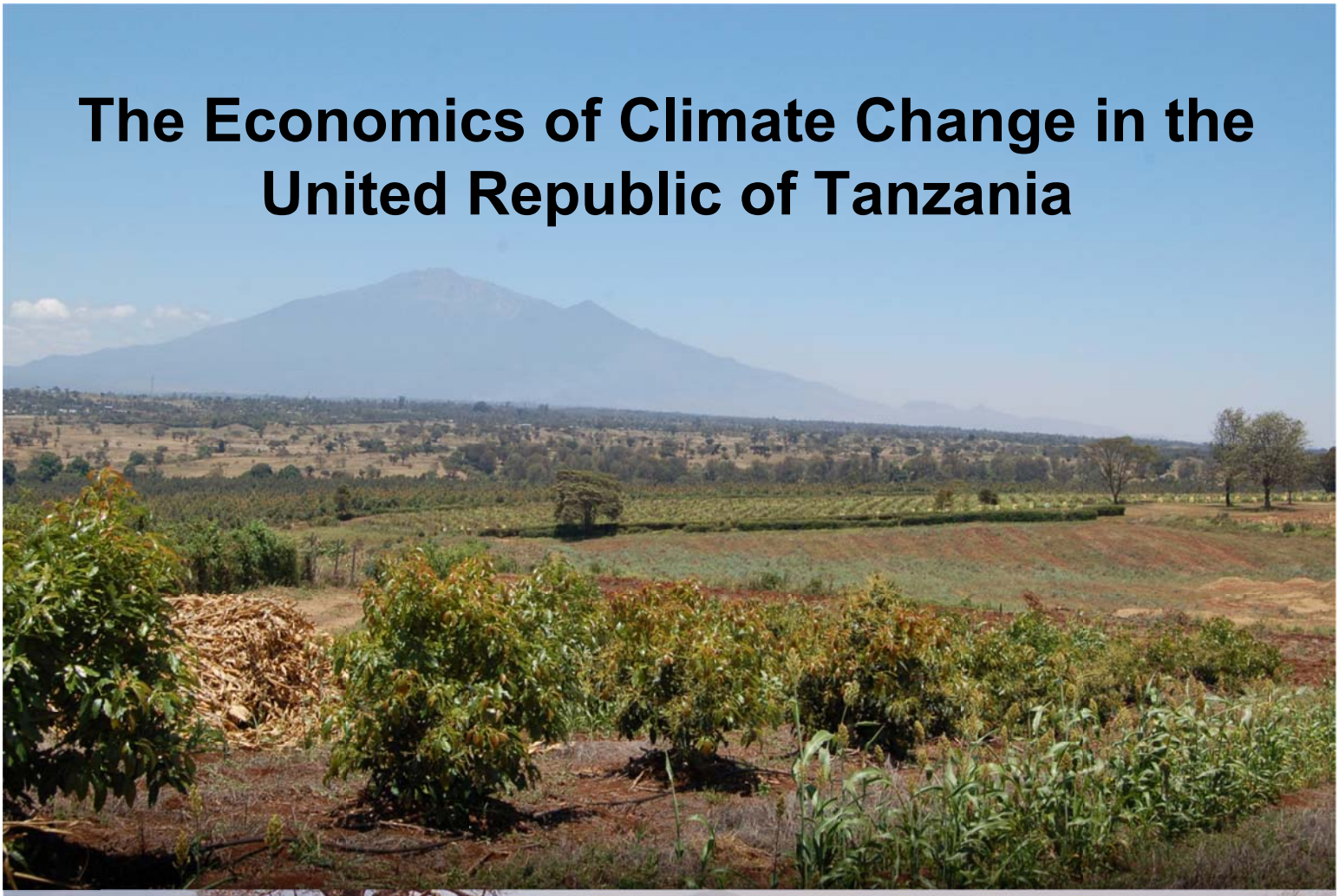
The Economics of Climate Change in the United Republic of Tanzania



THE UNITED REPUBLIC OF TANZANIA

UKaid from the Department for International Development

Development Partners Group
on Environment and Climate Change

A study by the Global Climate Adaptation Partnership and partners.


Summary Report. January 2011.

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Robert Okanda, Peres Mwangoka, taken from ‘Changing Climate, Changing Lands: Images of Tanzania’

Key Messages

➢ Tanzania currently suffers high economic costs due to extreme events

- Tanzania's economy is very dependent on the climate, because a large proportion of GDP is associated with climate sensitive activities, particularly agriculture.
- Current climate variability, i.e. extreme events such as droughts and floods, already lead to major economic costs in Tanzania. Individual annual events have economic costs in excess of 1% of GDP, and occur regularly, reducing long-term growth and affecting millions of people and livelihoods.
- A key conclusion is that Tanzania is not adequately adapted to the current climate. The country therefore has a large existing adaptation deficit which requires urgent action.

➢ Climate change will lead to potentially high future economic impacts

- Future climate change could lead to large economic costs. While uncertain, aggregate models indicate that net economic costs could be equivalent to a further 1 to 2 % of GDP/year by 2030.
- There are potential threats from climate change to coastal zones (sea-level rise), health, energy supply and demand, infrastructure, water resources, agriculture and ecosystem services, with potentially high impacts and economic costs across these sectors.
- The combined effects of current climate vulnerability and future climate change are large enough to prevent Tanzania achieving key economic growth, development and poverty reduction targets, including the planned timetable for achieving middle income status.

➢ Adaptation can reduce these impacts, but requires significant levels of funds

- Adaptation can reduce the economic costs of climate change but it has a cost. Significant funding is required to address the existing adaptation deficit, as well to prepare for future climate change.
- An initial estimate of immediate needs for building adaptive capacity and enhancing resilience against future climate change is US$100 – 150 million per year. However, additional funding is needed to address current climate risks, with a conservative estimate of an additional US$500 million per year (but probably more). Addressing these current risks and the current adaptation deficit is essential in reducing future impacts and building resilience to future climate change.
- The cost of adaptation increases rapidly in future years. By 2030, financing needs of up to US$1 billion per year are reasonable, and potentially more if further accelerated development is included.
- The study has considered potential priorities to advance adaptation. There is a need to plan robust strategies to prepare for the future, rather than using uncertainty as a reason for inaction.
- Accessing adaptation funds will require the development of effective policy, institutions and mechanisms.

➢ A more sustainable, low carbon pathway would be in Tanzania's self interest

- The current use of energy in Tanzania is leading to economic, social and environmental impacts. The high reliance on unsustainable biomass use is leading to the removal of forests, while the increasing dependence on fossil fuels is leading to fuel price shocks and inflation, affecting the balance of payments and leading to air pollution (indoors and outdoors).

- The analysis has considered energy and emissions for Tanzania, consistent with planned development. Emissions of greenhouse gases (GHG) could double between 2005 and 2030.

- Increases in emissions will be necessary for Tanzania's growth, and given its development status, there is no suggestion that future emissions should be constrained. However, the emissions growth above is related to a specific development pathway that has increased dependence on fossil fuel use and unsustainable use of natural resources. This will lead to higher fuel costs, greater fuel imports, higher air pollution and increased congestion. Indeed, these factors are likely to reduce future economic growth and development.

- There is an alternative growth strategy, based around low carbon options, that would be more sustainable, and which would have the considerable benefit of providing potential carbon financing.

- The study has found a large number of 'no regrets' options that would enhance economic growth, improve sustainability, and reduce carbon emissions, whilst also allowing access to international credits. Many of these options re-enforce existing objectives, but through the low carbon focus, it would provide a source of finance to fund the transition.

- There are also emerging opportunities from new sources of finances, such as for forestry (REDD+) and from emerging linkages between adaptation and low carbon projects. The study has investigated how to enhance the opportunities for Tanzania.

➢ Tanzania needs to get ready and act now

A number of priority areas are set out in the report. In terms of translating these into concrete action, a number of specific next steps are recommended:

- Tanzania should further build it's national climate change strategy, towards climate resilient and sustainable/low carbon growth. An integrated strategy would encourage synergies and reduce conflicts, and help Tanzania take advantage of opportunities from the international negotiations.

- The national policy should be linked to sectoral objectives, with effective mainstreaming mechanisms for implementation, monitoring, reporting and verification. However, as well as the current plans, there is a need to include this in longer-term strategy up to and beyond 2030, including in revising the Vision objectives and supporting intermediate objectives and policy, as well as cross-sectoral policy.

- To support all of these areas, there is an urgent need to build capacity, with mechanisms, institutions and governance systems.

Summary

The development partners group, with funding from the UK (DFID), have sponsored this initial study on the 'Economics of Climate Change in the United Republic of Tanzania'.

The work was led by the Global Climate Adaptation Partnership, together with the Stockholm Environment Institute, working with other international and local partners.

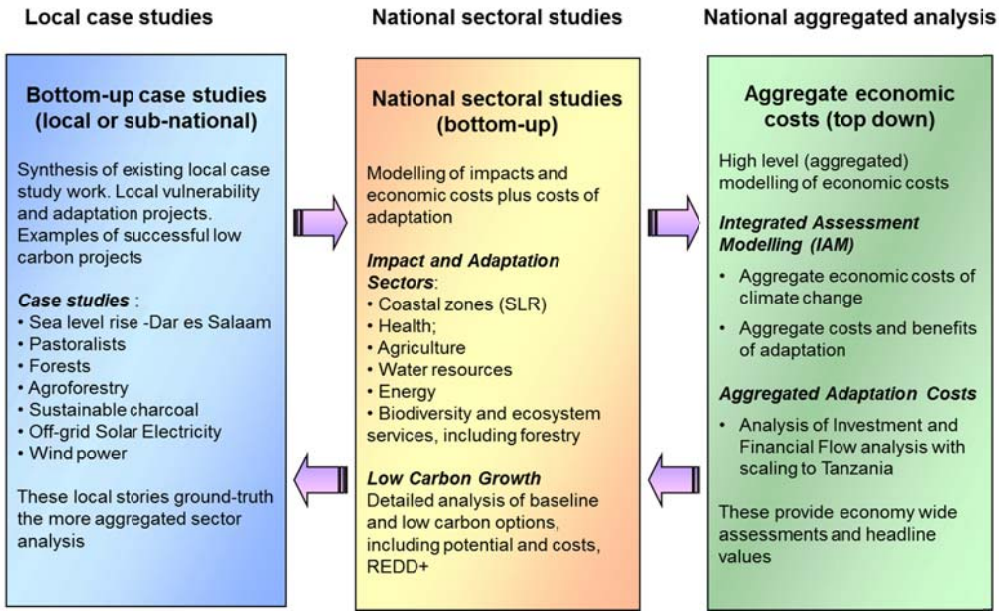
The study has assessed:

1. The impacts and economics costs of climate change in Tanzania;
2. The costs and benefits of adaptation; and
3. The potential for low carbon growth.

