

# Climate Change Impacts, Adaptation and Mitigation in Tanzania

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## The CCIAM

Programme

July 2009 – June 2014

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A Programme Document for Norwegian  
Government Support to a Joint Proposal  
by four Institutions to Address the  
Challenges of Climate Change in  
Preparation for the REDD Initiative in  
Tanzania in Collaboration with  
Norwegian Universities and Research  
Institutions.



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### Prepared and Submitted by:

Sokoine University of Agriculture, in collaboration with University of Dar es Salaam; Ardhi University and the Tanzania Meteorological Agency

### Correspondence: The Director

Directorate of Research and Postgraduate Studies  
Sokoine University of Agriculture  
P. O. Box 3151 Morogoro, Tanzania  
Phone and fax: +255 23 2604388  
Email: [matovelo@suanet.ac.tz](mailto:matovelo@suanet.ac.tz); [drpgs@suanet.ac.tz](mailto:drpgs@suanet.ac.tz)

Re-submitted:

November 1<sup>st</sup>, 2009

**COOPERATION BETWEEN THE GOVERNMENT OF THE UNITED REPUBLIC OF TANZANIA AND THE  
GOVERNMENT OF THE KINGDOM OF NORWAY**

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**PROPOSAL FOR A PROGRAMME ON CLIMATE CHANGE IMPACTS, ADAPTATION AND MITIGATION IN  
TANZANIA**

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**GOAL:** Better Management of Natural Resources and the Environment through Appropriate Adaptation and Mitigation Strategies and Participation in Climate Change Initiatives

**PURPOSE:** Develop and Sustain Adequacy in National Capacity to participate in Climate Change Initiatives and Address the Effects and Challenges of Climate Change

**PROGRAMME DURATION:** JULY 2009 – JUNE 2014

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**Correspondence:** The Director

Directorate of Research and Postgraduate Studies  
Sokoine University of Agriculture  
P. O. Box 3151 Morogoro, Tanzania  
Phone and fax: +255 23 2604388  
Email: [matovelo@suanet.ac.tz](mailto:matovelo@suanet.ac.tz); [drpgs@suanet.ac.tz](mailto:drpgs@suanet.ac.tz)

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## PROGRAMME ENDORSEMENTS

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A proposal on climate change impacts, adaptation and mitigation in Tanzania, being submitted to the Royal Norwegian Embassy in Dar es Salaam, jointly by the institutions in Tanzania wishing to collaborate in the implementation of the proposed programme as hereby endorsed by the collaborating institutions:

1.     **The Vice Chancellor**  
         **Sokoine University of Agriculture**  
         **Morogoro**

**Date:**

2.     **The Vice Chancellor**  
         **University of Dar es Salaam**  
         **Dar es Salaam**

**Date:**

3.     **The Vice Chancellor**  
         **Ardhi University**  
         **Dar es Salaam**

**Date:**

4.     **The Director General**  
         **Tanzania Meteorological Agency**  
         **Dar es Salaam**

**Date**

## EXECUTIVE SUMMARY

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### BACKGROUND

#### Overview

One of the biggest challenges of the 21<sup>st</sup> century is climate change. The accumulation of green house gases such as carbon dioxide (CO<sub>2</sub>) from different sources in the atmospheres promotes global warming (IPCC, 2007). The major source of green house gases in the atmosphere is the burning of fossil fuels that is estimated to contribute about 80%. Land use and land cover change especially forest deforestation and degradation contribute the remaining percentage (Stern, 2007).

Among the major impacts of climate change in Tanzania is its influence on ecosystem services. Tanzania is endowed with different ecosystems and thus a variety of ecosystem services. While we are aware of the different ecosystem services that are provided by different ecosystems in Tanzania, knowledge on how these services are vulnerable to climate change and to what extent they will be impacted by climate change are not well known. Based on the above situation the proposed programme aims at investigating how the different ecosystems and associated ecosystem services will be impacted by climate change.

The impact of climate change poses serious challenges to sustainable livelihoods and economic development, particularly for least developed countries like Tanzania. The adverse impacts of climate change are already noticeable in many countries including Tanzania. The ramifications of climate change are particularly evident on environment, human health, food security, human settlements, economic activities, natural resources and physical infrastructure. In recognition of these challenges, the Government of the United Republic of Tanzania and the Kingdom of Norway are committed to work together to address the problems. The two governments have therefore agreed to establish a partnership with the purpose of implementing programmes for adaptation to and mitigation of climate change. Bali conference identified four key issues including: adaptation, mitigation, technology transfer and financial mechanisms to support implementation particularly of mitigation and adaptation activities. Specifically, Tanzania and Norway are committed to participate in the development and implementation of the REDD (Reduced Emissions from Deforestations and forest Degradation) initiatives as proposed in the Bali Conference to combat deforestation and the challenges of climate change.

The history of REDD started at CoP 11 in Montreal, Canada in 2005, and continued at CoP 12 in Nairobi in 2006. During the CoP 13 in Bali in 2007 major advances were made, and there was a clear commitment of Parties to deal with this issue in the context of an overall package for a post-2012 regime. A time span of 2 years was set for negotiations which should culminate in agreement on this post-2012 regime at CoP 15 in Copenhagen (December, 2009). It was also agreed to start demonstration activities to support REDD as a climate mitigation and adaptation measure. The Decision (CoP 2.13) expressly focuses on reduced emissions from deforestation and degradation. Other possible options mentioned are 'sustainable forest management', 'forest enhancement' and 'conservation'. However, various issues for REDD readiness including methodologies for baseline determination, monitoring, assessment, reporting, and verification, benefit sharing mechanism are yet to be addressed. Other issues include enhancement of capacity building to address climate change research, dissemination and strategic interventions relevant to REDD.

