Climate Change and Possible Adaptation Options

The study has undertaken a review and initial climate change assessment of vulnerability, impacts and adaptation on Zanzibar. These findings were discussed with stakeholders at workshops on Unguja and Pemba. The findings are summarised below, presented by sector. A full report on impacts and adaptation work is included in a technical report (Report 4 - Vulnerability, Impacts and Adaptation) which is available on the project web-site at <http://www.economics-of-cc-in-zanzibar.org/>.

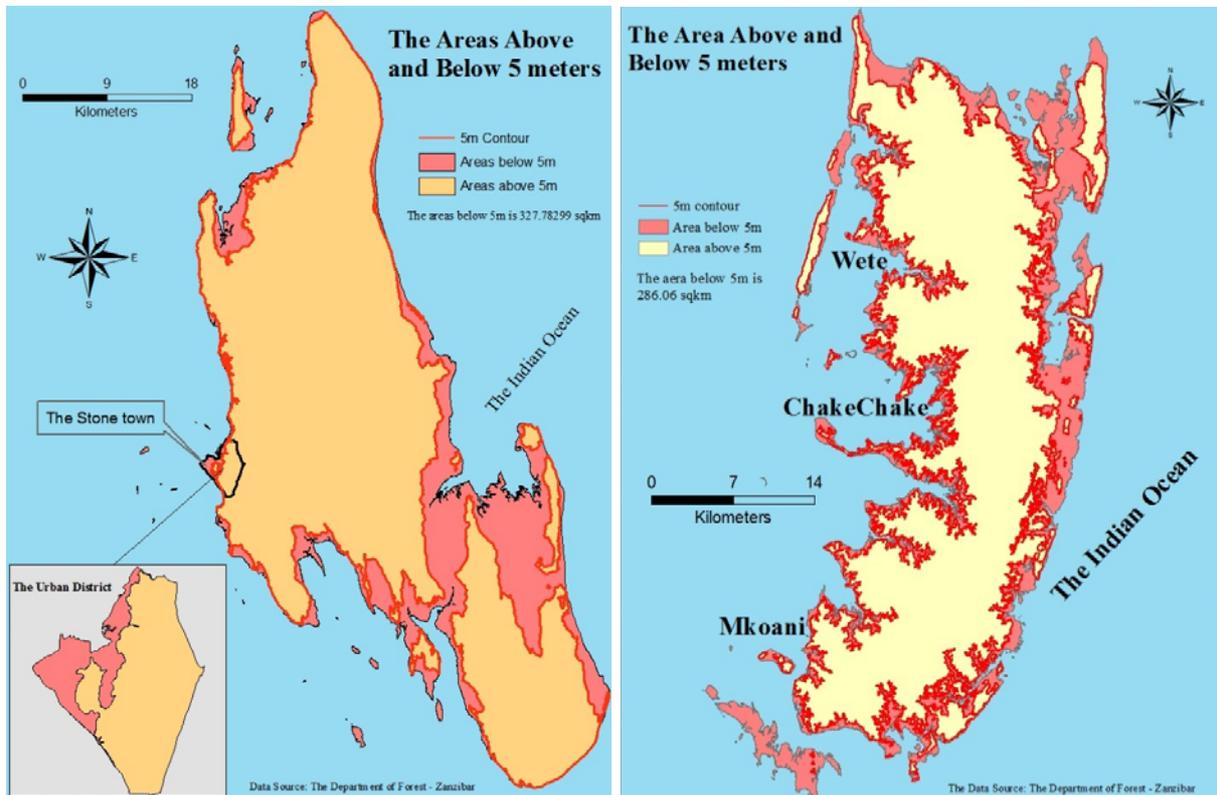
Coastal Zones

The coastal zones of Zanzibar contain high populations and significant economic activity. These areas are at risk from future sea-level rise and storm surge, as well as from coastal erosion.

- The coastal areas of Zanzibar are already vulnerable to coastal erosion and there are reports of enhanced flooding on the islands, as well as salt water intrusion in water supplies. While changing weather patterns on the islands may have a role, these effects need to be seen against a background of socio-economic development, population growth, land pressures, resource use, and natural processes, i.e. they are not due only (or indeed mostly) to climate change. Nonetheless, addressing these existing impacts is an early priority, to reduce existing impacts and help build resilience for the future.
- As an island, Zanzibar will be vulnerable to future sea level rise from climate change. The potential impacts of sea-level rise include flooding and loss of low-lying areas, shoreline (coastal) erosion, saltwater intrusion and increased salinity in aquifers and water supplies. The inundation and erosion (flooding and eventually loss of land) may affect human settlements, agricultural land, infrastructure, transport, and water resources within the coastal zone, as well as tourism and provisioning services (fishing, aquaculture and agriculture).
- The study has progressed a rapid analysis of the vulnerability of the islands to sea level rise. Contour mapping show the areas at potential risk on both islands (shown in the figures below). This reveals significant low lying areas, on both islands, though it is stressed that these are the areas at risk of flooding (not of disappearing under water). The results show a high proportion of the land – and an even higher proportion of the population – is located in these low lying coastal zones. Based on these results, further work on more dis-aggregated contour mapping and hazard analysis is recommended – as this would allow more accurate identification of the potential areas at risk.
- It is highlighted that this information also needs to feed through to spatial planning/land-use policy and infrastructure siting decisions, to avoid building and development in areas of current or future high risks. There is also a need for enhanced capacity building including awareness raising, institutional strengthening, and monitoring and assessments to provide the evidence base for future decisions, including coastal and marine data (e.g. sea surface temperatures, wind speeds, shoreline erosion)
- The study has also reviewed potential adaptation options and costs, drawing on the previous Zanzibar Adaptation Programme of Action (ZAPA) and other literature. While hard coastal protection may have a role for some key areas (Stone Town), the most promising and cost-beneficial options are likely to be ecosystem-based adaptation, because of multiple benefits that these options offer (so called 'no regret' options). These include shoreline vegetation and forest planting, mangrove restoration and replanting (i.e. coastal forest buffer zones) and seagrass replanting. There is also a need for strengthening of the on-going plans for integrated coastal zone management.

The Coastal Areas most at Risk

The figures below show the 5 m contour line for Zanzibar. These are the areas below 5 metres that are hydrologically connected to the sea.



5 metre contour line for Unguja and Pemba

These represent land area most at risk from major storm surges and high tides (which are likely to increase with sea level rise) – but it is stressed that the area that will be inundated will be much lower (as sea level rise is only likely to rise by 0.3 to 1 metre over the next century).

The mapping of the country shows large low-lying areas. For Unguja, around 328 km² is below the 5 metre contour line and for Pemba around 286 km² is below the 5 metre contour line. This equates to 19.7% of Unguja and 28.9% of Pemba.

Similarly, the population in these zones has been estimated. For Unguja, around 224 000 people live below the 5 metre contour line (29%) and for Pemba, the number is higher at around 281 000 (54%). This highlights that a high proportion of people and assets (homes) are likely to be concentrated in many of these at-risk areas.

These maps can identify areas at risks, and help prioritise potential adaptation, though further work to improve the resolution of mapping is recommended. They can also provide important information on vulnerable areas, which are important for spatial planning and development, allowing the most at risk areas to be avoided, and thus reducing future risks.

Coastal and Marine Ecosystems and Ecosystem Services

Coastal and marine ecosystems are the backbone of the Zanzibar economy, and support a very large number of livelihoods on the islands. They provide large economic benefits, known as 'ecosystem services', by providing food, shoreline protection, and tourism revenues.

- The economic value provided by fisheries and, seaweed farming, and tourism make up at least 30% of Zanzibar's GDP, and are an even higher proportion of exports and foreign income. These coastal ecosystem services are critical to the economy of Zanzibar, but are at potentially at high risk from climate change. All of these coastal ecosystems are already under pressure from other drivers already, and these pressures are likely to increase on the islands with rising population and development. Again addressing these existing risks is a key priority for early action.
- Climate change has potentially negative effects on all of these ecosystems, and the services they provide. The degradation and potential loss of ecosystems will cascade through to many other sectors, affecting coastal infrastructure and increasing erosion, but also affecting key economic sectors such as tourism, and island livelihoods more generally.
- The study has reviewed potential adaptation options. As highlighted above, ecosystem based approaches would have multiple benefits in replenishing these ecosystems (and enhancing their economic value) as well as providing wider benefits. The ZAPA identified these options as a priority, recommending management practices that will ensure the successful attainment of conservation and management goals, promoting management practices that confer resilience to the ecosystem, and protecting and enhancing habitat protection

More detailed information is provided by category below.