The key messages are presented in this summary. A full technical report and annexes from the study are available on the study web-site, http://economics-of-cc-in-tanzania.org/

Introduction

This scoping study, on the economics of climate change in the United Republic of Tanzania, has advanced a number of approaches to investigate the impacts and economic costs of climate change, the costs and benefits of adaptation and low carbon growth. To do this the study has combined several lines of evidence: an aggregated analysis (top-down), a sector by sector national assessment (bottom-up) and a series of case studies, as shown below.



The combined evidence across the framework provides a view of the economic costs of climate change impacts and adaptation in Tanzania. The analysis provides high level information for policy as well as useful outputs for setting national and sectoral priorities and action plans.

The Economic Costs of Climate Change Impacts in Tanzania

Existing Climate Variability

The study has first reviewed the existing impacts of climate on the economy of Tanzania.

Existing climate variability already leads to significant economic costs in Tanzania, with costs of major droughts and floods often in > 1% of GDP.

- Existing climate variability leads to significant economic costs already, because the economy of Tanzania is very dependent on the climate, and because a large proportion of GDP is associated with climate sensitive activities, particularly agriculture. Periodic droughts and floods (extreme events), such as the major droughts that occurred in 2005/6 and the major floods in 1997/8, cause major socio-economic impacts and reduce economic growth.

- The economic costs of these events affect the whole economy. Major drought years lead to loss of crops and livestock, reduce hydro-power generation and electricity supply, and reduce industrial production.

- The 2005/6 drought affected millions of people and had costs of at least 1% of GDP. Tanzania suffers from these periodic extreme events on a regular basis, largely as part of the El Niño – Southern Oscillation (ENSO) cycle.

- The continued burden of extreme events reduces long-term growth. There is some indication of an intensification of these events over recent decades and this may reflect a changing climate. However, impacts also have to be seen in the context of changing patterns of vulnerability, for example from changing land–use, population growth and economic development.

- A key first finding is that Tanzania it is not adequately adapted to deal with existing climate risks, i.e. it has a large existing adaptation deficit.

Future Climate Change

The study has assessed the impacts and economic costs of future climate change. Africa is predicted to have greater impacts from climate change than other world regions, because of higher vulnerability and lower adaptive capacity. Impacts could threaten past development gains and constrain future economic progress. The study has assessed the aggregate (headline) economic costs of climate change in Tanzania and finds potentially very large economic costs in Tanzania from climate change, on top of existing climate variability.

Future climate change will lead to additional and potentially very large economic costs for Tanzania.

Top-down aggregated estimates

The study has undertaken top-down aggregated analysis of the economic costs of climate change using global models.

- These future economic costs are very uncertain. However, aggregate models indicate that the additional net economic costs (market and non-market costs, on top of the costs of existing climate variability) could be equivalent to a loss of 1.5 to 2 % of GDP each year by 2030 in Tanzania.

- The combined and cumulative effects of current climate vulnerability and future climate change are large enough to reduce the likelihood of Tanzania achieving key economic and development targets as well as challenging the timetable for achieving middle income status.

- In the longer-term, after 2050, the economic costs of climate change in Africa and Tanzania could rise potentially very significantly.

- However, the aggregate models report that global stabilisation scenarios towards a 2ºC target could avoid the most severe social and economic consequences of these longer-term changes. This reinforces the need for global mitigation as well as local adaptation.

Bottom-up national sectoral analysis

The study has also undertaken bottom-up assessments looking at the impacts and economic costs of climate change, for a number of priority sectors. In order to assess these impacts and economic costs, the study has first looked at recent observational evidence, as well as the projections of future climate and socio-economic change.

- Tanzania has a complex existing climate, with wide variations across the country due to topography and altitude. It has very strong seasonality. It is also affected by strong patterns of climate variability and extremes, not least due to the periodic extreme events (floods and droughts) highlighted above.

- There have already been changes observed in Tanzania's climate. The National Adaptation Programme of Action reported an upward trend in minimum and maximum temperatures over the last 30 years at many meteorological stations. Furthermore, while rainfall trends are more difficult to interpret, in recent periods, rainfall patterns have become more unpredictable with some areas/zones receiving extreme minimum and maximum rainfall per year.

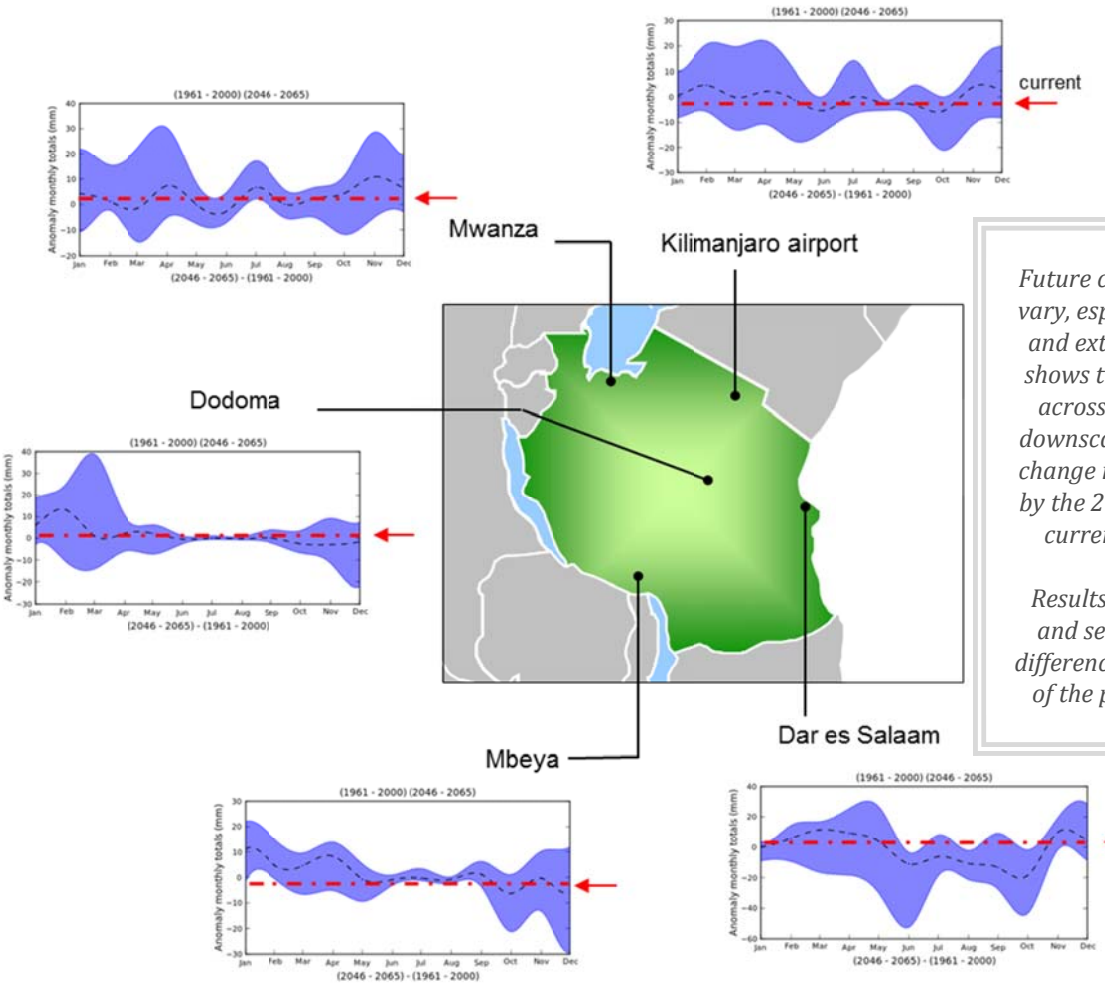
Future projections of climate change

The study has produced statistically downscaled climate projections of future climate change for Tanzania from a wide range of climate models. The findings are summarised below:

- *Temperature*. The projections indicate future increases in average annual temperatures of 1 ºC to 3ºC above the baseline period from a range of models and emission scenarios by the 2050s (the years 2046 - 2065), with projections towards the lower end of this range under a low emissions scenario (B1) and towards the higher end of this range under an unmitigated future global higher emission scenario (A2). By the end of the century (2100) average temperatures are broadly expected to increase in the range of 1.5°C to 3°C for the lower emission scenario and 3°C to 5°C for the higher emission scenario.

- *Rainfall*. The changes in precipitation from the models are more uncertain. All the climate models show that rainfall regimes will change, but the degree and even the direction of change differ across the models. They also vary widely between seasons, regions and rainfall regimes. Many of the models (but not all) project that precipitation may increase in the future, especially during the late part of summer. Many of the models (but again, not all) also show the potential for drying signals later in the year in southern and central regions, though potential increases at other times. One set of results from the models is shown in the figure below, for the changes projected for rainfall across the county in the 2050s.

- *Extreme events*. The information on extreme events (floods and droughts) is much more uncertain and the model projections vary widely. Many models indicate an intensification of heavy rainfall, particularly in some regions and thus greater flood risks. Droughts are likely to continue, however, while some models project an intensification of these events, particularly in some regions, other models indicate reductions in severity.



Future climate projections vary, especially for rainfall and extremes. The figure shows the range (in blue) across nine alternative downscaled models, as the change in monthly rainfall by the 2050s, compared to current levels (in red)

Results vary with region and season – with even differences (+/-) in the sign of the projected change.

Envelope of modelled average monthly precipitation across the year (Jan – Dec) – showing the change from current rainfall by the period 2050s (A2 scenario). Source CSAG.

- The range of model results highlights the uncertainty in predicting future climate change, especially in relation to scenarios of future rainfall, floods and droughts.

- It is essential to recognise this uncertainty, not to ignore it. There is also a need to plan robust strategies to prepare for uncertain futures, rather than using uncertainty as a reason for inaction.

There is also a need to take account of socio-economic changes that will affect the future impacts of climate change, for example, high population growth (forecast to exceed 100 million people by 2050) and urbanisation in Tanzania, as well as future economic growth and development baselines.

- These drivers will have as much potential impact as the changes from climate, and have been considered in the analysis below.

- The Mkukuta vision will reduce some climate impacts through sound development. However, population growth and increased infrastructure will continue to drive major climate costs. The impacts of future climate change are strongly related to development strategies chosen in the next five years.