#### Programme Justification

The Norwegian Government is committed to support the participation of Tanzania in the development and implementation of programmes to address challenges of climate change with a purpose of increasing the participation of Tanzania and other developing countries in the mitigation of and adaptation to the effects of climate change. The emphasis is to enhance Carbon (C) sequestration and storage through sustainable forest management and conservation of existing C stocks (e.g. through reduced deforestation, de-vegetation and degradation). This approach will improve livelihoods of people and ensure better adaptation to the impacts of climate change. In response to the initiative, Sokoine University of Agriculture and collaborating institutions; the University of Dar es Salaam, Ardhi University and Tanzania Meteorological Agency, as well as Norwegian University of Life Sciences (UMB) are submitting this proposal requesting the Royal Kingdom of Norway to support Tanzania build up institutional capacities and knowledge base for appropriate responses to the challenges and opportunities brought about by climate change. Of particular relevance is the focus on enhancement of a much greener environment by promoting natural forest conservation, afforestation, reforestation and better agricultural practices for improved livelihoods as espoused in the "Reduced Emissions from Deforestations and Forest Degradation (REDD)" initiative. Recognizing that this is a challenge demanding participation across diverse disciplines and sectors, the programme will involve collaboration of relevant institutions in Tanzania and Norway which will adopt a multi-stakeholder approach to its implementation.

Developing, optimizing and sustaining readiness and adequacy in capacity to address the challenges brought by climate change will require a number of interventions through raising awareness, training to build capacity at various levels, research and outreach. This programme therefore will provide support in terms of documenting and disseminating research backed experiences generated from REDD demonstration activities. The proposed programme is online with the supporting role of research institutions in Tanzania to the development and implementation of REDD policy as stipulated in the UN-REDD and National REDD Implementation Frameworks. It

is in the realization of both the essence and the urgency to adapt to and mitigate climate change that this proposal is being put forward for consideration.

This proposal emphasises the need for promoting forestry through REDD initiatives aimed at increased C sequestration as a mitigation and adaptation mechanism to climate change, and as a way of counteracting deforestation, protecting the environment and meeting the energy needs of the rural and urban communities, through efficient production of fuel wood and bio fuels. The opportunity for carbon sequestration both in larger forests and in smaller forest enclosures, plantations of fruit trees and multipurpose trees planted for food, fodder, timber, and fuel will be promoted to avoid leakage under REDD schemes.

Better management and conservation of natural forests and small-holder forestry practices will be studied as among the major ways of ensuring that local communities benefit by participating in the emerging C trading markets for Reduced Emission from Deforestation and forest Degradation (REDD). Factors contributing to the failure of the forest sector in Tanzania not to benefit from Clean Development Mechanism (CDM) afforestation/ reforestation scheme as elucidated under Kyoto Protocol, will be investigated with the aim of aligning Tanzania forestry projects in a better position to benefit from the post-Kyoto arrangements.

The REDD initiative is envisaged to develop and promote mechanisms of payment for ecosystem services. So far, forest ecosystems are known to be a good repository of biodiversity and also contribute significantly to livelihoods of adjacent communities but taken for granted. Under climate change scenarios it is believed that forest ecosystems will be impacted differently and thus the impact will affect differently the existing biodiversity in forest ecosystems and community livelihoods. Until today it is not well known as to how climate change will affect forest biodiversity. It is also not well known how the forest biodiversity will respond to the different scenarios of climate change in Tanzania. Unless the impact and response of forest ecosystems to climate change are known, mitigation and adaptation measures will be difficult to develop. Under the proposed programme pertinent investigations will be undertaken to determine how climate change will influence forest biodiversity and related livelihoods under REDD pilot areas.

One of the major causes of deforestation and forest degradation in tropical countries including Tanzania is poor agricultural practices. These lead to poor crop production, shifting cultivation, land degradation, as farming communities' clear forests to establish new farms. In order for the REDD initiative to succeed adjacent communities need to be empowered through tangible incentives including those emanating from forest conservation initiatives. These incentives can also be used to encourage farming communities to adopt better farming practices and less destructive land use practices. The intention of this program is to investigate the viability of better farming practices that promote the achievement of REDD policy objectives for adaptation and mitigation to climate change.

Extensive pastoralism is also responsible for deforestation and land degradation. Under REDD initiatives, better animal husbandry practices need to be integrated in the land-use plans for better adaptation to and mitigation of climate change. Proper balances for cultural values and carrying capacity need to be addressed for purpose of sustaining the gains from REDD. In this programme, the link between deforestation and pastoralism will be investigated for better animal husbandry that ensures increased productivity and reduced emissions.

Currently, women are poorly represented in training, research and decision making organs in the country particularly in the fields of agriculture and life sciences. This programme will make deliberate attempts to ensure active participation of women and other vulnerable groups in the programme activities. Other issues the programme needs to address will include: the role of women in land and tree tenure, gender sensitive benefit sharing mechanism for values of ecosystem services. The contribution of women in deforestation and forest conservation is poorly studied. Moreover, the role of gender in small and medium scale enterprises (SME) related to natural resource management need to be promoted with the overall intention of facilitating the attainment of REDD policy initiatives.

Adaptation to climate change requires focused and sustained long-term series of actions with cumulative impacts over time through building institutional capacities in training, research and development (R&D). The emphasis of the proposed programme will be on better management of forest and other land resources for REDD readiness. The programme will also address socio-economic and gender aspects related to climate change such as livelihoods of various communities, vulnerability and adaptation options. This programme focuses on developing and undertaking training and education programmes contributing to scientific knowledge on climate change with particular emphasis to the REDD initiatives. The programme will also contribute to capacity building among other REDD actors at all levels and opportunities will be availed to all Tanzanians. The proposing institutions have the capacity and expertise to adequately undertake the projects. It is expected that by the end of the programme, a comprehensive research and methodology development programme for climate change adaptation and mitigation will have been completed and enable Tanzania to implement the post-2012 climate mitigation and adaptation regimes. It is for this reason that this proposal is tabled for funding.

## **Objectives of the Proposed Programme**

### **Main objective**

To develop and sustain adequacy in national capacity to participate in climate change initiatives and address the effects and challenges of climate change with particular emphasis to the REDD initiatives.

### **Specific objectives**

This programme will address the following specific objectives:

1. To determine and develop appropriate climate change mitigation and adaptation strategies in forestry, other land uses, ecosystems and biodiversity management
2. To assess climate change impacts on and vulnerability of ecosystem services and livelihoods under REDD initiatives
3. To conduct policy and legal framework analysis of climate adaptation and mitigation with emphasis on economic efficiency, ecological effectiveness and wider political legitimacy
4. To develop and undertake capacity building, dissemination and strategic interventions for adaptation and mitigation to climate change

## **FOCUS AREAS AND ACTIVITIES**

This programme is designed to be executed through four strategies; research, capacity building needs to address climate change, strategic interventions and documentation, promotion and publicity administration.