Fisheries

Fish constitutes the most important source of protein in Zanzibar, and fisheries are an important economic sector on the island as well as sustaining many livelihoods.

- The impacts of climate change on fisheries potentially include shifts in species, food chain effects, diseases, and increased ocean acidity. There is some evidence that warming temperatures are negatively affecting some fisheries. However, this is an emerging area and a key priority is to get better monitoring and to enhance research.
- The study has reviewed potential adaptation options. An obvious early institutional adaptation is to bring climate change within existing sectoral policy. The current update to the Zanzibar fisheries policy provides an opportunity to take climate change into account. There is also a need for greater monitoring, linked to the physical changes in the sea around Zanzibar (see earlier section) and a greater focus on marine species monitoring, to be able to track changes (noting the complex issue of attributing changes). Finally, there are also a large number of cross sectoral linkages to other areas, notably enhancing the resilience of coral reefs and mangroves, because of their importance in fish stocks, because of their important role as breeding grounds and nurseries for young fish.

Coral reefs

Coral reefs line the coast of Zanzibar and provide important resources for the local economies and communities. These reefs have important roles in coastal protection, fisheries, as well as being important tourist sites, i.e. they provide important ecosystem services and have significant economic value.

- Corals are vulnerable to sea temperature, most obviously seen through coral bleaching. There was mass bleaching of many of Zanzibar's coral reefs during the 1998 El Nino event, which was reported

to have led to a large economic loss to the tourism industry. However, the reefs are also being degraded from a combination of other factors, including fishing, tourism and eutrophication. The MKUSZA II recognises that if coastal erosion and coral reef damages remain unchecked, it will affect all of these sectors. We also stress that it will also affect Zanzibar's economy.

- Coral reefs are particularly vulnerable to future climate change, and the risk of coral bleaching due to increased sea surface temperatures (leading to reduced growth rates and eventually mortality). Even modest sea surface temperature increases of 1 or 2°C above average over a sustained period of time can cause mass bleaching, and there are a range of other potential impacts from seawater chemistry (acidification) and from rising sea levels. Further pressures also arise from decreasing coral calcification rates from ocean acidification, and from sea level rise. Existing monitoring data shows significant increases in local sea temperature over recent decades – and these are likely to increase with climate change. The threat to the corals of the islands is therefore considered high, with potential impacts on fisheries, tourism value, and leading to enhanced shoreline erosion, and is a priority area.
- The Zanzibar Adaptation Programme of Action for Zanzibar recognised the importance of corals and proposed a number of options. There are also a wider set of tools and strategies for enhancing coral reef resilience including monitoring, transplantation, marine protected areas, integrated coastal management and fisheries management. There is an adaptation fund project on the mainland that is supporting reef rehabilitation through in situ techniques for coral breeding and transplantation, along with better management and enforcement systems, which provides a useful example for the islands.

Seaweed and seagrasses

Seaweed farming is an important activity for Zanzibar, supporting livelihoods, and a major source of foreign currency, and helps to reduce the degradation of the marine environment. There have been reports of sea-weed die-off along the coast of Tanzania, including Zanzibar, and sea surface temperature is the most likely cause. This has led to a need to move sea weed farming to deeper water.

The islands are also home to seagrass meadows, which provide various ecosystem services (fish, filtering sediment, stabilisation of sea floor, and reduction of erosion). Sea grasses appear to be declining around many coasts, including Zanzibar, though this is largely attributed to human impacts.

- Climate change is likely to have a number of effects on sea-grasses from a large number of factors including changes in salinity and temperature, ocean acidification, storm activity and ultraviolet irradiance. However, there could also be some beneficial effects as increases in the amount of dissolved CO₂ could lead to higher rates of photosynthesis.
- A mangrove and seagrass monitoring project has been set up for Tanzania (including Zanzibar), which is a key first step towards adaptation. Moving forward, there are effective management practices that could avoid some of the potential impacts, i.e. to enhance resilience to climate change, as well as restoration projects, and these measures also offer broader benefits in terms of resilience to a wide range of sectors (including fisheries).

Mangroves

Mangroves provide coastal protection against storms and coastal erosion and they are important breeding grounds for fish and crustaceans. They also provide wood sources, act as natural filters, and they may also help in preventing saltwater intrusion. They provide an extremely valuable ecosystem function and service, which has a very high value (estimated at hundreds of thousands of \$/hectare)

- These ecosystems are already under pressure from other factors (land-use change and other) on the islands, and there have been significant losses of mangroves recorded (which has led to other impacts, such as enhanced erosion, increased inundation, etc.).

- Mangroves are potentially vulnerable to the impacts of climate change, from a combination of sea-level rise, salinity (and salt water intrusion) and storms, as well sea surface temperature. However, impacts are determined by other factors notably whether these systems have sufficient sediment supplies and whether they have the room to move inland with rising sea levels.
- There are general resilience options for mangrove conservation, such as risk strategies, identification of critical areas, managing human stress, establishing buffer zone (for migration), restoration, connectivity, monitoring, adaptive strategies, alternative livelihoods and partnerships. As highlighted above, there is real potential for Zanzibar to use mangrove restoration as an ecosystem based adaptation, and this is considered a priority area for early adaptation.

Agriculture

The agriculture sector is another mainstay of Zanzibar's economy, as well as having a key role in sustaining livelihoods on the islands. It is also a very climate-sensitive sector.

- Recent climate variability, notably the poor and erratic rains in 2006/7, significantly reduced agricultural production and also led to widespread malnutrition. There are reports that greater unreliability of the rains is affecting farmers.
- Future climate change has the potential to exacerbate current production risks in agriculture, either from changes in temperature and rainfall trends, from greater extremes of climate variability, or from other effects. However, there are potentially positive as well as negative effects, and the changes vary strongly with individual crops and locations. While negative impacts on highly temperature sensitive crops such as maize are projected in the longer-term, there is only relatively low production of this crop on the island. However, changes in temperature and rainfall do have the potential to affect other major crops, especially those that are rain-fed. Rice is affected by temperature and precipitation, and national studies indicate a potential reduction in yields is possible. Banana yields could also be potentially affected by climate change (and also by changes in disease) and some regional studies indicate small decreases in yield. Cassava is considered a more resilient crop – and is seen as a promising adaptation strategy to cope with potentially hotter and drier conditions in the future – as part of a diversification strategy. Any effects on domestic production will have important effects on prices, household income and food security and livelihoods on the islands (noting the former will also be linked to the changes happening elsewhere in the region and elsewhere, from the global effects of climate change).
- As well as direct production, there may also be changes to pests and diseases. In the longer-term, there is the potential for major agro-ecological shifts – a key issue due to the small geographical area of the islands – though future zones are likely to remain within tolerance levels for production. A potentially greater impact, even in the short-term, is from the intensification of rainfall in rainy seasons, and higher levels of variability. There are also risks from salt water intrusion, and some coastal (rice) fields have already experienced these effects. High value exports, notably cloves, are vulnerable to increased storm and high winds, and this could be a future issue given the observed data on strengthening wind regimes. Finally, there are potential risks to the livestock sector, particularly through the potential from heat extremes, and from changes in the burden of pests and diseases.
- Agriculture is clearly a key priority for adaptation, especially in relation to existing climate variability. The study has reviewed potential adaptation options and costs, drawing on the previous ZAPA and other literature. There are a very large number of potential options identified, and a key issue will be to prioritise which of these should be taken forward. There is also a need for enhanced capacity building including awareness raising, institutional strengthening (particularly for extension services), and strengthening the capacity of agricultural research institutes on the islands.