The impacts and economic costs of climate change by sector

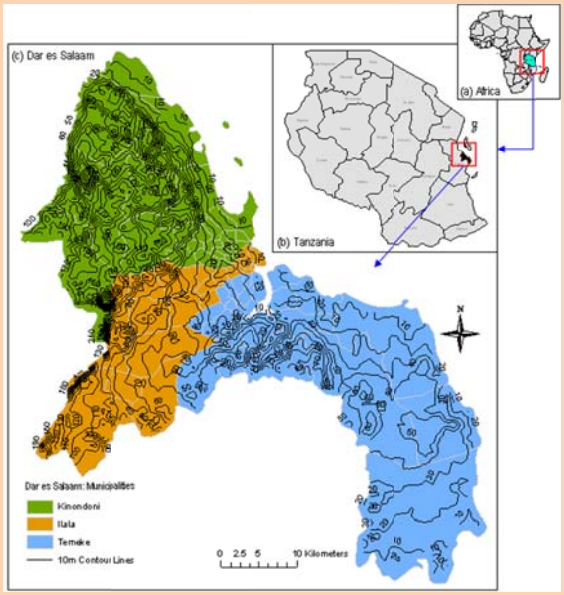
The study has applied available projections to national level sectoral assessments, outlined below[1].

Coastal zones. The coastal zones of Tanzania contain high populations, significant economic activity and important ecosystem services. These areas are at risk from future sea-level rise. The study has assessed the impacts and economic costs of sea-level rise to Tanzania across a range of future sea level scenarios: the results indicate that without adaptation, the physical, human, and economic impacts will be significant.

- With no adaptation, the expected number of people at risk of annual flooding is estimated at 0.3 to 1.6 million people per year by 2030, rising to 1.0 to 2.1 million people per year by 2050. The analysis also shows significant loss of land, forced migration (potentially up to hundreds of thousands of people) and that approximately 8% of Tanzania's wetland could disappear by 2050. The study has also estimated the economic costs associated with these impacts. Without adaptation, the total annual costs are estimated at between $26 and $55 million in 2030 (2005 prices, undiscounted), increasing to $100 to $200 million/year by 2050, and rising further in later years.

The study has also undertaken a case study on Dar es Salaam, see box below.

Dar es Salaam is Tanzania's largest city (3 million people), and one of the largest coastal cities in Africa at risk of sea-level rise. It is also one of the fastest growing, with estimates that Dar will become a mega-city of >10 million people by 2040. The study has used land elevation (see contour map, right) and population data (current and future) to look at the potential number of people and economic assets at risk of coastal flooding due to extreme water levels, i.e. to a 1 in 100 year storm surge flood event, with sea level rise.



The results show that currently, about 8% of the land area of Dar es Salaam, 140,000 people, and economic assets worth more than $170 million, are currently below the 10m contour line, i.e. in potentially vulnerable areas, with 31,000 people considered at risk. By 2030, without adaptation, this will increase to more than 100,000 people and over $400 million assets (2005 values), and rise further in later years. The analysis highlights that, without action today to ensure sustainable development and planned population settlement, population and economic growth as well as climate change will increase the exposure to coastal innundation. These future risks are extremely important in relation to the current Dar development plans.

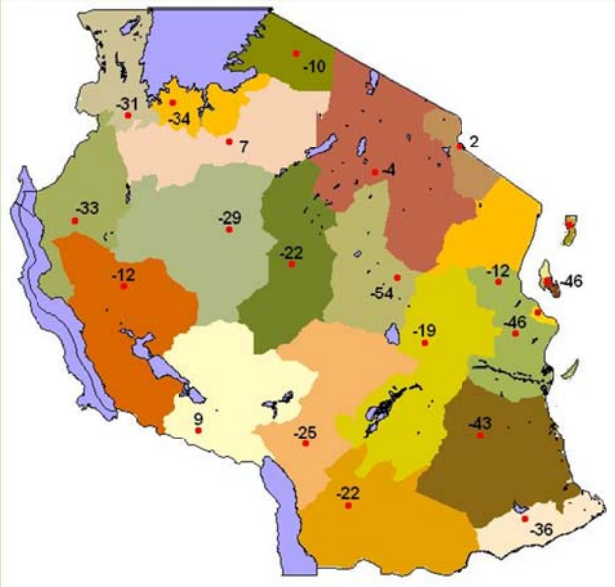
[1] Unless otherwise stated, the report uses US$ at current market exchange rates rather than at current purchase power parity. Future values presented are in current prices and not discounted. The intention of the analysis here is to explore the upper and lower bounds of plausible estimates — it is not possible to produce a fully consistent net present value with the available evidence. For comparison, the current exchange rate is very approximately US$1 = TZS 1500.

Agriculture. The agriculture sector is the mainstay of Tanzania's economy, as well as having a key role in sustaining livelihoods. It is also a very climate-sensitive sector. Future climate change has the potential to exacerbate current production risks in agriculture, either from changes in temperature and rainfall trends, from enhanced variability, or from other effects.

- A number of previous studies have considered the potential effects of climate change on Tanzania Under some projections and with certain models, some studies predict very negative impacts on the sector. However, for some regions and projections, other studies estimate much lower impacts, with some even showing benefits in terms of increased agricultural yields for some regoins. The study has undertaken additional new modelling work, see box below.

The study has undertaken additional new modelling work looking at the cultivation of maize, which is potentially highly vulnerable to climate change (due to the combination of rising temperature and decreasing precipitation). Under more positive climate projections, where rainfall does not decrease, modest impacts are predicted, with even benefits in some regions.

However, under some of the more negative high emission projections, where rainfall decreases by up to 15% and there is no adaptation, average maize yields could decrease by up to 16% by 2030 (a loss of around 1 million tonnes/year) and 25 - 35% by 2050 (2 to 2.7 million/tonnes per year). An example of the output is shown in the figure to the right.



Percent change in maize yield by 2050 compared to the baseline for a high emission (A2) scenario by the 2050s (no farm level or planned adaptation).Source: Sokoine University of Agriculture, Morogoro, Tanzania

While farm level adaptation would be likely to reduce these impacts, the analysis shows climate change could have very large economic costs, potentially several US$ hundred millions/year (current price, undiscounted).
It is also highlighted that a very complex range of factors will be important in determining future effects on agriculture from climate change, which are not included in the current suite of studies, including the effects from extreme events and variability, pests and diseases, etc.

The study has also undertaken a case study on pastoralists, who have resilience to the historical risk of climate variability in arid and semi-arid lands (ASAL). The case study reports that multiple factors present new risks that will decrease resilience and system stability and that if climate change increases climate variability, this will have significantly impacts.

Health. Climate change is likely to affect human health in Tanzania. This may happen directly, as with the effects of heat extremes or flood injury, 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).

There are already some observational data that show malaria moving to higher elevations (where the disease is currently limited by temperature).

- The study has estimated the potential increase in malaria and some other climate sensitive disease from climate change, as part of a scoping assessment. The findings, whilst indicative, estimate that the potential costs of higher treatment costs to address the increased disease burden in Tanzania could be $20 to 100 million /year by 2030, rising to $25 to 160 million/year by 2050 – the range reflecting different climate and development assumptions.

- The study has also undertaken a qualitative assessment of the potential effects of more extreme high temperatures, looking at the projected number of days exceeding 32°C. The results show significantly increased exceedences in warmer locations such as Dar es Salaam. As well as potentially leading to additional health impacts, these would reduce labour productivity.

Energy. Climate change will affect both energy supply and demand.

- On the energy supply side, hydropower currently provides 55% of the country's power generation, and has been affected heavily by drought events in recent years. This has led to reports (by the World Bank) of high costs (~$70 million) from the use of incremental thermal generation plants, and reduced economic growth in drought years by more than 1% due to electricity shortages.

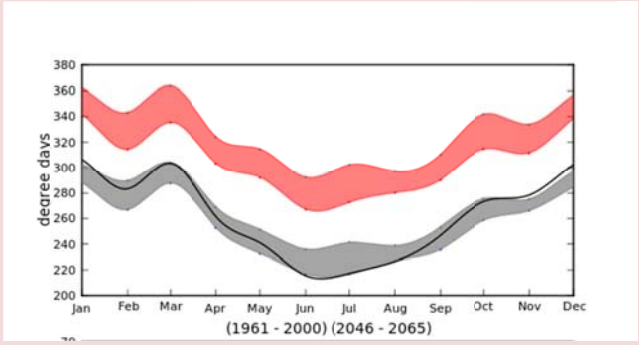
- It has also led to the widespread introduction of small diesel generators, with associated high economic costs, as well as additional air pollution. The study has considered future electricity supply in Tanzania. While there is some diversification away from hydro in future years, it will still remain the dominant electricity capacity and supply technology. Future climate change could exacerbate the current issues with reliability, due to evaporation and also other potential factors associated with river flow and variability. The effects vary with the climate projections, and the wide variation in rainfall, temperature and variability from the models, however, under some scenarios there is the potential for detrimental effects on hydropower generation in southern and central Tanzania central region.

- There are also projected impacts on thermal generation (coal and gas). First, increased temperatures will impact on these plants by reducing generation efficiency. An initial analysis based on the future 2030 grid mix estimates that this will lead to costs (current prices) of $10 million by 2030, which could rise further in future years to 2050. Second, these plants require cooling water, and any detrimental effects on water availability may also impact on these thermal plants (as well as on hydro). There is therefore a potential concern that extreme events in future drought years could reduce supply across the system.

- Finally, there are effects of climate change on energy demand that are potentially even larger, at least in terms of economic costs. While current levels of cooling demand on the system appear low, this will change with rising incomes, and higher temperatures from climate change. This will increase the demand for cooling, which is important for building comfort levels and health, and in turn this will increase electricity demand through increased air conditioning use. The study has undertaken analysis to investigate the potential importance of this, reported in the box below.

- There are well established relationships that link levels of cooling energy demand with income and with temperature. In line with these, future socio-economic development in Tanzania will increase electricity demand.

- These will be further affected by higher temperatures from climate change. The study has undertaken an initial analysis to investigate the potential implications and costs of these changes. The climate model projections (e.g. see right for figures for Dar es Salaam) show large increases in cooling degree days (a metric of cooling burden) in Tanzania, with increases of 25 to 100% increase due to climate change.



Projections of cooling degree days for Dar es Salaam. Source: CSAG. Note the results presented are for a higher cooling threshold.

The figure presents the monthly CDD over the year for the modeled current conditions (in grey) and for the future (2050s) (in red) with climate change.

- These changes will lead will lead to high economic costs, particularly for urban areas and for some sectors (notably tourism). Importantly, it will also increase peak demand on the electricity supply system, affecting electricity supply and capacity requirements. The indicative analysis here estimates that by the 2030s, climate change could have additional cooling costs of $60 million per year (current prices, no discounting). The continued temperature and per capita income growth would lead to much higher costs by the 2050s.