### **Focus Areas for Research**

#### **Development of appropriate climate change mitigation and adaptation strategies in forestry, other land uses, ecosystems and biodiversity management**

- Quantification of the potential for forestry based carbon off-sets and carbon trading
- Development of forest carbon assessment and monitoring system
- Determine effective and efficient payment system for REDD in Tanzania
- Determine appropriate approach to limit deforestation and forest degradation in Tanzania for its participation in REDD
- Modelling of impacts of climate change and management scenarios in forestry, land-use, ecosystem and biodiversity
- Assessment of Small Holder Forestry Potential for Climate Change Mitigation, Adaptation and Rural Development
- Financial analysis of Carbon sequestration and storage
- Development of strategic interventions for adaptation in forestry, and other land uses including human settlements.
- Assessment of innovative agricultural land use and farming systems for adaptation to and mitigation of climate change to support REDD initiatives.
- Development and testing of various range land management strategies for the purpose of reducing pressure on forest resources for adaptation and mitigation to climate change

#### **Assessment of climate change impacts on and vulnerability of ecosystem services and livelihoods under REDD initiatives:**

- Establishment of trends and projections of ecosystem services associated with climate stressors.
- Model effects of alternative management options on ecosystem services under changing climate.
- Development of methods to describe relationships between ecosystem services, climate stressors and management responses.
- Assessment of local climate change vulnerability of biodiversity and forest related livelihoods and adaptation options.
- Assessment of macroeconomic impacts of climate change in forest resource management and its implication for different ecological zones.
- Integrated analysis and synthesis of lessons learned from adaptation options and macroeconomic impacts.

**Policy and legal framework analysis of climate change adaptation and mitigation with emphasis on economic efficiency, ecological effectiveness and wider political legitimacy**

- Analysis of climate change related policies and legal framework in Tanzania.
- Analysis of land competition in the context of climate change adaptation and mitigation efforts and how the competing interests are balanced in Tanzanians present policies and policy implementations.
- Analysis of various REDD initiatives that are addressed through markets, private and public sector management, and civil society.
- Determine how institutional arrangements and governance affect various forest management regimes (CBFM, Plantations, Private forests, general land forests and forest reserve) in the context of climate change.
- To determine the feasible incentive structures, monitoring mechanisms, controls leakages and additionality to influence policy formulation and implementation for climate change adaptation and mitigation.

**Focus Areas for Capacity Building**

**Develop and Undertake Human Capacity Building to Address Adaptation and Mitigation to Climate Change**

- Mainstreaming climate change issues in tertiary institutions curricula.
- Conducting specialised climate related training at various levels for Tanzanians including 50 MSc and 17 PhD students with special emphasis on climate and ecological modelling with emphasis on REDD pilot areas.
- Developing modules incorporating analytical modelling in socio-economic and ecological issues to be used for analysis of adaptation to climate change and variability.
- Developing short courses on different topics on climate change for policy makers and trainers.
- Conducting training and dissemination workshops for various stakeholders
- Enhancement of special skills in modelling for technicians and scientists
- Engagement of 15 young and 12 senior professionals in exchange programmes. This will involve Norwegian and Tanzanian postgraduate students and other young researchers in collaborative research projects to acquire skills and/or exposure to experiences that may add value to their study programmes.

**Develop/Rehabilitate Physical Infrastructure to Address Adaptation and Mitigation to Climate Change**

- Establishment of database to pool all information generated by the programme
- Provision of equipment (e.g. weather monitoring equipment (Automatic Weather Stations), data loggers, GIS software and equipment, computers).
- Provide reliable internet services and connectivity in partner institutions to facilitate access of scientific information for research
- Strengthening existing climatological monitoring station network and communication system by TMA
- Strengthening the existing climate research and establish modelling laboratories
- Avail hardware and software for short course training of various participants on modelling climate change effects.
- Improvement of field research laboratory at Mazumbai for monitoring of climate change impacts on high forest ecosystems and related biodiversity
- Strengthening of research laboratory for monitoring of climate change impacts on aquatic ecosystems and related biodiversity at UDSM
- Acquire tide gauges for continuous observation reference station for sea level monitoring by ARU.
- Acquire a total of five vehicles to support project implementation and coordination activities. Each institution shall receive one car, and one extra will be for coordination at SUA.

**Focus Area for Strategic Intervention**

**Develop and Undertake Strategic Intervention for Climate Change Adaptation and Mitigation**

Some of the strategic intervention needs include:

- Document existing REDD related activities and technologies and report the same to relevant meetings
- Assess community-based projects aimed at alleviating poverty through different approaches to climate change adaptation and mitigation developed by NGOs in REDD pilot
- Support CDM and REDD demonstration projects
- Support demonstration projects at community level on biofuels technologies and options to support REDD implementation.
- Value chain analysis of farming systems in Tanzania for REDD
- Provision for advisory and developmental services on emerging constraints in adaptation to climate change by small producers

**Focus area on outreach programmes**

**Documentation, communication and dissemination**

Outputs from the dissemination and out reach include:

- Enhanced understanding about climate change and its impacts under REDD initiatives
  - Increased awareness of the risks and opportunities associated with climate variability and change under REDD initiatives.
  - Enhanced understanding of vulnerability of ecosystems to climate change
  - Adaptation and mitigation strategies to manage the impacts of climate change using the REDD initiatives.
- Enhanced skills and knowledge on climate change among stakeholders for improved natural resource management.

## **PROGRAMME STRUCTURE, MANAGEMENT AND COORDINATION**

### **Institutions involved**

#### **TANZANIA**

##### **Sokoine University of Agriculture (SUA)**

- Director of Research and Postgraduate Studies (DPRGS)

##### **University of Dar es Salaam (UDSM)**

- Director of Research and Publications

##### **Ardhi University (ARU)**

- Director of Research and Publications

##### **Tanzania Meteorological Agency (TMA)**

- Director of Research and Training

#### **NORWAY**

##### **Norwegian University of Life Sciences (UMB)**

- UMB through NORAGRIC will serve as an anchoring institution in the north for the purpose of identifying and engaging participating Norwegian institutions as sought by the programme.
- UMB shall coordinate a visit for the collaborating institutions to Norway in order for them to acquaint themselves with Norwegian science and research organisations for further collaboration.