- There are obvious early (no regret) benefits from better information, with short-term and seasonal forecasting, and early warning systems (e.g. for heavy rain and flood risks, and droughts), and these are seen as an early priority. This links to the earlier discussion of better information on agro-meteorological services (capacity, equipment and data/monitoring) and enhanced disaster risk management including the communication and dissemination to key stakeholder (farmers).
- Recent studies have identified promising options that are robust to the possible future changes (in climate extremes and from climate change), particularly those that have wider cross sectoral benefits (e.g. soil and water conservation), those that might provide greater resilience as well as potential opportunities or synergies with low carbon (e.g. conservation agriculture, agroforestry), and those that offer no regret opportunities (e.g. reducing post-harvest losses). Furthermore the use of rain water harvesting and storage as a low cost approach for water management, particularly for small holder farmers, is a potentially important option. Many of the most promising options fall within a general definition of sustainable agricultural land management (SALM) practices, and these are considered a priority to build resilience, increase production and generate wider benefits for the islands.

Tourism

Tourism is already a major economic sector on the island, and underpins future growth objectives. It is also a highly climate sensitive sector. Climate change is therefore potential important for sector.

- Tourism on Zanzibar is a combination of beach, activity (water based), historic and destination tourism. The current (tropical) climate of the islands and beaches are undoubtedly one of main attractions of the islands, as are the coral reefs (see above). There does not appear to have been detrimental effects from recent extreme on tourism arrivals on the islands, but the loss of the electricity connector in 2009/10 did significantly impact the sector, and this highlights the potential vulnerability to shocks/extremes. Tourism is also a driver (and a pressure) on many of the other sectors highlighted elsewhere, e.g. in relation to water and energy use, natural resources, etc.
- The impacts of climate change on tourism on the islands are complex, because of the diverse nature of tourism on the islands, and because effects will occur in both direct and indirect ways. The tourism attractiveness of Zanzibar will change in many ways, and these effects also have to be seen in an international context, because of the comparative changes relative to elsewhere (i.e. to competing destinations). Effects are also strongly linked to the mainland as part of combined destination trips.
- Tourism is closely associated with climate, particularly beach tourism, and climate change can affect the destination preferences of tourist by changing temperatures (and rainfall). There is already a strong seasonality to the current tourism numbers, with peaks in the dry seasons and significantly lower numbers in the rainy seasons. Climate change has the potential to affect the attractiveness of the islands. The changes in average climate expected for Zanzibar are unlikely to lead to major effects in the short-term, but changes in extremes and variability are considered of more concern.
- There is a significant threat from the degradation and loss of marine ecosystems (corals) for diving/snorkelling related tourism. There are also threats to tourism hotels and infrastructure from coastal erosion and sea level rise, and in the longer-term, to key tourist areas such as Stone Town. It is stressed that tackling the threats of climate change in other sectors will reduce many of the potential impacts on tourism (or to put it another way, failure to tackle the issues in other sectors will have detrimental effects on tourism).
- Climate change will also affect the energy and water use of the tourism sector, increasing demand for both. Rising temperatures will increase air conditioning use (and costs) and will increase overall electricity demand on the island, especially with tourism growth rates and projected increases in high

class tourism. Similarly, rising temperatures will affect water demand, which is already extremely high in the tourist sector (measured as litres per tourist per day), particularly from high class hotels. These effects will be compounded as the monthly flow of tourists is directly opposite the monthly rainfall received, i.e. tourist arrivals are highest when rainfall is lowest. While this is not surprising, it highlights an issue with supply and demand (and recharge levels) that could be exacerbated by climate change and by tourism projections, particularly with the lower rainfall in dry months projected from climate change. It is also highlighted that water demand from the tourism industry is likely to increase due to higher temperatures from climate change, exacerbating these pressures.

- The study has reviewed potential adaptation options for tourism, drawing on the previous ZAPA and other literature. Many of the threats to the tourism sector come indirectly, and thus the adaptation responses in other sectors will have benefits for the tourist sector. Because of this, adaptation for tourism needs to be considered from a cross-sectoral perspective.
- Given the importance of the tourism sector to future growth objectives for Zanzibar, there is a need to make sure sectoral policy builds in climate considerations. A key early step is therefore to include climate change in sector development plans, to raise awareness of the issue, to build capacity, and to undertake research to look at the potential effects. This also extends to low carbon tourism (discussed in a later section) and the need for sustainable tourism, and the potential to expand eco-tourism on the islands.
- In terms of specific adaptation there is the potential for protection (defences to protect shoreline tourism infrastructure) and beach nourishment (for beach erosion), though as highlighted above, a preferred approach would be to encourage ecosystem based adaptation for protecting tourist assets. There are also early (no regret) priorities to address the impacts of rising cooling demand and water use, with energy efficiency, passive alternatives, and the efficient use of water. All of these areas represent early priorities for the sector, reducing costs and enhancing resilience, and align with sustainable tourism. Many of the future potential threats to the sector could be addressed through development controls and standards (e.g. requiring buildings to be set back and raised, requiring energy and water efficiency as conditions in planning consents) and this is highlighted as a priority for early investigation, especially given the proposed numbers of hotel planned for the islands.

Health

While Zanzibar has had made significant progress in reducing cases of malaria, other climate sensitive diseases are still prevalent. There are also periodic outbreaks of water borne disease, associated with floods (from contamination) or from droughts (when people turn to alternative water supplies).

- Climate change has the potential to affect human health on Zanzibar in the future. This may happen directly, as with the effects of flood injury, wind storms or heat extremes or indirectly, for example, through the changes in the transmission of vector, food or water-borne diseases. There are also a wider set of indirect impacts from climate change on health, which are linked to other sectors (e.g. food security and malnutrition).
- Given current malaria rates and control programmes, the most important impact from climate change is likely on diarrhoea, i.e. food and water borne disease, associated with higher temperatures but also extremes (floods and droughts). An indicative analysis estimates that the additional costs of climate related health impacts on Zanzibar could run to several \$million/year by the 2030s.
- The study has reviewed potential adaptation options and costs, drawing on the previous ZAPA and other literature. A wide range of measures have been identified in the health sector to adapt to climate change impacts. Most of these build on well-established public health approaches and are therefore theoretically easy to implement. The importance of community awareness on existing

issues is highlighted, and a number of no regret options are identified (notably safe water and sanitation), which are essential in reducing the future impacts of climate change, and re-enforce the earlier discussion of the need to address the current adaptation deficit.

Energy

The energy use of Zanzibar is described in more detail in the low carbon section. The discussion here relates to how climate change might affect energy supply and demand. This is a particularly important issue for Zanzibar as an island state, because of the risks of supply disruption.

- On the energy supply side, the main issue is reliance on mainland connection, which itself has a high reliance on hydropower, and has been affected heavily by drought events in recent years. While adaptation responses on the national grid mix fall to the mainland, there are options for Zanzibar in reducing transmission losses and other forms of energy efficiency, and the potential for local generation and diversification, discussed in the low carbon section. Furthermore, a high proportion of electricity on Zanzibar is used for water pumping, and again there are low carbon options and efficiency options that could be explored.
- As well as energy supply, climate change also affects energy demand, as outside temperature is a key factor in cooling (from air conditioning). Climate change will increase the potential energy demand associated with cooling and this is important because of the high cooling demand in the tourism sector on the islands. The level of increase depends on the temperature (and humidity) but also income levels and penetration rates. As well as the extra cost of electricity, increased energy for cooling might also increase emissions from non-renewable plants or local diesel generators, and heat extremes may also cause additional issues of peak electricity demand.
- The lack of data makes a quantitative analysis of these effects difficult at the current time, and investigating these areas is an early priority. However, it is clear that the effects of climate change (and even other drivers associated with development) are not taken into account in the electricity plans for the island and this is an important omission.
- The study has also reviewed potential adaptation options and costs. There are a range of options available to address these impacts, from energy efficiency (more efficient AC units) through to passive ventilation, building design, etc. However, many of these require a greater planned response (including e.g. building regulations or codes for new hotels) and are most cost-effective at the construction stage. They are particularly important given the long life-time of buildings. A greater focus on awareness-raising of energy efficiency and passive alternatives is key, but the potential for the introduction of proposed efficiency standards, and even consideration for building codes (for new tourism or other building infrastructure) are highlighted.