- The rising cooling demand from future climate change has not been recognised in energy planning to date in Tanzania, and is identified as a key area for future investigation.

Water is a critical sector for Tanzania. In addition to the multi-sector links to agriculture and energy (above), it is important for tourism, industry, and other economic sectors including mining. It also supports livelihoods through fishing and traditional farming irrigation systems, as well as terrestrial and aquatic ecosystems including associated ecosystem services (provision of fuel wood, water purification, climate regulation, etc.).

- Tanzania's current rainfall – and thus water resources and availability - vary temporally and geographically over the country. Many areas are already subject to water scarcity, and this will increase with population growth. Against this background, climate change has the potential to affect water availability (and potentially water quality), as well as potentially exacerbating the pattern of extreme events.

- The analysis of future impacts is made difficult by the wide variation of outcomes (positive and negative) from the projections. However, under certain projections, there could be reductions in rainfall, river flow and groundwater systems that will have potentially large impacts (and high economic costs) for household water supply, irrigation, power generation, industry, and the functioning of existing water infrastructure and ecosystems services.

- There are also potential changes from climate change in the intensity and severity of extreme events.

- Even in the absence of climate change, the economic costs of the periodic droughts (and floods) that affect Tanzania could rise significantly in future years, due to socio-economic change (population and economic growth). Many of the projections indicate a reduction in the return period for heavy precipitation events for some regions of Tanzania, which could increase the economic costs of periodic flood events. The range of model projections is more uncertain for periodic droughts, though under some projections, some regions could be heavily affected. A key priority therefore is to increase the resilience of Tanzania to cope with these extreme events.

Forests. 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.

- While there are some potential benefits to forests from climate change, there also many threats, either directly (changing temperature, precipitation and variability including extremes) and/or indirectly (including from effects on soil, moisture, pests and diseases, fire risk, etc.). These may affect growth, tree health, wider biodiversity and even system stability, with potentially irreversible losses. In turn, these impacts will reduce the services and economic value that forests provide, including direct provisioning services (timber, fuel wood, building material), supporting and regulatory functions (soil and flood protection, carbon storage), and cultural and tourism value. Previous studies indicate potentially large changes in ecological zones in Tanzania from climate change, which could have major impacts on current forests.

- The study has not undertaken new modelling analysis on forests and climate change, and it is highlighted that such analysis is extremely challenging, given the wide range of model projections and the multiple factors involved in impacts. However, the potential effects could be one of the higher economic losses from climate change. It is also highlighted that climate change could therefore affect the UN Reduced Emissions from Deforestation and Forest Degradation (REDD+) scheme, in terms of the future viability of current afforested areas and thus revenues. The issue of the effects of climate change on forest is highlighted as a priority for consideration in the context of REDD development.

Biodiversity and Ecosystem Services. Tanzania has exceptional biodiversity. These ecosystems provide multiple benefits to society, which in turn have economic benefits, though these are rarely captured by markets. These benefits are known as 'ecosystem services' and include provision of food, supporting services such as nutrient recycling, regulatory services including flood protection and recreational and cultural services, including tourism. There are many stresses on these systems already and climate change will add to these pressures.

- An initial mapping and review shows that high importance of ecosystem services in Tanzania: they are integral to the economy and underpin large parts of GDP, foreign revenue (including through tourism revenue) and export earnings, as well as sustaining a very large proportion of the population. The effects of climate change could be very severe on ecosystems, and previous work has highlighted the potential for major shifts in agro-ecological zones in Tanzania. However, there are also other potential factors, all of which have to be seen in the context of socio-economic development pressures. In many cases, there are barriers to species and ecosystem movement, which will lead to changes in existing areas and supporting services. Given the linkages across the current economy, any detrimental changes will lead to high economic costs, and further investigation of these effects is a priority.

Summary. Overall, the bottom-up sectoral analysis shows that economic costs of climate change in Tanzania could potentially be very large.

- The analysis for agriculture, coastal zones, electricity and health alone indicate future economic costs could be several billion dollars / year by the 2050s under some of the more extreme projections.

- There are also potential effects on ecosystem services, which whilst difficult to estimate in monetary terms, will be important and will have potentially large economic costs. The additional case studies also highlight major impacts in some non-market or informal sectors that are not captured by formal economic analysis, but that are essential to livelihoods.

2. The Costs and Benefits of Adaptation

Adaptation can reduce many of the impacts and economic costs highlighted in the section above, but it has a cost. The study has investigated the potential costs of adaptation for Tanzania.

Adaptation can reduce the impacts of climate change, but it has a cost: the adaptation financing needs for Tanzania are potentially very large.

This is an uncertain area, and the costs of adaptation are still emerging. One of the methodological challenges is on to define the boundaries of what is included or excluded in these estimates. Recognising this, a number of categories of adaptation have been identified that relate to the balance between development and climate change. The first two of these are development activities and are targeted towards the large economic costs of current climate variability. They are:

1. Accelerating development to cope with existing impacts, e.g. integrated water management, electricity sector diversity, natural resources and environmental management.
2. Increasing social protection, e.g. cash transfers to the most vulnerable following disasters, safety nets for the most vulnerable.

Two others are associated with specifically tackling the future risks of climate change and are

3. Building adaptive capacity and institutional strengthening, e.g. developing meteorological forecasting capability, information provision and education.
4. Enhancing climate resilience, e.g. infrastructure design, flood protection measures.

The overall costs of adaptation vary according to which of these categories is included.

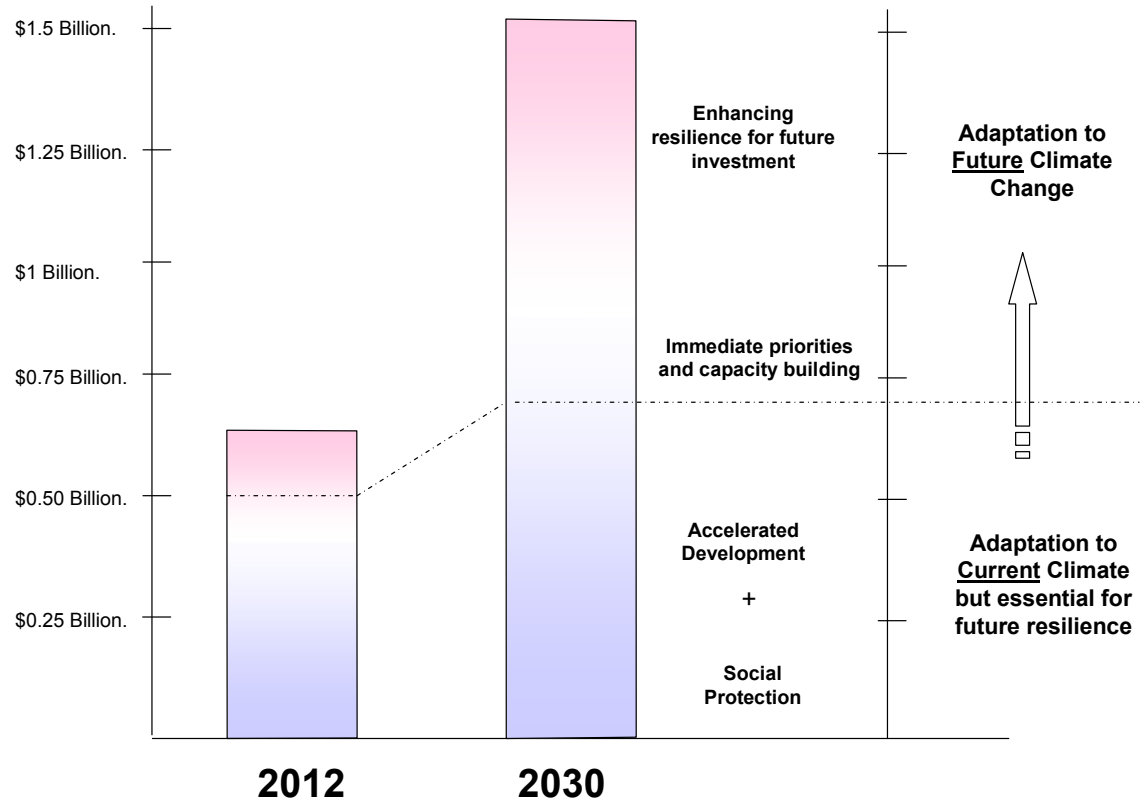
Top down aggregated estimates

The scoping study has investigated the top-down aggregated estimates of the costs of adaptation, using estimates for Africa/East Africa and scaling these to Tanzania. This leads to the following indicative estimates.

- The immediate needs (for 2012) for building adaptive capacity and starting to enhance resilience (immediate priorities) for future impacts are estimated at $100 – 150 million/year for Tanzania. It is noted that this is a significant increase - by an order of magnitude - from the current National Adaptation Programme of Action (NAPA). However, a much higher value of $500 million/year (or probably more) is warranted if the categories of social protection and accelerated development are included. As highlighted above these categories are associated with current climate variability – such as the existing vulnerability to droughts and floods - and are therefore associated with development, rather than with future climate change. However, investment in these areas provides greater resilience for future change and they are essential in reducing future impacts.

- The estimated costs of adaptation will rise in future years. The aggregated estimates provide a possible range, with implications for the source and level of finance required. Estimates of medium-term costs to address future climate change are typically of the order of $250 – 1000 million per year for Tanzania by 2030, focused on enhancing climate resilience. Note that the investment in 2030 builds resilience for future years when potentially more severe climate signals occur. However, higher values (a total in excess of $1500 million /year) are plausible if continued social protection and accelerated development are also included, noting that these are primarily development activities.

- Using these numbers, as shown in the figure below, the study reports that a conservative estimate of immediate needs for addressing current climate and preparing for future climate change is $500 million / year (for 2012). The cost of adaptation by 2030 will increase: an upper estimate of the cost could easily be of the order of $1 billion / year, though higher than this if additional enhanced development for resilience and social protection is included.



Indicative costs of adaptation to current variability and future climate in Tanzania $ billion/year

Sectoral (bottom-up) assessments

The study has also assessed the costs of adaptation for Tanzania using a national sectoral bottom-up approach. This looks to investigate and validate the estimates above and gives greater insight into sectoral planning. This focus on sectoral adaptation also has included a greater focus on uncertainty. To progress this, the study has advanced a framework to prioritise early adaptation, which considers uncertainty within an economic framework. This identifies early priorities for adaptation of:

- Building adaptive capacity;
- Encouraging pilot actions to test promising responses
- Focusing on win-win, no regret or low cost measures (justified in the short-term by current climate conditions or involving minimal cost); and
- Identifying those long-term issues that require early pro-active investigation (though not necessarily firm action).