### **Programme Administration and Management**

#### **Programme Co-ordination**

There shall be a **Programme Director** responsible for overall programme guidance. However, for effective day to day administration follow-up of activities, there shall be a **Programme Coordinator** who shall have the overall executive responsibilities. In this respect, the programme coordinator shall be the secretary for the Programmes Management Team and the Programme Director shall be the Chairperson. For smooth linking and networking between participating institutions, there shall be designated Institutional Programme Co-ordinators (IPC) for each of the participating institution (in the office of Director responsible for Research), There shall also be one Coordinator at UMB for the collaborating institutions in Norway.

Organisation and administration of the Programme shall be governed by the Grant Contract Agreement between the Government of the United Republic of Tanzania and the Government of the Kingdom of Norway. The overall governance of the programme shall be vested in the Annual Meeting which is a summit organ of the programme that brings together representatives of the Government of the United Republic of Tanzania and the Government of the Kingdom of Norway. The overall responsibility for guidance of the programme/projects shall rest on the Joint Programme Steering Committee which shall have representation from all the Tanzanian and Norwegian institutions participating in the programme. The Joint Programme Steering Committee shall meet twice per year.

The Committee shall be referred to as the Steering Committee for Climate Change Impacts, Adaptation and Mitigation (CCIAM) Programme. The execution of day to day activities of the programme/projects shall be administered by the Coordinator and Institutional Coordinators and shall be guided by the Programme Management Team chaired by the SUA Director for Research and Post Graduate Studies as the Programme Director.

The coordination hub of the programme shall be located at SUA which is the programme main contract holder. For purposes of ownership and accountability, the participation of each side and each institution shall be guided by a subcontract to be drafted between the Principal Contract holder and the other participating institutions. This programme shall operate under the following organizational set-up:

- Annual Meeting
- Joint Steering Committee
- Programme Management Team (PMT)
- Institutional Programme Co-ordinators



## **Annual Meeting**

There shall be an Annual Meeting chaired by the Permanent Secretary, Ministry of Education and Vocational Training (MEVT). Other members shall include:

- SUA Management
- Representatives from Collaborating Institutions (UDSM, TMA, ARU)
- Representative from the Ministry of Natural Resource and Tourism (Forestry and Beekeeping Division)
- Representatives from the Vice President's Office (Division of Environment), Ministry of Finance and Economic Planning, Ministry of Foreign Affairs, Ministry of Agriculture, Food Security and Cooperatives, and COSTECH
- Representatives from RNE
- UMB Rector or his representative and One Norwegian Institutions Representative

The Programme Coordinator shall be the Secretary to the meeting and shall ensure that the following are undertaken:

- Meeting documents together with the notice of the meeting are made available to members one month before the meeting
- Minutes of the meeting are drafted and sent to the Chairman and RNE for comments not later than two weeks after the meeting
- Agreed Minutes are signed by both parties and distribute to members not later than one month after the meeting.

Annual meetings shall be held before the end of November and their main functions shall be to:

- Review the progress and overall performance of the programme
- Approve work plans and budgets for the next financial year
- Receive and discuss issues of special concern for implementation or for future action.

## **Joint Programme Steering Committee**

Based on the nature of the proposed programme, that include multi-disciplines and coordinated activities from different participating institutions, the Joint Steering Committee shall be designed to accommodate this nature. It is proposed that three members from each of the participating institutions will be required. The three members will include a representative of the management (VC and DVCs/DG-TMA), Directors responsible for research in each of the participating institutions, and a subject matter specialist. The Programme Coordinator will have the duty to advice the Steering Committee on technical matters. The committee will also incorporate one member each from MNRT, VPO-ENVIRO, MoAFSC and COSTECH. From the Norwegian side, members to the Joint Steering Committee shall include one representative from UMB and one representative from the other collaborating institutions in Norway on a rotating basis.

. The Terms of reference for Joint Steering Committee shall be:

- Have oversight and overall ownership of the programme
- Provide guidance and review implementation of the programme
- Review, consider and approve research projects, progress reports, work-plans and budget prior to submission to Annual meetings
- Approve concept notes, research proposals and grant awards to winning proposals
- Discuss and approve proposals for extension of on going or new projects, including capacity building projects
- Approve changes/deviations on approved work-plans and budgets
- Receive, discuss and Approve any appropriate recommendations from the PMT for enhancing performance of the programme

Decisions of the Steering Committee shall be binding unless revoked or amended by the Annual meeting.

## **Programme Management Team**

The PMT will be responsible for technical coordination of the programme. The PMT composition shall be as follows:

- Programme Director who will also be the Director for Research and Postgraduate Studies at SUA who will chair the PMT meetings
- Programme Coordinator will be responsible for technical coordination of the overall programme
- Institutional Programme Co-ordinator (IPC) at UDSM
- Institutional Programme Co-ordinator (IPC) at ARU
- Institutional Programme Co-ordinator (IPC) at TMA
- Institutional Programme Co-ordinator in Norway.

## **Institutional Programme Co-ordinators**

For smooth linking and networking between participating institutions, there shall be designated Institutional Programme Co-ordinators (IPC) for each of the participating institution (in the office of Director responsible for Research), There shall also be one Coordinator at UMB for the collaborating institutions in Norway.

## **Programme Duration and Schedule**

Initially five years duration (July 2009 – June 2014) is being sought. However, considering the long term nature of the challenge at hand, prospects to extend the programme could be examined during the mid-term and end-term reviews. After 24 months, a mid-term review will take place to assess progress and overall performance and make recommendations to be taken into consideration for the subsequent period of 3 years.

## **Programme Implementation, Monitoring and Evaluation**

### **Application Procedures, Reporting Mechanisms and Information Flow**

Research proposals by scientists from collaborating institutions have to be formulated and endorsed by collaborating researchers before they are forwarded through Institutional Programme Co-ordinator (IPC) to the Programme Co-ordinator (PC). To facilitate collaboration with researchers from partner institutions, a list of researchers in various institutions will be prepared and circulated to all potential collaborators and a mechanism to enable researchers interact will be planned at the beginning of the project.

### **Criteria for Selection of Project Proposals**

In order to ensure that research projects are undertaken collaboratively, each project leader must make sure that research members come from at least two of the collaborating Institutions.