Water

Water is a critical sector for Zanzibar. In addition to the multi-sector links to agriculture and energy (above), it is important for tourism; it supports livelihoods, and affects ecosystem services (provision of fuel wood, water purification, climate regulation, etc.). Ancillary stresses of pollution, salinisation, sedimentation and over-extraction of groundwater exacerbate current vulnerability, and future drivers such as population and economic growth are likely to put additional pressures on resources.

In terms of public water supply, groundwater is the primary source of water in Zanzibar. Zanzibar receives relatively high rainwater (see earlier climate section, though this does vary across the islands) and has large groundwater resources (especially on Unguja). There are cases of salt-water intrusion into a number of water supplies on the island, but these are thought to be due to a combination of factors, rather than just climate change.

- The impacts of future climate change will have effects on future water resources, though other drivers (population, abstraction rates) are likely to be more important. Nonetheless, future climate trends has the potential to exacerbate growing issues of water demand and supply and additional issues are likely to arise from the increasing extremes (heavy rainfall) and potentially decreases in rainfall during the dry season.
- Zanzibar already has one adaptation project, funded as part of the URT NAPA (Shallow Water Wells Affected by Inundation). The study has reviewed potential adaptation options and costs, drawing on the previous ZAPA and other literature. This identifies a large number of measures, though many studies have highlighted the potential for small-scale rain water harvesting on the islands. However, a key priority appears to be the need for better monitoring of existing water abstraction and groundwater levels, and the need to move towards integrated water resources management, especially as pressures on available water supplies increase. Finally, an early no regret option is to address the current connections and leaks to improve the efficiency of the current system.
- For the risks of flooding, a number of adaptation options are available, a number of which were identified in the ZAPA. Early steps are to identify areas at risk, and for dense urban areas, an obvious response is to improve flood management. There is already a large Zanzibar Urban Services project which is constructing storm water drainage channels outside of Stone Town and this provides a useful example for wider application.

Forests and terrestrial ecosystems

Zanzibar has extensive forest vegetation, and the forests of the two islands form an important part of the East Africa Coastal Forests Eco-region. These forests have been under pressure and have been significantly reduced in area, but there is now a Zanzibar National Forest Plan, and Zanzibar (as part of the URT) is a pilot REDD+ country (Reduced Emissions from Deforestation and Degradation).

- The potential impacts of climate change on forests are complex, but forests are acclimatised to existing ecological zones, and have long life-times and slow rates of growth. They are therefore at risk of climate change from a combination of temperature, precipitation and extremes, as well as other factors such as changing pests and disease.
- These forests support wider biodiversity, and changes to these areas and other terrestrial vegetation will also affect wider biodiversity. Some species are capable of adapting to climatic shifts and will survive, but for an island state such as Zanzibar, the potential for species movement is very limited, and this is highlighted as a critical issue.
- The study has reviewed potential adaptation options and costs, drawing on the previous ZAPA and other literature. A number of options are highlighted, many of which overlap with the REDD+ actions. However, it is important that climate change is factored into these plans, to ensure that appropriate buffer zones and planning takes account of the future shifts in climate on the islands.

Cross cutting issues

The study has also considered some of the issues with climate change in relation to gender and inequality. A number of the effects outlined above are likely to have a strong gender bias (e.g. the impacts of sea surface temperature on seaweed farming, the existing effects of gender and water and the possibility of increased effects from climate change on water collection, etc.). It is also clear that there will be a strong distributional aspect to the impacts, and climate change will not be felt equally across Zanzibar, in different locations, and across groups in society. The poor are particularly vulnerable to climate change on the islands, because of their limited livelihood base, poor access to markets and

services, and low adaptive capacity. Further work is needed to explore these effects in detail, and design adaptation strategies accordingly, and this is highlighted as a priority. It is also stressed that the previous ZAPA identified a priority for community based adaptation as a way of addressing some of these issues.

Stakeholder consultation

At the stakeholder workshops, participants were asked to review key concerns (in terms of current climate vulnerability and future climate change) and were then asked to prioritise these in order. The areas of greatest concern, i.e. those risks that were ranked the highest (within sector categories) are shown below. This approach does not replace a detailed scientific analysis, and it is only representative of the views of those present at the meetings, but it does provide a useful guide on key local concerns.

Key Risks from Climate Variability/Change as Identified by Stakeholders on Unguja and Pemba

Highest Ranking Risks	Unguja	Pemba
Changing trends	Number participants who identified as priority	
Coastal erosion	.....(13)	.....(7)
Salt water intrusion	.....(7)	.....(16)
Agriculture (planting dates, productivity, etc)	.....(13)	.....(7)
Sea surface temp and seaweed farming	.....(8)	•
Coastal /Marine		
Flooding and inundation	.....	.....(8)
Coastal erosion	.....	.....(8)
Salt water intrusion	.....(8)	.....(12)
Coral	.....(12)	••
Mangroves	.....(10)	.....(8)
Fisheries	.....(18)	.....(12)
Forests and Terrestrial ecosystems		
Forests	.....(11)	•••
De-forestation	.....(11)	.....(13)
Agriculture		
Rice	.....(7)	.....(11)
Food security	.....(16)	.....(7)
Drought	•••	.....(7)
Health		
Food borne disease	.....(7)	•
Water		
Salt water intrusion	.....(13)	.....(10)
Floods	.....(7)	
Droughts	.....(8)	
Energy		
Energy for cooling	..... (6)	••
Energy for water pumping	.....(8)	••••
Mainland generation and Interconnector	.....(8)	
Infrastructure and extremes	.....(8)	
Tourism		
Climate change – attractiveness – extremes	.....(14)	•
Marine/recreational coral	.....(17)	••
Heritage (coastal and stone town)	.....(14)	••
Energy (cooling)	.....(12)	

What is also interesting is that there are differences between the islands, e.g. effects on tourism were a key concern on Unguja but not on Pemba - whereas the effects of drought and salt water intrusion were considered higher priorities on the latter, no doubt influenced by existing vulnerability in these areas.

Participants were also asked to provide a ranking of preferred adaptation options, again with options prioritised within sectors (see below). Again, these priorities are only representative of the views of those present at the meetings, but it does provide a useful guide on local preferences for adaptation options.

Highest Ranking Adaptation Options as Identified by Stakeholders

Highest Ranking Adaptation Priorities	Unguja	Pemba
	Number participants who identified as priority	
DRR/ EWS		
Strengthen DRR/DRM	••	•••••(6)
Community based systems	•••••(5)	•
Data gathering and reporting	•••••(6)	••
Risk Maps		•••••(5)
Coastal		
Ecosystem based (mangrove, seagrass, shoreline)	••••••••(10)	
Shoreline protection (that not destroy habitat)	••••••••(11)	••••
Integrated coastal zone management	••••••••••(16)	••••••(7)
Land use measures (wetlands) to mitigate SLR	•••••(6)	••
Research	••••••••(11)	•••••(6)
Marine protected areas	•••••(5)	•••• (5)
Research of marine areas		••••(5)
Community capacity building programme		••••••••••(12)
Water		
Rain water harvesting	•••••(7)	••••••••••(11)
Integrated water management	•••••(7)	•
Sustainable land management/soil water conserve	••••••••••••(17)	•••••••(9)
Agriculture		
Agriculture research can capacity	•••••(6)	••••••(7)
Conservation agriculture	•••••(6)	
Agro-forestry	•••••(6)	•••
Forests		
Afforestation	••••	••••••(7)
Agro forestry	••	•••••••(8)
Awareness raising	•••••••(8)	•••
Health		
Safe water and sanitation	•••••(6)	•
Community awareness (vector borne)	••••••••••••(16)	•••
Tourism ZAPA		
Awareness raising (including investors)	•••••••(9)	•
Coastal protection/Coastal zone management	••••••••••••••••(21)	
Stimulate employment local people	••••••••••(13)	
Improved planning and enforcement	•••••••(8)	
Energy		
Diversification including renewables	••••••••••(11)	••
Energy efficiency	••••••••••••(15)	•
Passive ventilation (bdg codes and hotels)	•••••••(9)	
Infrastructure resilience (extremes)	••••••••••(13)	