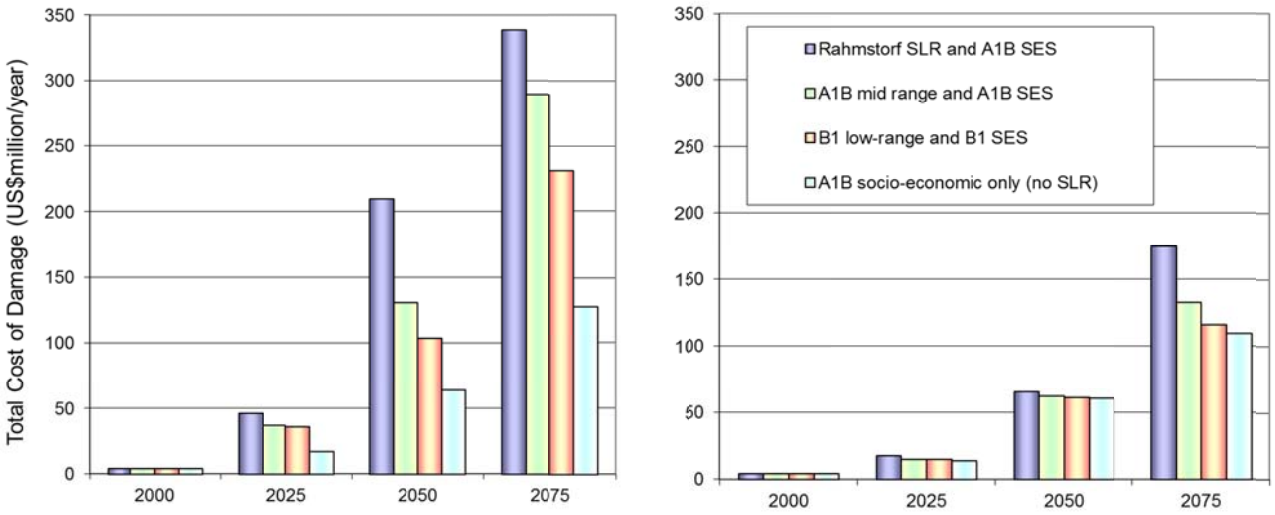
The study has considered these adaptation responses as a series of steps, together forming an 'adaptation signature'. These identify a range of actions. While the broad outline of steps is the same in each sector, the exact activities vary, hence the use of a 'signature' concept that considers options on a case by case basis. These signatures have been used to consider initial sector actions, and for some sectors, indicative adaptation costs. These have been complemented by case studies which include examples of adaptation projects and costs. The results are summarised by sector below.

Coastal zones. The study has assessed the potential costs and benefits of adaptation, following on from the national sector study.

- The results show that when adaptation is applied, in the form of coastal protection (to address floods) and beach nourishment (to counter erosion) the potential impacts and economic costs can be significantly reduced, with the number of people at risk of flooding reduced from 0.3 - 1.6 million per year in 2030 (no adaptation) to 0.04 to 0.1 million per year (with adaptation) with even larger reductions in later years. Similarly, the costs of climate change fall from up to $55 million / year in 2030 (2005 values, undiscounted) to under $20 million / year (with adaptation) – as shown in the figure below. The benefits are even larger in the later years.

- The analysis also shows that adaptation is cost-effective, and has high benefits when compared to costs. Even so, the costs of adaptation are considerable, estimated at $30 to 80 million / year by 2030 (2005 dollars undiscounted) depending on the sea-level rise scenario, rising potentially to $35 to 120 million / year by 2050. Note that even with these measures, there will be residual damages (including to coastal wetlands). It is highlighted that even under a case of no sea-level rise, the costs of protection would need to rise to address rising population and assets.

- The results also show that there is a significant need for a current strengthening of coastal adaptation (to cope with the current risks). Other key actions include the need for improved monitoring of both sea level and extreme coastal events (a key step in building adaptive capacity), further work to address spatial and development planning policy for current and future flood risks (especially in key hot spots), improved disaster risk reduction, and the need to move towards integrated coastal zone management (ICZM) to allow iterative and flexible decision pathways to address future climate change.



No Adaptation With Adaptation

Total Costs of Sea Level Rise ($million/year) – no adaptation (left) and with adaptation (right).

Source: University of Southampton. Note does not include existing deficit, and shows sum of sea level rise and socio-economic change.

- The case study in **Dar es Salaam** has also considered adaptation. The results show that the risks of extreme floods from sea-level rise could be significantly reduced by introducing a sustainable spatial planning policy for population settlement and economic activities, i.e. by steering future development away from low-lying coastal zones to alternative areas that are not threatened by current or future sea-level rise. For example, by restricting growth and development in the most vulnerable areas, exposure to the 1 in 100 year flood event in 2030 is reduced from 200,000 down to 35,000 people and from $400 billion to only US$40 million assets at risk even under the highest sea-level rise scenario.

- The case study highlights, however, that enforcement of such a policy is challenging where informal settlements dominate urbanisation. It also highlights that additional appropriate adaptation measures (e.g. protection in terms of beach/shore nourishment and dikes) could be considered in order to keep risks at an acceptable level, but also highlighting that this will require appropriate capital investment and subsequent maintenance. The importance of these issues is highlighted as a priority in relation to current Dar es Salaam development plans.

Agriculture. The study has considered the adaptation options and costs to address projected cereal yield losses, using a mix of national analysis and case studies. The study picked options that are robust against future uncertainty. The areas of analysis are included in the box below.

The study has examined current plans, but also future projections, which show even without climate change there is a significant funding increase needed to address the current adaptation deficit – this mirrors the discussion in the top down analysis above.

The study identified a number of key strategies for the agricultural (cereal) sector. These included:

- To increase investments in smallholder farmers' irrigation.
- To introduce soil and water conservation in the highlands.
- To strengthen the capacity of agricultural research institutes to conduct basic and applied research.
- To invest in rural road infrastructure.

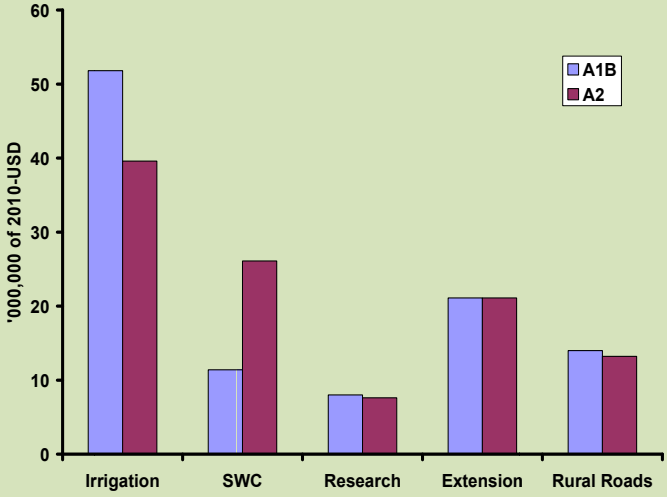
Bench terraces with high value crops in the Western Pare Mountains.

- To institutionalize climate information data collection, analysis and dissemination in the District Agricultural Development Plans.

The study then estimated that the additional cost of adaptation (for the five key policies) to address future climate change, considering an upper emission scenario.

This estimates the total additional investment, which are equivalent to an additional $107 million per year.

These are shown in the figure (right), noting that these represent the total investment cost, presented as a discounted equivalent annual cost. Note these values are not directly comparable with the top-down or coastal numbers above.



Projected total adaptation investment costs, for Agriculture in Tanzania. Source Sokoine University.

The case study on pastoralists has highlighted a number of adaptation options, including early steps to build capacity, community based adaptation initiatives, and wider cross-cutting policies.

Health. The study has assessed the potential costs of adaptation to address the potential increasing burden of malaria and has found that epidemic detection and prevention would be very cost effective, alongside enhanced monitoring and surveillance to track the change in the disease burden. It has also considered other potential disease burdens and identified preventative measures and low cost options that would reduce future impacts.

Energy. The study considered the potential options for both supply and demand.

- For energy supply, a number of potential adaptation options have been identified to address the current adaptation deficit and the future impacts of climate change. For hydro generation, the options include demand management (of water), a no regret option to help manage current and future water sources; integrated basin catchment management; and upstream land management, to improve water availability and address sedimentation and siltation in the flows.

- There is also a need for capacity building to support these options, for example in strengthening basin water offices to balance hydropower requirements with other demands for water. More generally for the electricity sector, there is also a need to increase the energy diversification of the system (see later low carbon section), noting that the lowest vulnerability will be through renewable (e.g. geothermal) rather than fossil based alternatives. At the aggregated level, development of regional power trading (interconnection of networks) would help in providing greater system resilience, as well as providing other opportunities for power export.

- For energy demand there is a need to consider and adapt to future cooling demand. The most immediate need is to measure and monitor current usage (linking air conditioning to temperature and demand), to allow greater understanding of current and future demand levels, and to try to introduce more efficient units, an early no regret option. There is also a need to start considering alternatives to air conditioning, through building design to provide passive cooling, at least in new building stock with long-life times.

Water. The analysis of the water sector shows a baseline of increasing water scarcity for both urban (including water for industry) and rural areas, highlighting the challenge for the current plans, due to insufficient levels of investment and the high levels of future socio-economic development. Future climate change could make closing the water supply—demand (deficit) gap even harder, though the key challenge is to consider the high degree of uncertainty.

The study has investigated a number of potential adaptation options.

- For urban areas, these, include investment in catchment management programmes and also demand management (leak reduction and controlling illegal connections). These options have benefits in reducing the current adaptation deficit, as well as enhancing resilience to future climate change i.e. they are no regret options. However, in future periods, under some of the more extreme climate projections, these options may need to be complemented by enhanced storage or supply capacity: early research to investigate the potential for these options would be useful (to learn for future possible implementation).

- For rural areas, early capacity building options include the need for mapping of rural water-points to serve as an input into district-level planning and standardizing technologies. Adaptation measures for the rural sector include development of groundwater wells, shifting from surface water sources to deep boreholes, and an increase in rainwater harvesting structures. In relation to the risks of extreme events from floods, a key priority is to increase the resilience of Tanzania to cope with current extreme events.

Forests, biodiversity and ecosystem services. The analysis indicates that the most immediate response needed is to increase monitoring programmes to study the response of forest and tree species and research projects to investigate potential ecosystem shifts. The additional stress of climate change is also likely to mean a greater focus on reducing and managing existing stresses, such as fragmentation, pollution, population encroachment and habitat conversion.