### **Call for research proposals**

There shall be three calls for research and strategic interventions concept notes: 2009, 2010 and 2011.

The concept notes will be reviewed based on the following criteria:

Received concept notes will be reviewed based on the following criteria:

- Relevance to goals/themes of the programme with special emphasis to addressing REDD initiatives
- The research must address at least one of the three research focus areas stated in the programme.
- Emphasizing the role of gender in REDD
- Emphasis on multidisciplinary approach with involvement of partners from; institutions, NGOs, institution (s) in Norway, and target communities in REDD pilot areas
- Research issues that should have a priority to capacity building through provision for training PhDs and MSc. degree students
- Research subjects should be innovative leading to technology development relevant to climate change adaptation and mitigation
- Provision for basic research ideas related to Climate Change issues
- Biotechnology applied research leading to conservation of genetic resource threatened by climate change
- At least 50% of the research projects should be related to forestry and forestry related focus areas
- For concept note regarding strategic interventions among other issues, the following will apply:
  - should have technological innovations that turns scientific knowledge into products
  - Should encompass research and innovation, product development and technological diffusion

- Should generate research output with potential commercial values and quantifiable emissions reduction
- Should allow for small and large-scale pilot testing, scale up the production of the product and setting up demonstration plots/pilot plants
- Should promote technology/process generated from high quality and strategic research that have potential reduction of emissions

For concept note regarding strategic interventions among other issues, the following will apply:

- should have technological innovations that turns scientific knowledge into products
- Should encompass research and innovation, product development and technological diffusion
- Should generate research output with potential commercial values and quantifiable emissions reduction
- Should allow for small and large-scale pilot testing and up-scaling
- Should promote technology/process generated from high quality and strategic research that have potential reduction of emissions

Successful concept notes will be invited to develop full research proposals.

## **Review and awarding procedures**

### **a) Research projects**

- Review of concept notes and full proposals will be done by an independent panel of experts including internal ones in the pertinent research theme. Experts from collaborating institutions will be involved, but they will be excluded where there seem to be conflicts of interest,
- The criteria for review will directly reflect the information requested in the guidelines for concept notes and full proposals
- Each participating institution shall be awarded at least one project in their area (s) of competence
- Nominal budget will be awarded to all projects, however increase of the operational budget is possible based on nature of the project, extent to absorb students and publications
- Incentive will be awarded to projects that demonstrate participation in climate change related workshops and conferences (e.g. CoP)
- Cooperation between institutions whereof one from Norway should also be a criteria and bonus should be given to those with an extensive collaboration.

### **b) Strategic interventions**

There will be two types of selections:

- Demand driven application based on REDD demonstration projects
- Solicited proposals to address special needs

Selection of these types of strategic intervention will be based on the following criteria:

- technological innovations that turns scientific knowledge into products
- product development and technological diffusion
- output with potential commercial values and quantifiable emissions reductions
- small and large-scale pilot testing, scale up the production of the product and setting up demonstration plots/pilot plants
- technology/process generated from high quality and strategic research that have potential reduction of emissions
- The other type of strategic intervention will be based on emerging cross-cutting issues related to GHGs emission reductions. The programme coordination will identify actors to address these issues.

### **c) Human resource capacity building activities:**

There will be one call for 17 PhD students in year 2009 and two calls for 25 MSc students each in year 2009 and 2010. The guidelines for dispensing postgraduate students are attached in Appendix 3.

Selection criteria for PhD and MSc students

- Students shall be selected by the coordination with consultation with the approved research projects
- Students will be selected based on the following criteria and as detailed in the score sheet in Appendix 4.
  1. Academic merit
  2. Validity of employment/studentship at participating institutions (SUA, UDSM, ARU and TMA)
  3. Validity of employment with Agricultural Sector Lead Ministries (ASLM) and the Ministry of Natural Resources and Tourism (MNRT)
  4. Relevance of the study focus areas to the goal and purpose of the programme.
  5. Relevance of the proposed activities to the overall goal of the CCIAM Programme
  6. Gender
  7. At least 1/2 of the opportunities will be dedicated to staff of the participating institutions (SUA, UDSM, ARU and TMA)

8. Applicants may be stratified into categories according to disciplines of specialization or institution of affiliation so as to diversify awards and distribute them within and between institutions/disciplines of specialization.
9. Relevance of the selected topic to the targeted research project
10. Originality of thoughts and ability to formulate research proposal
11. Performance during interview
12. Relevance of the Academic Qualifications
13. Research experience for PhD applicants

### **Selection criteria for short courses**

Candidates for training shall be selected by collaborating institutions and relevant national Institutions based on needs. Admission requirement and courses to be offered by each institution shall follow regulations of each institution. To avoid duplication, collaborative course involving partner institution will be priority. The courses to be taken by students shall be identified from collaborating institutions but will have to be channelled through the collaborating Institutional Programme Co-coordinator (IPC) and to the Programme Management Team for endorsement. In case of short training courses, course content and duration shall will be prepared and circulated to all potential collaborating institutions endorsed by the PMT.

### **Monitoring and Evaluation**

The monitoring and evaluation (M&E) shall cover all research and training activities, strategic interventions, funding, financial management and research infrastructure.

The compositions and size of the monitoring and evaluation teams, as well as the durations of the M&E missions will be guided by the Programme Management Team of the programme depending on the nature and size of the projects to be monitored and evaluated. The PMT secretariat shall prepare the standard format for instruments to be used for M&E and shall present the instruments for approval by the Programme Management Team (PMT).

The monitoring and evaluation will be conducted at least once a year, preferably in early June in order to allow planning for items to be incorporated in Steering Committee and Annual Meeting in October. All the institutions involved in Tanzania shall be visited by the M&E teams for the purpose of monitoring and evaluation for duration not exceeding 7 days for each.