Moving to Adaptation Pathways (Prioritisation)

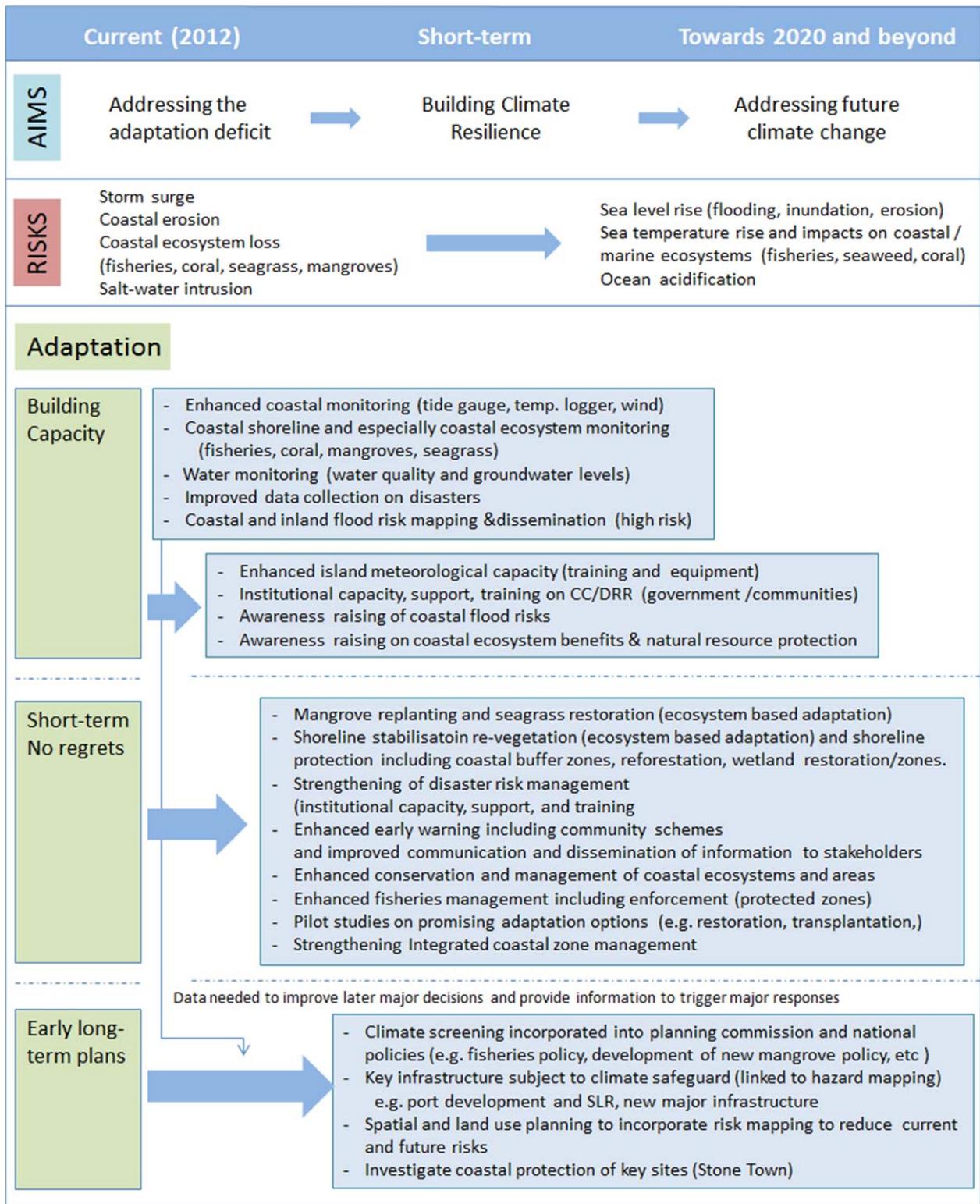
While the general climate trends are clear, there is uncertainty on the specific changes with climate change. More importantly, there are already existing risks from current climate variability, which need to be addressed first, and which offer the opportunity for immediate benefits as well as future resilience. Set against this background, and the very wide range of potential future impacts, it is often difficult to know what to do first. In response, the study has advanced a framework to prioritise early adaptation, which considers uncertainty, and helps to identify the most rationale and efficient early steps.

The proposed framework identifies early priorities for adaptation based on:

- Building adaptive capacity;
- Focusing on win-win, no regret or low cost measures (justified in the short-term by current climate conditions or wider benefits);
- Encouraging pilot actions to test promising responses;
- Identifying those long-term issues that require early pro-active investigation (though not necessarily firm action), particularly areas involving infrastructure (long life-times), decisions that take a long time, areas, decisions that are irreversible (such as land-use planning) or areas that involve major risks in the future (such as major ecosystem loss).

The study has considered these adaptation responses as a series of complementary activities, together forming an 'adaptation pathway' (and taking into account stakeholder inputs as outlined above). These identify a range of actions, split into capacity building, short-term measures and planning for the future, with a focus on the key recommended actions in early years. An example is shown below for the coastal sector.

Additional pathways for tourism and agriculture and included in the main report (Report 4) available on the project web-site.



Adaptation Pathway for Coastal Adaptation

Low Carbon Growth

The final part of the study has been the analysis of lower carbon development. This work is summarised below. A full write-up of the analysis is included in a technical report (Report 5 - Assessing the Benefits of a Lower Carbon Development Pathway for Zanzibar), available on the project web-site at <http://www.economics-of-cc-in-zanzibar.org/>.

Background

Zanzibar is aiming to eradicate poverty and develop a stronger, diversified economy by 2020, as outlined in the Vision 2020. This vision is progressing through the MKUZA II Strategy, which runs from 2010 to 2015, and will implement a range of policies and programmes that sustain economic growth, promote sustainable tourism, further increase agriculture sector productivity, improve social services and address unemployment. As highlighted above, climate change could undermine these development goals, and therefore action is needed to address potential impacts through screening and adaptation. However, there is also an opportunity to promote a more sustainable, green growth pathway in the MKUZA II strategy, through a focus on lower carbon development policies and programmes. This opportunity is real.

- A number of different countries in the region, such as Ethiopia, Rwanda and Kenya are all progressing a lower carbon development pathway (also called 'green growth'), and these are expected to benefit these countries by delivering long term sustainable growth. It also positions them to more easily access climate funding over the next 5-10 years. Similarly initiatives are also emerging in a number of Small Island Developing States (SIDS), including Mauritius, Seychelles and Maldives.
- Previous work in the East Africa region highlights that pursuing a lower carbon development pathway is in a country's national interest due to the strong synergies with measures needed to promote sustainable long term development and help deliver robust economic growth.

It is important to recognise that Zanzibar has a unique set of characteristics not shared by other countries in the region, with its own distinctive situation as an island country, including the energy connector, limited land availability, low resilience to economic shocks, and a specific institutional and constitutional arrangement as part of URT. However, many of same issues – and the same potential benefits – apply.

Analysis of the Current Development Pathway and Key Challenges

Zanzibar has a number of challenges, listed below, which need to be addressed if it is to meet its development goals. Such challenges are made more difficult by high population growth, natural resource depletion, future climate impacts and the unique characteristics of Zanzibar as an island country.