- Furthermore, additional adaptation measures are likely to be needed, which include creating forest buffer zones, increasing ecological zone connectivity. Given the irreversibility of land-use changes, these are highlighted as an early priority. Similar measures are also relevant for the wider area of biodiversity and ecosystem services.

- One key area is the potential for an Ecosystem-based Adaptation (EbA) approach, which seeks to enhance healthy and resilient ecosystems, for example by managing individual components as part a larger landscape and introducing multi-functional land uses and conservation of natural capital. Several no-regret EbA measures have been identified, such as restoring the natural coastal vegetation to enhance coastal forest buffer zones in coastal locations.

Summary. The sectoral assessments and the case studies show relatively high adaptation needs, which re-enforce the top down adaptation estimates for 2030 and justify investment. The studies demonstrate that adaptation has potentially very large benefits in reducing present and future damages.

- Across all the sectors, options have been identified that work within a framework of decision making under uncertainty, focusing on key areas that provide robust options to enhance resilience, as well as helping to address the current adaptation deficit. Interestingly, many of these options are cross-sectoral in nature, and build on existing good development policies.

- While adaptation reduces damages, it will not be able to remove the impacts of climate change entirely. Residual impacts in Tanzania, particularly for some regions and groups of society, are expected and will need to be managed. These residual impacts – and their economic costs – are additional to the costs of adaptation.

- Finally, while there is a large need for adaptation finance, accessing adaptation funds will require the development of effective mechanisms, institutions and governance structures. There is a need for Tanzania to agree on next steps, the future focus and to build capacity, including national and sectoral planning objectives, enhanced knowledge networks and verifying outcomes of adaptation strategies and actions.

3. Sustainable Energy Use and Low Carbon Growth in Tanzania

The study has considered the potential benefits of sustainable energy use, aligned to low carbon growth and the emerging opportunities under the various international mechanisms. The main focus is a technical assessment of the near and medium term potential of Tanzania to invest in more sustainable, lower carbon projects / programmes, which have economic development and growth benefits, as well as conserving the natural resource base.

Current baseline: energy use and the economy

The study has first considered the baseline energy use and the relationship with the economy.

- Forests provide over 90% of the national energy supply through wood fuel and charcoal. This reflects a lack of affordable and reliable energy alternatives.

- There are various reported figures, but recent estimates put annual forest loss at 1.2%, driven largely by biomass energy demand and land-use change. This rate of deforestation is unsustainable. While there are Government tree planting programs and land being set aside for forestry and national parks to address this problem, this remains a key concern.

- Related to this, the current production and use of biomass (for charcoal) is extremely inefficient, which leads to unnecessary biomass use. These low grade technologies also lead to health impacts from indoor air pollution.

- The access to electricity is limited and subject to many outages, which disrupt business activities and reduces economic growth: costs are incurred from lost production and revenues, damage to equipment, back-up production, etc. The value of lost (unserved) load has been estimated by the World Bank at several % of GDP. The situation is compounded by high system losses and inefficient tariff structures. Moreover, current access to grid electricity is very low in Tanzania, reducing the availability of modern energy services for households and businesses.

- Tanzania's reliance on fossil fuels is increasing, as the energy system diversifies away from dependency on hydro generation for electricity and biomass for non-commercial sector energy needs. This is also being driven by high growth rates in fossil intensive sectors, notably transport. An increasing use of fossil fuels will increase energy security concerns and expose the economy to price fluctuations, as well as macro-economic burdens (balance of payments, fuel price shocks and inflation). As an example, in 2007, high oil price increases led to a significant increase in the cost of imports. These fossil fuels also lead to high environmental impacts, including outdoor and indoor air pollution.

- High population growth and the continuing rapid rate of urban growth have put significant pressures on existing urban infrastructure, especially in Dar Es Salaam. The problems are evident in terms of urban road congestion, where vehicle numbers exceed road capacity, which leads to lost time (and lost profits). There has also been considerable unplanned development.

- Future socio-economic trends, not least growing population and urbanisation, will exacerbate these existing energy access issues and associated impacts.

- Tanzania's economy is heavily based on natural resource use. The annual levels of growth needed to match the development objectives in the Vision document (8% annual GDP growth), and the type of economy outlined in the document (a semi-industrialised economy, with a comparable industrialised sector to most middle income countries) may be restricted an increasing reliance, and by inefficient use, of fossil fuels.

Against this background, a more sustainable, low carbon growth pathway has the potential to address the issues above, whilst also providing Tanzania with additional carbon finance to help invest. In addition to reducing carbon, many of these options could lead to more growth and development through protecting natural resources, improving environmental quality, delivering economic opportunities and reducing reliance on fossil imports.

Low Carbon Options can help deliver more sustainable economic growth and also provide the finance to fund this transition

Emission projections

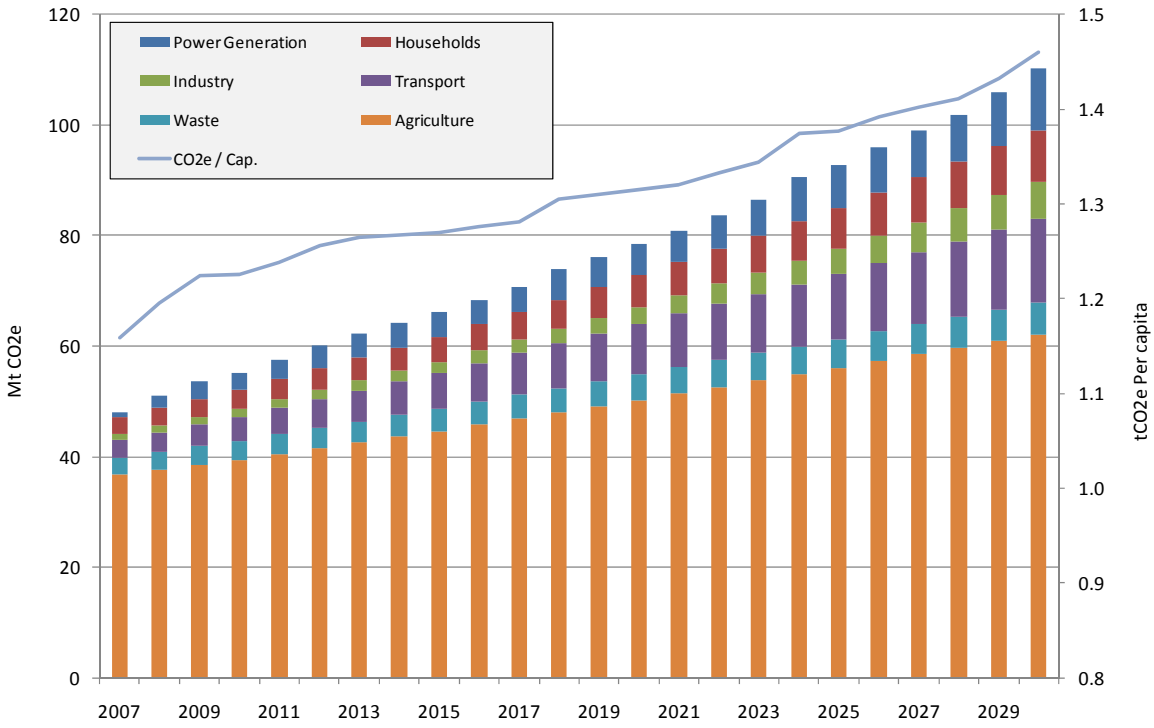
To determine the current or future role carbon financing could play in providing funding for investment in the economy, it is important that the level of GHG emissions is assessed through the development of a current year inventory and projections.

- The analysis has first considered current emissions. Tanzania currently has relatively low emissions of greenhouse gases (total and per capita). Current year emissions are dominated by the forestry and agriculture sectors, illustrating the importance of these sectors to the economy but also the very low fossil energy use in the economy.

- Per capita emissions are estimated at 1.3 tCO_2e per capita (all GHG, excluding forestry) and 2.7 tCO_2e per capita, when forestry emissions are included, though it is noted that actual CO_2 emissions are very low. Tanzania has also introduced a range of low carbon options across many sectors. These include renewable energy in the electricity sector, more efficient use of biomass and sustainable land use management.

- However, emissions are rising rapidly and will continue to do so. The study has estimated future emissions in line with planned development as set out in the Vision 2025, and based on population forecasts from the UN. The projections show that future total and per capita GHG emissions rise significantly, even though Tanzania is already initiating a number of low carbon options.

- Under this future 'business as usual' scenario, the study estimates that total emissions of greenhouse gases will more than double between 2005 and 2030.



GHG emission projections for Tanzania (excl. LUCF), $MtCO_2e$, 2007-2030

- These future increases are driven by the continued and increasing use of biomass for energy, rapid transport growth and agriculture sector activities. Emissions in other sectors will also rise, such as the electricity generation sector, where planned increases in the use of fossil generation (due to the need for diversification and use of indigenous resources) will increase the carbon intensity of generation. The increases would occur at a time when there are likely to be greater economic opportunities for international carbon credits, particularly if national level GHG mechanisms emerge.

Of course, increases in emissions will be necessary for Tanzania's growth, and given its development status, there is no suggestion that future emissions should be constrained.

However, the emissions growth above is related to a specific development pathway that has high fossil fuel use and unsustainable use of natural resources. Such a pathway will lead to an increase dependence on, and inefficient use, of fossil energy, with associated economic, social and environmental impacts, for example, increased congestion, higher fuel costs, greater fuel imports and higher air pollution.

There is, however, an alternative growth strategy, based around low carbon options, that would be more sustainable, and which would have the considerable benefit of providing potential carbon financing.

Low carbon options

Having established projections of future emissions, the study has investigated the potential for more sustainable, low carbon options, focusing on options that:

- Generate carbon financing opportunities, providing investment and financing from projects / programmes that reduce CO_2 emissions.
- Have strong policy co-benefits, aligned to current or planned policies.
- Strengthen development and growth, by stimulating new economic sectors and reducing costs e.g. through energy efficiency measures.
- Have adaptation synergies, where these investments align with actions needed to enhance climate resilient growth. This is seen as a particularly important area, as it provides the potential for win-win policies.

The study has found opportunities exist across all sectors of the economy, for example:

- Reducing the reliance on wood fuel energy and protecting the forests would promote sustainable resource use, protecting biodiversity and the economic sectors that rely on forest resources. It also reduces household exposure to pollution and promotes more modern energy forms. The REDD+ mechanism offers an important source of financing that should facilitate conservation.
- Alongside this, increased switching to modern fuels in household and other end use sectors is important. Co-benefits include cleaner, modern energy for cooking, particularly for a growing urban population. This will require increased access to affordable electricity. However, as continued biomass use will be necessary; improving efficiency will be vital as part of a move towards sustainable use.