The Project Monitoring and Evaluation will generate the following information:

- An overview of research, capacity building and strategic intervention activities
- The project will be steered in the right direction
- A list of problems and possible solutions for each project activity
- A list of new ideas emerging from success or failure of the project or as a result of external factors
- Recommendations to ensure efficiency, effectiveness and impact of project activities
- Conclusions of the review and recommendations for the future
- A follow up schedule for the recommendations

### **Proposed Programme Budget**

The programme is estimated to cost about NOK 93.88 million (NOK ninety four point nine million) over a period of five years as detailed in Appendix 5

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## ACRONYMS

A/R	–	Afforestation and Reforestation
AFOLU	–	Agriculture, Forestry and other Land Use
ARU	–	Ardhi University
ASDP	–	Agricultural Sector Development Programme
ASLM	-	Agricultural Sector Lead Ministries
C	–	Carbon
CBFM	-	Community Based Forestry Management
CBT	–	Capacity Building and Training
CBOs	–	Community Based Organization
CCIAM	–	Climate Change Impacts Adaptations and Mitigation
CDM	–	Clean Development Mechanism
CERs	–	Certified Emission Reductions
CH <sub>4</sub>	–	Methane
CHP	–	Combined Heat-electricity Power generation
CICERO	–	Centre for International Climate and Environmental Research
CO	–	Carbon monoxide
CO <sub>2</sub>	–	Carbon dioxide
CoP	–	Conference of Parties
COSTECH	–	Commission of Science and Technology
DG	–	Director General
DRPGS	–	Director of Research and Postgraduate Studies
FAO	–	Food and Agriculture Organization
GDP	–	Gross Domestic Product
GHGs	–	Green House Gases
GIS	–	Geographical Information Systems
GPA	–	Grade Point Average
IPC	–	Institutional Programme Co-ordinator
IPCC	–	Intergovernmental Panel of Climate Change
LGAs	–	Local Government Authorities
LPG	–	Liquefied Petroleum Gas
LULUCF	–	Land Use, Land Use Change and Forestry
M & E	–	Monitoring and Evaluation
MEVT	–	Ministry of Education and Vocational Training
MNRT	–	Ministry of Natural Resources and Tourism
MoAFS	–	Ministry of Agriculture and Food Security
NAPA	-	National Adaptation Plan of Action
NGOs	–	Non-Governmental Organisations
N <sub>2</sub> O	-	Nitrous oxide
NO <sub>2</sub>	-	Nitrogen dioxide
NOK	–	Norwegian Kroner
NORAGRIC	–	Department of International Environment and Development Studies

NIMP	–	National Irrigation Master Plan
NSGPR	–	National Strategy for Growth and Poverty Reduction
NTFPs	–	Non-Timber Forestry Products
NVH	–	Norwegian College of Veterinary Sciences
OD	–	Outreach and Documentation
PC	–	Programme Co-ordinator
PMT	–	Programme Management Team
R&D	–	Research and Development
REDD	–	Reduced Emissions from Deforestation and Degradation
RNE	–	The Royal Norwegian Embassy
RSI	–	Research and Strategic Intervention
SME	–	Small and Medium Enterprises
SUA	–	Sokoine University of Agriculture
TAFORI	–	Tanzania Forestry Research Institute
TMA	–	Tanzania Meteorological Agency
UDSM	–	University of Dar es Salaam
UMB	–	Norwegian University of Life Sciences
UNFCCC	–	United Nations Framework Convention on Climate Change
UN-REDD	–	United Nations - Reduced Emissions from Deforestation and Degradation
URT	–	United Republic of Tanzania
VC	–	Vice-Chancellor
VPO	–	Vice-President's Office
WWF	–	Worldwide Fund for Nature

## 1.0 INTRODUCTION

The global scientific community is now in agreement that the warming of the climate is 'unequivocal' and that this observed increase is linked to anthropogenic GHG emissions. The impacts on Africa are predicted to have serious consequences. For example, across the African continent temperatures are predicted to rise while precipitation is expected to decrease in northern and southern Africa (IPCC, 2007).

The reality of climate change and its effects is becoming even more apparent as exemplified by more frequent and severe droughts, hurricanes, floods and storms. These changes are increasingly threatening the livelihoods of especially people in the developing world. Tanzania already stressed by other factors, is highly vulnerable to effects of climate change and extreme weather variability, and will need to adapt at various levels in order to cope with the additional challenge of climate change. It is on this background that this proposal framework is being put forward for consideration.

Climate change models suggest that the climate will become more variable. The challenge lies in forging strategies for managing risk, reducing vulnerability and enhancing agricultural productivity, protecting the environment and ensuring sustainable development under a changing climate. The need for the proposed program is derived from the observations that too little adaptation and mitigation work has been done so far to reflect readiness and adequacy in terms of capacity to address the effects or challenges brought about by climate change (URT, 2007).

Apart from the impact of climate change generated by the burning fossil fuels, Tanzania contributes significantly to green house gas emissions through deforestation and forest degradation. However, Tanzania has not been able to participate fully in the existing global mechanisms to reduce GHGs such as the CDM window [afforestation and reforestation (A/R) activities] because of various technical and institutional constraints. These constraints include the complexity of rules and high transaction costs which have been offset by the consultants' research organization and government agencies. Another reason is that the definition of a forest is ambiguous making it difficult to implement CDM in many developed countries. It requires highly degraded land where productivity may not be economically attractive to investors. While deforestation is a serious issue in tropical countries the CDM mechanism excluded "avoided deforestation". By excluding deforestation CDM has excluded the role of local communities who are the main actors in deforestation and need to be motivated to avoid deforesting. Thus, local communities have not benefited from CDM A/R activities partly because of the above reasons. Little carbon value has reached local beneficiaries. The emerging REDD initiatives provides a unique opportunity for Tanzania to participate in the market based carbon trading through avoided deforestation and forest degradation. On the other hand REDD initiatives focus on reducing emissions through avoided deforestation and degradation and target local communities as the main targets and beneficiaries.

This proposal emphasises the need for promoting forestry initiatives aimed at increased carbon sequestration as a mitigation and adaptation mechanism to climate change, and as a way of counteracting deforestation, protecting the environment and meeting the energy needs of the rural and urban communities, through efficient production of fuel wood and bio-fuels. Better management and conservation of natural forests is proposed to be one way of ensuring that local communities benefit by participating in the emerging carbon trading markets including Reduced Deforestation and forest Degradation (REDD). The energy and other wood demands from urban and rural dwellers is a major driving force for the deforestation taking place in Tanzania. Currently there is little possibility for alternative energy sources such as natural gas, LPG, coal and hydro-electricity to cater for energy demand in the country in a near future. Increasing tree cover in agricultural landscapes for example through agroforestry can meet energy demand and it can conserve and sequester high amount of carbon and generate moderate to high income to farmers. This approach can contribute to avoid leakage and complement REDD in pilot areas. The opportunity for carbon sequestration both in larger forests and in smaller forest enclosures, as well fruit trees and multipurpose trees planted for food, fodder, timber, and fuel will be promoted.