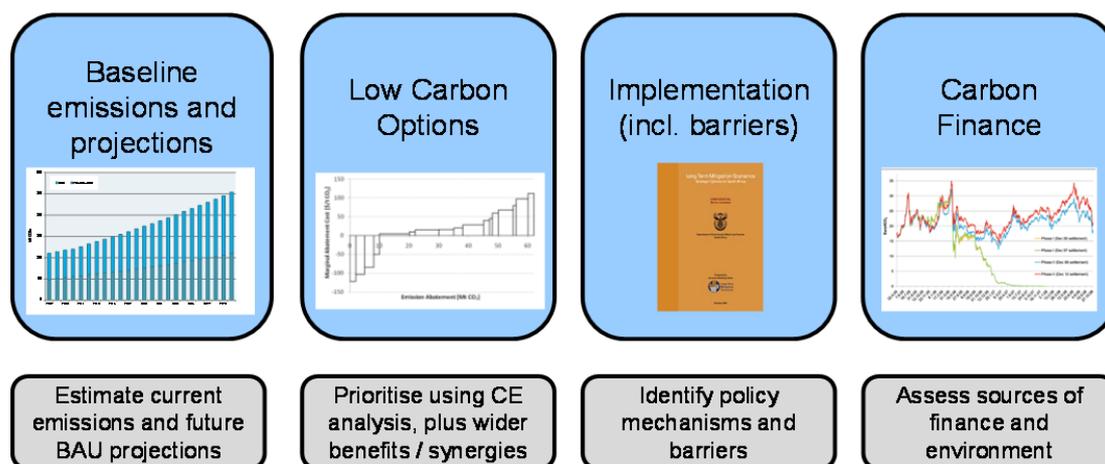
- If Zanzibar follows a business-as-usual pathway, as outlined in the table below, this could undermine development goals. However, a move towards a more sustainable, lower carbon pathway could help address many of these challenges, and actually help to achieve development objectives. This is because there are strong synergies between lower carbon initiatives and the policies needed to meet the challenges.
- Such a pathway could include promotion of renewable energy (to enhance energy security), increased efficiency of biomass fuel use for cooking (to minimise impact on the sustainability of forest resources and wood supply), a focus on urban and transport sustainability (to improve urban environments, reduce transport fuel use and congestion), the adoption of sustainable agriculture practices (leading to increased productivity, resilience to climate change, and rural income generation through carbon finance) and the promotion of sustainable tourism (reducing environmental impacts, increasing high value tourism).

Meeting development challenges: business-as-usual versus sustainable, lower carbon pathway

Development challenge	Business-as-usual pathway	Sustainable, lower carbon pathway
Access to reliable and sustainable energy	+ Unsustainable supply of bioenergy + Reliance on mainland electricity supply + Exposure to oil price hikes	+ Forestry protection and improved efficiency + Diversification to renewable generation + Energy efficiency promotion, reducing demand
Agriculture productivity	+ Low productivity + Reduced soil fertility	+ Adoption of systems for enhancing productivity, carbon stocks and resilience
Forestry protection	+ Further reduction in stocks and future acute fuel supply problems / higher prices	+ Increased promotion of tree planting, forestry and protection (via REDD+) and reduced demand side pressure (higher efficiency use)
Sustainable transport systems	+ Congestion and high pollution levels + Increasing reliance on oil products	+ Increase public transport / non-motorised provision + Better maintained, lower polluting vehicle stock + Reduced reliance on oil products
Urban environment	+ Lack of waste management + Unplanned development of urban areas	+ Improved waste management (waste water / MSW) + Sustainable building / community design (taking account of energy needs and climate impacts)
Sustainable Tourism	+ Unsustainable growth leading to increasing environmental impacts + Limited contribution to local community	+ Focus on efficiency of resource use, and benefits to local community
Financing	+ Limited financing for inward investment	+ New source of income via carbon finance

It is important to highlight that many of the strategies of the Zanzibar Government already fully recognise these challenges, and the importance of an increased emphasis on sustainability.

Against this background, the study has assessed the potential for an alternative low carbon development pathway. The method used is summarised below.

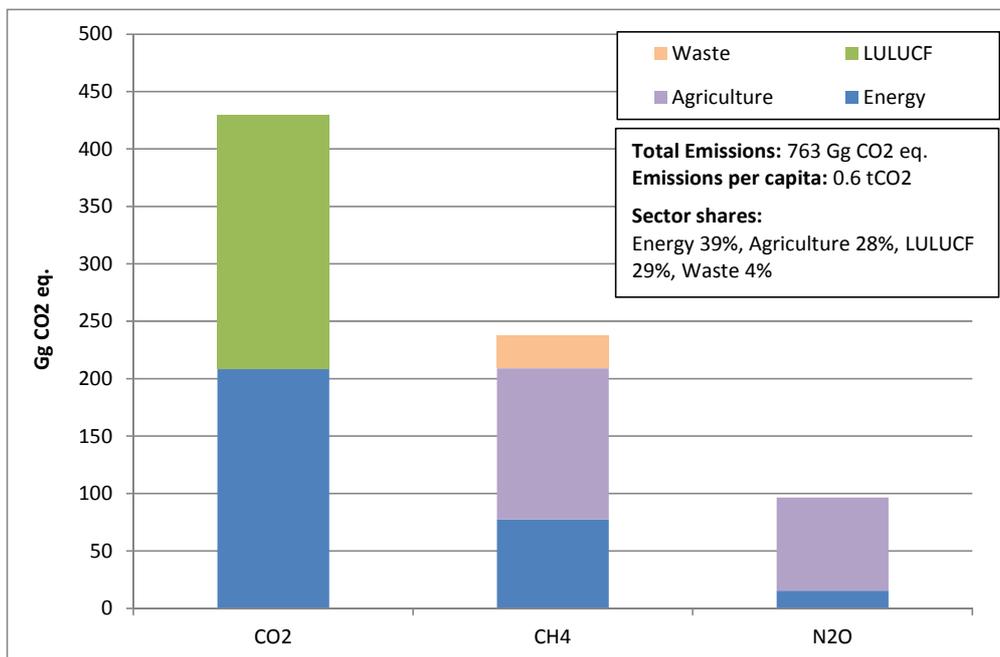


Method Steps in the Low Carbon Analysis

Current and Future Carbon Emissions

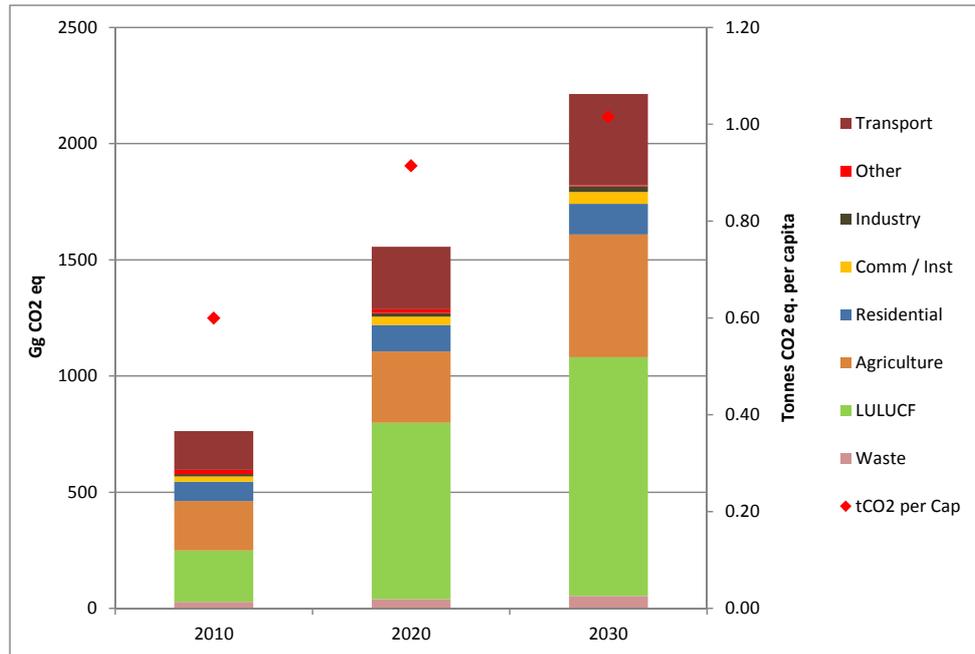
To assess opportunities for lower carbon development, the first step is to understand current GHG emission levels, and how these will evolve in the future. In the absence of an inventory for Zanzibar, the study has built up emission estimates including projections. Developing these projections also provides quantified information on the challenges facing Zanzibar, for example in terms of energy demand growth, projected increase in vehicles etc.