Low carbon, sustainable case studies

The study has considered a number of case studies, to highlight the potential for low carbon options. This includes household and micro-grid renewables (as well as large-scale schemes), agroforestry projects which reduce emissions through cropland management whilst also improving yields, and sustainable charcoal production, fuel switching/alternative fuels and improved charcoal sector coordination (see example right, from the Dar Es Salaam Charcoal Project), as well as improved stoves.

A Half Orange Brick Kiln constructed in one of the villages under the Dar Charcoal Project

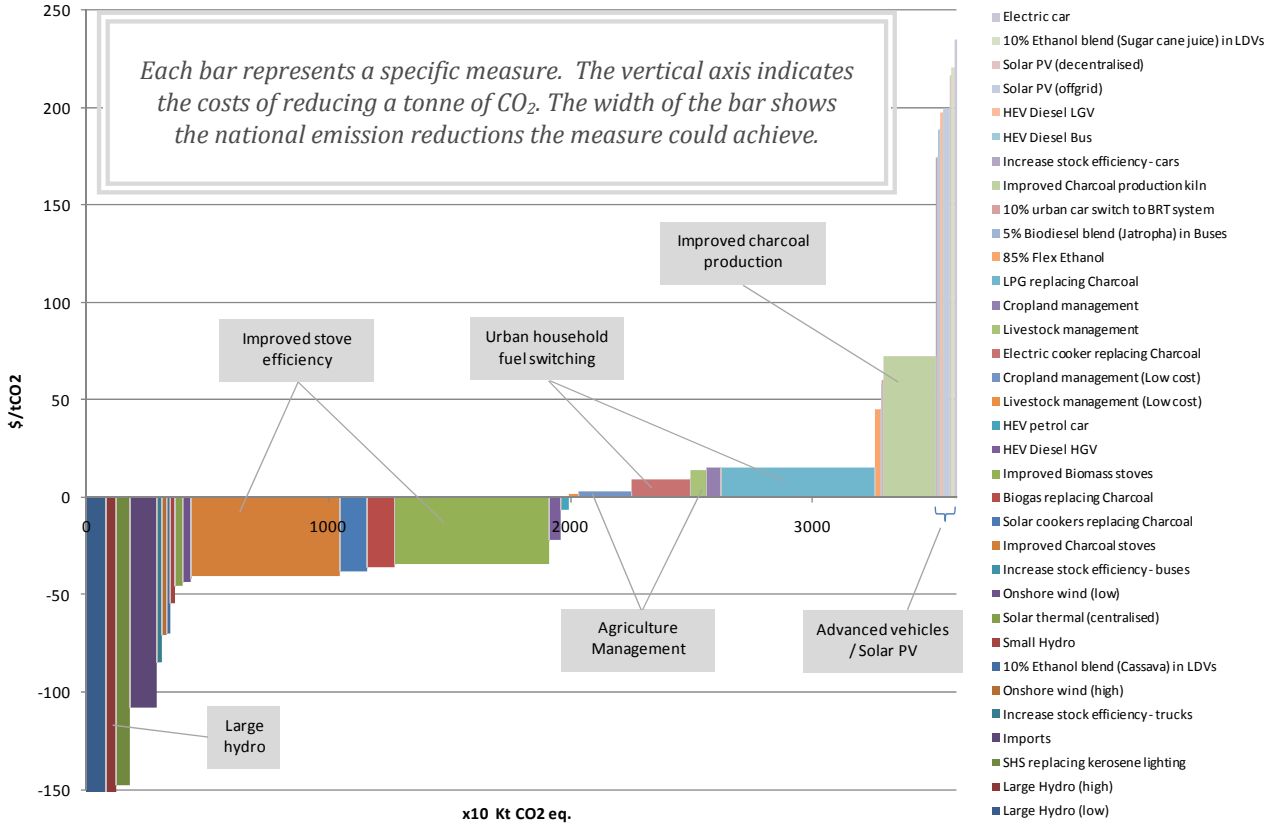
- Tanzania has long invested in renewable generation through the development of hydro generation. There is considerable potential for other renewables including wind, solar and particularly for geothermal. The latter would have the benefit of reducing the vulnerability of the current hydro-dominated electricity system, whilst also providing potential low carbon finance. Promoting both grid and household-based renewables will further strengthen energy independence so long as it is carefully planned.
- To facilitate these changes, investors will need to be incentivised through the tariff structure and be able to use the carbon financing mechanisms. Promotion of solar home systems is already being developed; mitigating the problems of affordability will be key for rural technology dissemination.
- Developing a sustainable transport system would help reduce reliance on oil imports, protect urban environmental quality, enhance urban infrastructure, reduce congestion and potentially help develop a sustainable biofuel sector. This also includes promotion of vehicle efficiency.
- Agricultural sector measures are also available, including viable carbon finance projects. In addition, many of these measures increase the climate resilience of systems and enhance productivity.

Economic Benefits of Sustainable / Low Carbon Options

A range of potential options that could help Tanzania move towards a more sustainable growth path, have been assessed. These options would also generate carbon finance to support investment.

- These low carbon projects can help safeguard forests, reduce reliance on energy imports, provide more access to modern energy services, promote more sustainable biomass use, promote efficient and clean transport systems, and enhance economic competitiveness.
- In this development and economic context, emission reductions are effectively a co-benefit of other policy drivers, and the introduction of these options is driven by self-interest, economic and existing development objectives.
- The introduction of carbon financing has the potential to increase the relative attractiveness of these options and to help finance their introduction.

- To compare these options, the study has assessed the marginal abatement costs of options in terms of the cost-effectiveness of emission reduction potential. These have been plotted – below - as a marginal abatement costs curve.



Indicative MAC curve ($/tCO$_2$ vs/ Gg) of selected abatement measures for Tanzania in 2030.

Future cost are discounted at 10%, using a net annualised cost metric

- An important insight is that many low carbon measures are 'no regret', i.e. negative or negative cost. This implies that such investments should be made irrespective of whether carbon finance is available, as over their lifetime such investments save money. These arise from improvements in transport efficiency, domestic stoves and agriculture, as well as for the electricity sector. An example is potential energy efficiency measures that actually save the individual or company money (e.g. from reduced fuel costs) when compared to the current baseline.

- These options also have wider economic benefits from greater energy security and diversity, as well reducing air pollution and reducing environmental impacts, and often enhance resilience to future climate change.

- The availability of carbon finance would help the introduction of these options, and provide a shift towards a sustainable, low carbon development path.

Implementation issues

To implement these options, financing will be critical to raise the necessary capital. In addition, a range of additional financing will be needed (to provide capital), as well as some additional existing barriers. Various regulatory, institutional and financing barriers will need to be overcome, such as:

- Economic / market barriers (e.g. no finance, poor commercial case): Tanzania has been slow in accessing the international carbon finance markets to date, with only one project registered under CDM and only recent uptake of voluntary credit schemes in the forestry sector. Commercial banks seem currently unwilling to lend to low carbon projects due to the track record in implementation. There is also a mismatch between the short term domestic deposit base and the long term tenor required for capital intensive projects, creating a role for international financial institutions. It is noted, however, that many of these are common issues across Africa, and there is a need for systemic barriers to be addressed in future negotiation mechanisms.

- Low levels of information / awareness: The relatively low levels of absolute and per capita emissions, lack of track record in low carbon development and competing priorities of poverty alleviation have resulted in low levels of awareness. Climate change continues to be seen through a development aid perspective, rather than from the perspective of domestic led economic restructuring or growth.

- Policy / regulatory framework: The development of a coordinated climate policy framework is at an early stage. The fiscal framework to support low carbon options remains under-developed. For example, utilities pricing supports traditional fossil fuel generation at the expense of other renewables, with limited use of technology specific tariffs.

- Technical problems of use in-country: Tanzania lacks the necessary operation and maintenance infrastructure to support complex technologies. Solar PV, however is building economies of scale and may be the first break-through technology. It is highlighted that this is a common problem in Africa, and there are key issues on technology transfer that need to be addressed in the international negotiations.

- Lack of skills / know-how: This is particularly pertinent to technical and financial project preparation, and acts as a barrier under CDM applications. Skills and training are of particular importance for those areas where behaviour is a significant element in emissions, such as forestry and agricultural soil management practices.

- Limited institutional capacity: Multiple institutions play a role in low carbon policy development with a clear need for streamlining roles and responsibilities. This is particularly true of Forestry management and transport planning, which account for the bulk of forecast growth in Tanzania's GHG emissions. Building institutional capacity is key to making low carbon development work.

Despite the challenges, there are positive signs that Tanzania is beginning to embrace low carbon options both through its policies and regulatory structures. Nevertheless, these would benefit from further alignment. There are also clear signs of growing momentum within the private, voluntary and education sectors which are crucial to creating the implementation capacity required, and which may serve as a basis for scale-up of low carbon options over coming years.

Linking low carbon and climate resilient growth

In terms of the linkage between low carbon investments and climate resilient growth, the study finds a mix of potential synergies and conflicts. A number of areas are highlighted:

- The impact of climate change will affect the energy system of Tanzania, and is important in considering the potential development of current and also more sustainable growth pathways.

- Increases in temperature will increase demand for cooling, which will in turn increase energy demand through air conditioning. These changes could be very significant in terms of average and peak demand (see earlier section) and they should be considered in current electricity planning.

- The combined effects of changes in future temperature and precipitation could affect the electricity supply industry, particularly given the high proportion of hydro power but also some thermal generation, though the projections are uncertain. There is a need to screen future power proposals and look to building resilience through a combination of options (see earlier adaptation section).

- There are existing risks from current climate variability (droughts and floods), which could increase in the future, and again requires risk screening for new proposals for infrastructure.

- Future climate change could have important impacts on agro-ecological zones, affecting forests. This is a key point in relation to REDD+. The limited studies that are available indicate potentially large threats, which could affect the viability of afforested areas and thus the viability and revenues from such schemes. Research into possible ecosystem shifts and suitability under changing climates is highlighted as a priority for consideration, as well as increased monitoring programs to study responses of forest and tree species.

Other issues

A number of other issues are highlighted, that extend beyond the analysis above.

- The analysis here has focused initially on domestic aspects. However, there is a need for Tanzania to consider low carbon growth, and enhanced energy resilience, in a regional context. There is also a growing recognition that co-operative regional (East African) responses could enhance opportunities for carbon credits as well as provide enhanced resilience (e.g. through interconnections). The consideration of these regional perspectives is considered a priority for future discussion.

- This study has not assessed the potential effects of international climate change policy on Tanzania. However, certain areas of existing economic activity, which also have high planned growth in Vision 2025, could be affected by international action, notably the international tourist sector and higher value added agricultural and horticulture products (through supply chains). Given their importance to the economy, it is considered a priority for Tanzania to consider the implications of international climate policy on domestic growth plans.