In the National REDD Implementation Framework, it is envisaged that pilot REDD projects will be conducted in different ecological zones to capture variations of climate in the country. Key activities will include: creation or collation of land cover maps focussing on the important land covers, collection of spatial carbon stock data of the major land cover types, estimation of deforestation rate for different areas using pre-existing or new analyses on rates of deforestation, estimation of illegal logging rate from a variety of sources, collection of data on forest harvesting and forest harvesting methods, estimation of tree growth rates through establishment of permanent sample plots in different ecological zones, economic analysis to identify where projects would be most cost-effectively implemented and assessment of co-benefits and other environmental services.

Poor agricultural practices including shifting cultivation and extensive pastoralism are also among the major causes of deforestation and hence green house gas emissions. Through the REDD initiative it is envisaged that a landscape approach to capture and store carbon in farmlands and rangelands will be promoted. For example, better management of the agricultural landscape to reduce GHG emissions particularly through soil management to maximise C storage (Lal, 2004; Munishi *et al.*, 2004) and reduce N<sub>2</sub>O and CH<sub>4</sub> should be promoted. Improved land

management will result into better water and plant nutrients utilization for increased crop yield and reduce the need for shifting cultivation. Depending on various scenarios, the possible areas of research for crop improvement and management that can have impact to farming community and forest management, including improvement of soil fertility and minimising GHG emissions from soils. Other research areas include improvement of agronomic practices that increase efficient water utilization, promotion of root crops as staple food crops in the event of scarce rains, and promotion of fruit tree plantations as an additional strategy for carbon sequestration and storage to complement REDD Initiatives.

Climate change threatens both crop and forest tree genetic diversity leading to food insecurity and biodiversity loss in rural communities and hence contributing to forest and land degradation. Conservation of forest and crop genetic diversity can contribute to climate change adaptation and mitigation and constitute an important area for research in the context of REDD. Therefore testing and validation of best forest and land management practices in REDD pilot areas should be emphasised.

One of the major threats to marine ecosystems is the removal of mangroves which expose the coastal areas to erosion and flooding, consequently threatening the marine ecosystem with serious consequences on coastal and marine biodiversity. The impact of climate change will therefore compound these threats. Therefore research and training on the impact of climate change on fresh water and marine ecosystems will enhance better adaptation and mitigation strategies.

Tanzania is the third country in Africa in terms of livestock population. Most of these livestock are kept by pastoralists/agro-pastoralists and are the major contributors of deforestation. Therefore there is a need to address animal husbandry issues within the REDD pilot areas through improved rangeland management to reduce grazing pressures especially in the context of climate change mitigation and adaptation. More research is required to address socio-economic attributes associated with rangeland management in a changing climate.

Agroforestry practices that combine multipurpose plant species can be used in adaptation as they can provide fodder during the dry season, particularly for dairy animals. Multipurpose trees for food, fodder, timber, and fuel can also be used for carbon storage and trading. This example clearly illustrates that Tanzania by adopting more efficient production systems can feed its people using less land and with less emission of greenhouse gasses. However, hard data on the efficiency of various production systems is lacking and need to be developed. On-farm models for comparing potential for carbon sequestration as well as other outputs from various production systems in REDD pilot areas are particularly pertinent.

The contribution of developing countries, including Tanzania, to climate change initiatives is limited by inadequate trained human resources at various levels, climate data and processing equipment. Experiences from the various training institutions indicate that very few institutions provide courses that address climate change issues in various degree programmes. Considerable skills on climate change, vulnerability, adaptation and mitigation is needed within the partner institutions. This programme is expected to address issues of data availability and climate modelling by facilitating human capacity and infrastructure development.

## **1.1 Programme Justification**

The accumulation of green house gases such as carbon dioxide (CO<sub>2</sub>) from different sources in the atmospheres promotes global warming (IPCC, 2007). Land use and land cover change, especially forest deforestation and degradation, contribute about 20 percent of the emissions (*ibid*).

Among the major impacts of climate change in Tanzania is its influence on ecosystem services. Tanzania is endowed with different ecosystems and thus a variety of ecosystem services. While we are aware of the different ecosystem services that are provided by different ecosystems, knowledge on how these services are vulnerable to climate change and to what extent they will be impacted by climate change are not well known. Based on the above situation the proposed programme aims at investigating how the different ecosystems and associated ecosystem services will be impacted by climate change.

The impact of climate change poses serious challenges to sustainable livelihoods and economic development, particularly for least developed countries like Tanzania. The adverse impacts of climate change are already noticeable in many countries including Tanzania. The ramifications of climate change are particularly evident on environment, human health, food security, human settlements, economic activities, natural resources and physical infrastructure. In recognition of these challenges, the Government of the United Republic of Tanzania and the Kingdom of Norway are committed to work together to address the problems. The two governments have therefore agreed to establish a partnership with the purpose of implementing programmes for adaptation to and mitigation of climate change. Bali conference identified four key issues including: adaptation, mitigation, technology transfer and financial mechanisms to support implementation particularly of mitigation and adaptation activities. Specifically, Tanzania and Norway are committed to participate in the development and implementation of the REDD (Reduced

Emissions from Deforestations and forest Degradation) initiatives as proposed in the Bali Conference to combat deforestation and the challenges of climate change.

The history of REDD started at CoP 11 in Montreal, Canada in 2005, and continued at CoP 12 in Nairobi in 2006. During the CoP 13 in Bali in 2007 major advances were made, and there was a clear commitment of Parties to deal with this issue in the context of an overall package for a post-2012 regime. A time span of 2 years was set for negotiations which should culminate in agreement on this post-2012 regime at CoP 15 in Copenhagen (December, 2009). It was also agreed to start demonstration activities to support REDD as a climate mitigation and adaptation measure. The Decision (CoP 2.13) expressly focuses on reduced emissions from deforestation and degradation. Other possible options mentioned are 'sustainable forest management', 'forest enhancement' and 'conservation'. However, various issues for REDD readiness including methodologies for baseline determination, monitoring, assessment, reporting, and verification, benefit sharing mechanism are yet to be addressed. Other issues include enhancement of capacity building to address climate change research, dissemination and strategic interventions relevant to REDD.