- The emission inventory estimates for 2010 are shown below. These highlight the important contribution from all sectors (except waste, where the contribution is smaller). Total annual emissions are estimated at 763 Gg CO₂ eq, resulting in per capita emissions of 0.6 tCO₂. This is a low per capita value in regional and global terms, reflecting the very low consumption of fossil fuels for energy on the islands.



Total GHG emissions in Zanzibar, 2010.
See main report for caveats.

- The future emissions projections are shown in the figure below. They show dramatic increases in emissions from the forestry sector (LULUCF) due to stock changes resulting from fuel wood demand and assuming no major afforestation efforts. Transport emissions also increase significantly, driven by the strong growth in vehicle ownership. Finally, the agriculture sector shows increasing emissions growth due to increasing livestock numbers and fertiliser use.
- Overall, emissions increase by 190% over the 20 year time horizon from 763 GgCO₂e in 2010 to 2213 tCO₂e in 2030, leading to emissions per capita rising from 0.6 tCO₂e to 1.02 tCO₂e / capita, though this per capita level in 2030 is still significantly lower than most other countries in the region.



Projected GHG emissions in Zanzibar, 2010-2030

It is important to recognise that there are significant uncertainties associated with these estimates due to data availability issues and simplification of the approach taken, due to the rapid nature of this analysis. However, the estimates provide a useful insight into how emissions will evolve over the next 20 years, and a baseline for analysing lower carbon development pathways.

Assessment of Lower Carbon Options

There are a large number of promising lower carbon options across various sectors which could address development challenges, attract inward investment / funding, and promote sustainability and economic growth. These options are set out in five priority themes:

1. Access to Clean and Modern Household Energy

Biomass energy will continue to be an important source of cooking energy for many years on Zanzibar. However, the unsustainability of supply and inefficiency of use needs to be addressed. This can be done by reducing per capita demand through more efficient use in improved cook-stoves (ICS) and by switching to alternative fuels. On the supply side, resource availability can be improved through promoting tree planting and effective regulation to protect natural forests reserves. A number of issues are raised.

- Both improved cookstoves and tree planting programmes need to be ambitious to rapidly address the scale of the challenge facing Zanzibar. This will clearly require a high level of initial funding to ensure the viability of programmes; however, the direct and co-benefits of such programmes would be considerable.
- ICS can reduce indoor air pollution, reduce fuel costs, develop employment opportunities through the stove market, and make cooking more convenient and less time consuming. The costs of such technologies on a household basis are relatively low, and quickly paid back through savings in fuel costs. However, the upfront costs can often be a major barrier. Other barriers relate to cultural and social attitudes towards cooking technologies, and technology availability and reliability.

- A tree planting programme could provide potential income streams to rural communities and protecting the very resources that they rely on for their livelihoods. In Zanzibar, this programme could build on the efforts of community-based organisations active in this area, including the HIMA project. The challenge is scaling-up such an initiative so that it can have a significant impact and incentivising tree planting in different communities.
- All these measures are low carbon and have the potential to reduce emissions substantially, particularly given that the forestry sector accounts for at least one third of current emissions (and will continue to do so in future years). This therefore allows for the possibility of access to carbon financing, either via markets (as in the case of REDD+), multilateral funds or from donors providing bilateral funding for climate-based action. However, it is important to note that such measures could be equally 'badged' as sustainable energy or forest management measures, and therefore could be funded outside of climate funds or supplemented by carbon financing (through CERs, for example).

2. Electricity Supply Diversification through Indigenous Renewable Generation

It is clear that Unguja will require additional electricity capacity before 2020. Renewable generation offers an opportunity to reduce reliance on mainland supply, reduce the use of back-up diesel generation and enhance energy access for some communities. Reducing reliance on mainland supply will reduce exposure to mainland load shedding, increasing tariffs from TANESCO and the possibility of future cable failure.

- From an economic perspective, grid-connected renewable generation technologies are not cost-competitive with mainland supply, even with some form of financial incentive. However, this is going to change in future years as TANESCO prices increase. Wind power is probably the most economic and appropriate technology for Zanzibar. Other grid-connected technologies such as solar (expensive), marine (non-commercial as yet) and waste (lack of supply) all have near term barriers to deployment. Off grid technologies are also important, particularly in rural areas and as a potential back-up to grid supplied electricity. Solar household systems are widely used in East Africa for small load e.g. lighting, small appliances. Other applications include larger solar PV systems on buildings (although these are higher cost) and micro-wind e.g. for water pumping. Many such technologies are cost-competitive when compared to off grid diesel generators.
- More information is needed on the potential for different renewable generation technologies, and analysis of the cost and operation of different technologies within the ZECO system. This is critical for making recommendations about the least cost mix of technologies. This has to be balanced against the relative low cost supply of electricity from the mainland, an option that most SIDS do not have. The issue of affordability is also clearly critical for access for many residents.
- Preliminary projections suggest the need for additional capacity on Unguja before 2020, so in planning for new capacity and associated infrastructure, this is relatively near term. In this context, exploring the potential for renewable generation alongside additional mainland cable capacity would be important. Where carbon financing can help in incentivising renewable capacity, then such opportunities should also be considered. As shown in other countries, the policy framework and mechanisms are key to getting investment, and this is why many SIDS have sustainable energy strategies and / or renewable energy targets.
- Any policy framework should also focus on addressing energy efficiency, a very cost-effective measure for reducing demand. Such an initiative would reduce the amount of capacity on the system, and is critical in view of fast growing demand through use of electricity using appliances, such as air conditioners. Understanding the appliance market will be crucial for effectively targeting any specific action.

3. Promotion of Sustainable Urban and Transport Systems

Low carbon measures in the transport sector could lead to major benefits for Zanzibar. Measures to improve efficiency also have other benefits including reduced fuel costs for consumers and improved air quality in urban areas, particularly Zanzibar metropolitan area. Measures aimed at public transport and non-motorised modes lead to similar benefits but have the added advantage of addressing urban congestion, a problem that is set to get much worse in the next 5-10 years.

- Controlling the efficiency of vehicles at import or at point of sale seems to be the most promising measure. Accredited inspection organisations could ensure vehicles met specific requirements, e.g. an efficiency standard. Incentives could be incorporated into annual road taxes, lowered for those vehicles that were more efficient e.g. based on engine size and age. Further analysis is needed to assess the costs and benefits of different measures; however, such measures look highly beneficial and are widely implemented elsewhere. These benefits are going to increase year-on-year as the number of vehicles increases, and this needs to be taken into account in future appraisals.
- Maintenance and inspection of vehicles could be introduced, with specific goals to improve safety and reduce air pollution. In particular, this could be part of improving public transport provision, by making sure dala-dalas are in good condition and road worthy. Improved efficiency would be a modest co-benefit and therefore not the key driver for such a policy.
- Finally, improving the urban environment for walking and cycling would be highly beneficial, and could be linked into on-going and future urban development and transport projects.

4. Development of Lower Carbon Agriculture

There are a range of agriculture practices that can also lead to productivity gains, enhanced climate resilience and increased soil carbon sequestration. These include agroforestry, conservation agriculture e.g. low tillage, soil and water management and various improved agronomic practices (see earlier discussion).

- It makes sense that these measures are considered as part of wider agriculture investment programmes and policies, because of their general benefits, rather than as measures solely to access carbon financing. However, carbon finance opportunities should be investigated where appropriate, not least because these may provide initial capital or additional revenue.
- The consideration of finance – include funding from donors and government - is important because some of these measures have initial cost barriers which need to be overcome, particularly for some measures which fully generate benefits in the longer term. Community-based investment could also be considered, funded through credit schemes. A key factor in the success of such schemes will be the demonstration of benefits to smallholders, to incentivise investment and action, particularly where alternative practices come at an opportunity cost.

5. Promotion of Sustainable Tourism

The tourism sector offers significant opportunities for low carbon measures, particularly in terms of energy efficiency measures and renewable technologies. The promotion of such measures could be part of a broader sustainable tourism agenda that helps safeguard the island's resources, ensuring sustainability of the industry and helps the branding of Zanzibar as green tourism destination.