- A final issue is the consideration of a more radical policy shift for Tanzania. Because of the level of current development and the importance of near-term decisions in determining the long-term economic and social structure of the country, it might be possible to truly promote a more strategic approach to low carbon development and climate resilient growth within the context of environmental sustainability and economic growth in Tanzania. This would position the country internationally along a very progressive vision.

Low Carbon Summary

Tanzania is a growing economy, aiming for strong development and growth over the next 10-20 years. However, the unsustainable use of natural resources and the increasing reliance and inefficient use of fossil fuels threatens these objectives. A more sustainable pathway could be adopted, to ensure that Tanzania can become a middle income country whilst protecting its natural assets and environment.

This sustainable pathway aligns with low carbon development. This therefore provides the opportunity for Tanzania to access carbon financing to help invest in sustainable technologies. It would also address provide significant co-benefits (economic, social and environmental), which are very much aligned with domestic policy priorities. While Tanzania is and has already implemented many lower carbon opportunities, the move to adopt a more strategic approach to a low carbon- climate resilient growth pathway would enhance these benefits, and maximize the opportunities for Tanzania to benefit from the available international funds.

Overall, the study concludes that because of its location, availability of resources and socio-economic conditions, there are significant benefits for Tanzania in promoting low carbon projects to ensure a more sustainable growth pathway. Such a pathway appears strongly in the country's self-interest, providing potential extra investment from carbon financing and numerous policy co-benefits.

Recommendations

The study has outlined a number of recommendations and future priorities.

The key recommendation is for Tanzania to get ready and act now

The priority areas are set out below:

- Improving the estimates. Further work is needed to improve these initial estimates and to give a degree of confidence in the analysis. While there are recent studies which have started which will help address the gaps, a number of specific issues are highlighted.
    - There is a need to need to address the current economic costs of existing climate variability in Tanzania. One way to advance this might be through a more detailed economic study on current costs and how this affects GDP. This information could also be presented in a way that communicated the impacts on individual Government budget lines, to help mainstream actions to address the current adaptation deficit.

- Good progress has been made on impacts (the 2009 Climate Impacts Assessment by government) and a recently started project on impacts and vulnerability. However, A broader consideration of additional risks not yet covered, e.g. within existing sectors (such as assessing additional health risks beyond malaria), and sectors not yet covered (e.g. tourism and industry), as well as a much greater focus on cross-sectoral issues and indirect effects.
- A more comprehensive analysis of future emission projections and potential opportunities, with full marginal abatement cost curves and analysis of urgent priorities across all sectors, as well as on the links with climate change impacts. This would also be extremely beneficial in the context of emerging mechanisms. This could lead to a set of priority measure (e.g. a ten step plan) for low carbon options.
- For both adaptation and low carbon growth, analysis of the costs and benefits, including to government, the sector and individuals. This step could provide both adaptation and low carbon costs in detail and as part of an investment and financial flow analysis (by sector). Matching the costs against the wide range of potential finance is a prerequisite for a viable investment plan. A key focus here is to consider adaptation and low carbon issues together.
- Further work should also be undertaken on the potential macroeconomic and distributional (equity) effects of impacts, adaptation and low carbon policies, and more detailed assessment of the costs and benefits to different sectors / stakeholders.
- Taken together, this analysis could form the basis of an expanded national climate strategy (see below) that links national policy to sectoral objectives and targets, with effective mechanisms for implementation, monitoring, reporting and verification.

- Urgent priorities. There are a number of urgent priorities for Tanzania, which include but go well beyond those identified in the NAPA. This includes a focus on early no regret options, but also fast-tracked monitoring, forecasting and information provision (as these underpin future prediction and analysis), strengthening early warning systems and disaster risk management (including post-disaster coping mechanisms) and sectoral focal points and cross Government collaboration. There is also a need for sector priorities to be identified.

- Building Capacity. Access to substantial adaptation funds must be assured. However, mechanisms, institutions and governance systems for effective use must be developed to allow Tanzania to access these funds. Similarly, there are issues on further enhancing low carbon capacity, which will be key to the development of future plans. For both of these, there is a need to build capacity across all sectors, not just in key Ministries. This requires early and concerted action to build capacity across all stakeholders, with additional people, resources, research, training and expanded and new institutions. Related to this there is a need to address technology needs and transfer, building on the recent work that government has completed.

- Risk screening for both climate resilient and low carbon growth. There are already plans in Government to mainstream climate change, and this reflects the need to build future climate change risk screening into all development and planning, at a sectoral and regional level. This recognises that there are many benefits if Tanzania switches to a more sustainable and lower carbon growth pathway. However, this will not happen on its own and steps are needed by Government, business and civil society to realise these benefits and to maximise the potential flow of carbon credits under existing and future mechanisms. Similarly, there is a need to further consider and adapt to climate change, looking not just at the project level, but up to the macro-economic level.

- Specifically, i) climate resilient and low carbon plans should cut across all sectors and mainstreamed into sector plans (noting actions are already underway to start this within Government), ii) areas of development that increase future threats to climate change, but also future mechanisms or obligations in future years, should be identified, iii) linkages between adaptation and low carbon development (especially in relation to opportunities for finance) should be further explored.

- National policy and Vision documents. Planned revision of national policy should examine the potential effects of climate change and the potential for adaptation and low carbon growth. There is also a need to build on existing government and donor activities. There could lead to a new strategic vision for Tanzania that addresses these areas, for example, with further development of the Vision 2025 document, as well as supporting intermediate indicators and targets.

- Regional collaboration. There is also a need for regional collaboration and co-operation across the areas of low carbon growth and adaptation, to benefit from economies of scale and to enhance regional resilience. Given the many trans-boundary impacts of climate change, the need for international co-operation to address these, and the potential for regional opportunities, this is a key area. There is also a need to examine the potential international dimension of climate change and how this might affect Tanzania.

The areas above would provide national action on a low-carbon, climate resilience investment plan and help Tanzania in negotiations and securing finance.

In terms of translating these into concrete action, a number of specific next steps are recommended:

1. For Tanzania to produce and implement a National Climate Change Strategy, explicitly considering and linking adaptation (climate resilience) and low carbon growth opportunities. The Government of the URT produced an initial National Climate Change Action Plan in 2009. This could be further elaborated into a major National Climate Change Strategy, which includes climate resilient (adaptation) and sustainable / low carbon growth. This should also include emerging issues such as the NAMAs (Nationally Appropriate Mitigation Actions). Putting this in an integrated strategy will encourage synergies and reduce conflicts. The inclusion of the economics (and the costs and benefits) in this strategy will also ensure that Tanzania is well placed to take advantage of opportunities from emerging negotiation discussions. There are already plans for a Climate Change Strategy and Action plan within Government, and ensuring this is taken forward with appropriate resources, is the key priority over the coming year.

2. 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 national strategy, but will require co-ordination and integration.

3. To integrate climate change – and opportunities – into the strategic vision. As well as the step above, Tanzania should go further and start building climate change (resilience and low carbon) into longer-term strategy, including in any revision of the Vision document, and intermediate objectives and policies.

4. To undertake a capacity needs assessment and implement this. To support all of the priority areas above, there is an urgent need to build capacity, with mechanisms, institutions and governance systems, etc. A key way forward would be to undertake a capacity need assessment, and develop (and implement) a plan.

5. To fast track the implementation of a major case study. Finally, early practical examples will help build confidence. Domestically there is a need to demonstrate the benefits of such policies. Internationally, there is a need to demonstrate the investment environment in Tanzania. There would be major benefits in an early implementation study, to fast track and demonstrate the benefits of climate resilience and low carbon growth. One way to progress this might be through a sub-national level: for example, a suitable pilot area might be to implement a low carbon – climate resilience strategy for Zanzibar.

A summary of the key steps for adaptation and sustainable / low carbon growth are presented over the page.

Adaptation	Recommended Actions
Immediate needs and capacity building	• Early capacity building (institutions and organisations). • Early warning systems and meteorological capability. • Enhanced monitoring of key impacts. • Expanded research into impacts, adaptation and economics. • Extend national climate change plans into major national climate change strategy, including analysis of costs and investment plans. • Extension of existing screening of sector and regional plans for climate risks and adaptation opportunities, including national policy and long-term vision (Vision 2025) • Build on existing national adaptation authority, expanding capacity and looking to enhance sectoral co-ordination, link to international finance and support private sector. • Enhance links between adaptation and low carbon development.
Climate resilience	• Climate resilient strategies, objectives and targets for immediate concerns. • Screening for new projects, policies and programmes • Prototypes of sectoral actions and demonstrate with pilots, to allow later scaling up.
Social protection	• Protect vulnerable livelihoods and strengthen existing social protection programmes, expanding the coverage to consider climate change
Accelerated development	• Adapt existing development projects to include no regret measures and to reduce climate risks, and opportunities to develop adaptive capacity • Scale up successful prototypes to sectoral development plans

Low Carbon	Recommended Actions
Low-Carbon Growth (LCG)	• Full analysis of baseline projections, low carbon options, resilience to climate change, costs and prioritisation and development of strategy for mechanisms. • Develop national strategies to mainstream low carbon investment in planning. Build into long-term vision (e.g. Vision 2025), including potential effects from international action. • Facilitate carbon finance opportunities in voluntary and compliance carbon markets (VCM, CDM) and in REDD • Prioritize forestry, agriculture, transport and electricity generation low carbon measures, considering short-term opportunities but also longer-term areas where potential 'lock-in' and identify alternatives. Improve sectoral co-ordination. • Look for synergistic adaptation – low carbon project opportunities, e.g. agro-forestry and sustainable land-use. • Conduct an early study, to fast track and demonstrate the benefits and financing possible from such a strategy at a sub-national level: an example of a suitable pilot area might be to undertake a study for Zanzibar.
Climate resilience and co-benefits	• Climate risk screening of low carbon growth pathways • Consideration of energy demand (cooling) and supply (hydro, fossil stations) effects from climate change, with associated adaptation (diversity, demand management). • Analysis of potential impacts of climate change on forestry (REDD) and introduction of monitoring and move towards early adaptation. • Explore opportunities in case studies of major low carbon strategies such as geothermal, biofuels and on-farm carbon management and how they might be scaled up to achieve both reductions in future emissions and adaptive development.

Project Description and Project Team

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Full project reports and detailed technical annexes to support this document are available on the project website: http://economics-of-cc-in-tanzania.org/

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Robert Okanda, Peres Mwangoka, taken from 'Changing Climate, Changing Lands: Images of Tanzania'

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