- Based on experiences in other SIDS, such as Barbados, there is a significant scope for energy saving and the use of renewable energy. The energy efficiency potential in the hotel sector is widely reported to be around 40%. Information on the current potential in Zanzibar is not available, and therefore

energy auditing would be required to better understand the benefits. However, the economic benefits would be significant, particularly given the current issues (and costs) that the tourism sector has with electricity supply and the need for expensive back-up diesel generation.

- Renewable technologies are not widely used in the hotel sector. Technologies that could be considered include solar water heaters, solar PV systems, and micro-wind. Concerning energy efficiency, there are many cost-effective measures relating to the uptake of more efficient lighting, use of sensors and controls, improved AC units and improving staff / consumer behaviour in relation to energy use. Stronger building codes could also be introduced to minimise AC requirements.
- The tourism sector, as the largest source of investment, could drive this sustainable energy initiative forward. It could be further incentivised (or semi-enforced) by ZIPA when screening investments, and promoted by both the investor association and Tourism Commission. Such an initiative could help encourage such investments in other sectors, and catalyse activity across the islands.

Challenges and Priorities

There are implementation challenges across the different options above, and uncertainties around sources of funding, however, it is in Zanzibar's self-interest to be proactive in this area.

- While there is uncertainty around the emerging funding mechanisms for low carbon measures; many countries in East Africa, SIDS and other regions are already getting prepared, developing low carbon strategies and plans.
- There may also be opportunities for accessing carbon markets at the project level. However, the structure of mechanisms such as CDM and the smaller scale projects that would emerge from Zanzibar certainly make compliance markets much harder to access. Voluntary markets do provide opportunities although still often require large project development and transaction costs and low returns, as credits are much lower than those on the more rigorous compliance market. It will be important to assess how effectively the REDD+ pilot accesses the voluntary markets, and the level of returns that reach the communities involved.

Based on the work undertaken in this study, a range of recommendations have been made that could be considered as part of the strategy development work. These relate to policy options, further research needs and specific actions under each priority theme (PT). As part of future work in developing a climate strategy for Zanzibar (see below), these recommendations can be taken forward entirely or in part, based on further discussions about where the priorities lie.

In summary, there is a strong opportunity to include low carbon options in an emerging climate change strategy, and more widely in overall development and growth plans. Such options, as part of a lower carbon strategy, could help address some of the development challenges whilst promoting sustainability and resilience. This is critical for Zanzibar, heavily reliant on its natural resource base for agriculture and tourism, and subject to economic shocks as an island economy. The financing that such options could attract from different sources of funding could go some way to offsetting the additional costs of such a sustainable pathway.

PT 1: Household energy	Establish information on household energy use through surveys on fuel consumption, stove technologies and supply sources
	Further develop projections on future fuel requirements
	Develop large scale programme to introduce ICS, including assessment of financing options
	Promote awareness now on the benefits of ICS
	Further assess via study of alternative fuels potential, and aggregate impact on biomass fuel demand
	Develop a large-scale tree planting initiative, which also focuses on forest protection
PT 2: Renewable generation	Undertake survey of renewable generation potential [EU funded study already underway]
	Assess the economic impact and feasibility of renewables on the generation system, through modelling analysis
	Review frameworks for incentivising investments, from regulatory and financial perspectives
	Assess the role of EE through survey of appliances and buildings
PT 3: Sustainable transport	Assess the potential for improving vehicle efficiency through import controls, enhanced inspection regime
PT 4: Climate smart agriculture	Develop evidence base for the role of smart agriculture measures
PT 5: Sustainable tourism	Assess approaches to tourist sector investment screening and investments, to enhance sustainability
	Promotion of sustainable tourism criteria
	Implement pilot programme of hotel energy auditing to demonstrate benefits and options

Recommendations and Next Steps

In terms of translating these findings into practical next steps, a number of recommendations are made:

- The next step is for Zanzibar to produce and implement a Climate Change Strategy, explicitly considering and linking adaptation (climate resilience) and low carbon growth opportunities. This should involve stakeholder consultation and further analysis, and also look at some of the emerging opportunities for finance (see below).
- This climate strategy would benefit from a focus on prioritizing options, i.e. identifying priority projects for funding. On the low carbon side, this can be addressed through a process similar to the NAMA (Nationally Appropriate Mitigation Action) and a similar approach for adaptation. This can be advanced in a number of ways, but analytical, technical and economic assessments provide key evidence streams for these decisions. Such an approach would also give Zanzibar an early mover advantage, to position for funding as opportunities under new mechanisms become clear. Zanzibar also needs to engage with the URT Government on such issues, to ensure appropriate inclusion for example, in any future NAMA or wider climate strategy.
- Such a national strategy should also be linked to sectoral objectives, with effective mechanisms for implementation, monitoring, reporting and verification. This would build on the existing plans in Government to mainstream climate change and would help implement the strategy, but will require co-ordination and integration. It could also include building climate change into the emerging national development strategy. The mainstreaming should also extend to other Government policy and the private sector, for example, to incentivise tourism sector investments to promote renewable energy or

energy efficiency, in addition to other sustainability criteria. This could mean investment and development is 'steered' towards promoting low carbon, climate resilience growth. There is also a need for the development of a longer term sustainable energy plan that comprehensively covers all aspects of the system (household, transport, power).

- Zanzibar would also benefit from integrating climate change risks – and low carbon opportunities – into the Vision and MKUZA II. This would mainstream climate change resilience and low carbon thinking into development and long-term strategy. Climate could be included in any revision of the Vision. An initial review of the MKUZA II plans has identified a number of areas at potential risk – and a number of potential opportunities for climate finance – and these need to be investigated in more detail. Further, it would be beneficial to more strongly incorporate climate resilience and low carbon thinking (green growth) within the MKUZA II implementation plans, cascading through subsequently to sector objectives and policies. Finally, it would also be useful to introduce climate screening within the Zanzibar Planning Commission (within the President's Office Finance, Economy and Development Planning – POFEDP) to safeguard future decisions and particularly major future investment.
- There remain a number of important information gaps, and further research is needed to support the development of the climate change strategy, and also beyond for subsequent steps towards implementation. There is a need for this research to build on existing and emerging studies and identify and assess key gaps.
- To achieve all of the steps above, there is a need for capacity building, with mechanisms, institutions and governance systems. There are plans for such capacity building already, but a key issue is to ensure that this happens right across government, not only in VPO-Environment. Thinking forward to the major climate funds potentially emerging, climate funding needs to be identified and prioritised into planning and budgetary systems – and there is a need to enhance the capacity and information needed to access funds, which is likely to require greater capacity within the Ministry of Finance and Economic Affairs (MOFEA).
- In all of these areas, enhanced engagement with other SIDS to share experiences on energy and low carbon issues, climate resilience, and financing, would be particularly useful.
- Finally, Zanzibar needs to develop a strategy (or road map) for access to finance. There are a large number of different mechanisms for accessing climate finance, which will offer different benefits to the islands. There is a need to assess differing options for accessing climate finance, including those of established and future potential funds. It is stressed that the relationship between sources and channels of finance is complex, because decisions are strongly linked to the mainland. A key part of the development of a Zanzibar climate change strategy will be the review of alternative routes and options, including the institutional arrangements, to ensure Zanzibar benefits appropriately from the emerging opportunities.

This work was led by the Global Climate Adaptation Partnership, working with other international and local partners, with funding from UK (DFID) Government. It has been commissioned under DEW Point, the DFID Resource Centre for Environment, Water and Sanitation which is managed by a consortium of companies led by Harewelle International Limited.

Citation: Watkiss, P. Pye, S., Hendriksen, G, Maclean, A., Bonjean, M. Shaghude, Y, Jiddawi, N, Sheikh, M. A. and Khamis, Z (2012). The Economics of Climate Change in Zanzibar. Study Report for the Revolutionary Government of Zanzibar, Climate Change Committee.

Full information and reports is available on the project web site.

<http://www.economics-of-cc-in-zanzibar.org/reportsandpublications.html>

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