The Royal Norwegian Government committed to support the participation of Tanzania in the development and implementation of programmes to address challenges of climate change with a purpose of increasing the participation of Tanzania and other developing countries in the mitigation of and adaptation to the effects of climate change. The emphasis is to enhance Carbon (C) sequestration and storage through sustainable forest management and conservation of existing C stocks (e.g. through reduced deforestation, de-vegetation and degradation). This approach will improve livelihoods of people and ensure better adaptation to the impacts of climate change. In response to the initiative, Sokoine University of Agriculture and collaborating institutions; the University of Dar es Salaam, Ardhi University and Tanzania Meteorological Agency, and Norwegian University of Life Sciences (UMB) are submitting this proposal requesting the Royal Kingdom of Norway to support Tanzania build up institutional capacities and knowledge base for appropriate responses to the challenges and opportunities brought about by climate change. Of particular relevance is the focus on enhancement of a much greener environment by promoting natural forest conservation, afforestation, reforestation and better agricultural practices for improved livelihoods as espoused in the "Reduced Emissions from Deforestations and Forest Degradation (REDD)" initiative. Recognizing that this is a challenge demanding participation across diverse disciplines and sectors, the programme will involve collaboration of relevant institutions in Tanzania and Norway which will adopt a multi-stakeholder approach to its implementation.

Developing, optimizing and sustaining readiness and adequacy in capacity to address the challenges brought by climate change will require a number of interventions through raising awareness, training to build capacity at various levels, research and outreach. This programme therefore will provide support in terms of documenting and disseminating research backed experiences generated from REDD demonstration activities. The proposed programme is online with the supporting role of research institutions in Tanzania to the development and implementation of REDD policy as stipulated in the UN-REDD and National REDD Implementation Frameworks. It is in the realization of both the essence and the urgency to adapt to and mitigate climate change that this proposal is being put forward for consideration.

This proposal emphasises the need for promoting forestry through REDD initiatives aimed at increased C sequestration as a mitigation and adaptation mechanism to climate change, and as a way of counteracting deforestation, protecting the environment and meeting the energy needs of the rural and urban communities, through efficient production of fuel wood and bio fuels. The opportunity for carbon sequestration both in larger forests and in smaller forest enclosures, plantations of fruit trees and multipurpose trees planted for food, fodder, timber, and fuel will be promoted to avoid leakage under REDD schemes.

Better management and conservation of natural forests and small-holder forestry practices will be studied as among the major ways of ensuring that local communities benefit by participating in the emerging C trading markets for Reduced Emission from Deforestation and forest Degradation (REDD). Factors contributing to the failure of the forest sector in Tanzania not to benefit from Clean Development Mechanism (CDM) afforestation/reforestation scheme as elucidated under Kyoto Protocol, will be investigated with the aim of aligning Tanzania forestry projects in a better position to benefit from the post-Kyoto arrangements.

The REDD initiative is envisaged to develop and promote mechanisms of payment for ecosystem services. So far, forest ecosystems are known to be a good repository of biodiversity and also contribute significantly to livelihoods of adjacent communities but taken for granted. Under climate change scenarios it is believed that forest ecosystems will be impacted differently and thus the impact will affect differently the existing biodiversity in forest ecosystems and community livelihoods. Until today it is not well known as to how climate change will affect forest biodiversity. It is also not well known how the forest biodiversity will respond to the different scenarios of climate change in Tanzania. Unless the impact and response of forest ecosystems to climate change are known, mitigation and adaptation measures will be difficult to develop. Under the proposed programme pertinent investigations will be undertaken to determine how climate change will influence forest biodiversity and related livelihoods under REDD pilot areas.

Currently, women are poorly represented in training, research and decision making organs in the country particularly in the fields of agriculture and life sciences. This programme will make deliberate attempts to ensure active participation of women and other vulnerable groups in the project activities. Other issues the programme needs to address will include: the role of women in land and tree tenure, gender sensitive benefit sharing mechanism for values of ecosystem services. The contribution of women in deforestation and forest conservation is poorly studied. Moreover, the role of gender in small and medium scale enterprises (SME) related to natural resource management need to be promoted with the overall intention of facilitating the attainment of REDD policy initiatives.

One of the major causes of deforestation and forest degradation in tropical countries including Tanzania is poor agricultural practices. These leads to poor crop production, shifting cultivation, land degradation, as a result farming communities clear forests to establish new farms. In order for the REDD initiative to succeed adjacent communities need to be empowered through tangible incentives including those emanated from forest conservation initiatives. These incentives can also be used to encourage farming communities to adopt better farming practices and less destructive land use practices. The intention of this program is to investigate the viability of better farming practices that promote the achievement of REDD policy objectives for adaptation and mitigation to climate change.

Extensive pastoralism is also responsible for deforestation and land degradation. Under REDD initiatives, better animal husbandry practices need to be integrated in the land-use plans for better adaptation to and mitigation of climate change. Proper balances for cultural values and carrying capacity need to be addressed for purpose of sustaining the gains from REDD. In this programme, the link between deforestation and pastoralism will be investigated for better animal husbandry that ensures increased productivity and reduced emissions.

The government of the United Republic of Tanzania considers the REDD policy a viable option that can provide opportunities for the country to meet its obligations of managing her forests and woodlands on a sustainable basis and at the same time respond to poverty reduction initiatives accordingly. In this respect the government is envisaging to participate in the future REDD policy and in its development. However, it is still not very clear to what extent policies and legislations do comply to climate changes issues. There is therefore a need to undertake a policy and legal framework analysis of climate change adaptation and mitigation in order to ensure political legitimacy of REDD issues. This will also ensure, among other things, effective benefit sharing mechanism and financial flow among various stakeholders.

Adaptation to climate change requires focused and sustained long-term series of actions with cumulative impacts over time through building institutional capacities in training, research and development (R&D). The emphasis of the proposed programme will be on better management of forest and other land resources for REDD readiness. The programme will also address socio-economic and gender aspects related to climate change such as livelihoods of various communities, vulnerability and adaptation options. This programme focuses on developing and undertaking training and education programmes contributing to scientific knowledge on climate change with particular emphasis to the REDD initiatives. The programme will also contribute to capacity building among other REDD actors at all levels and opportunities will be availed to all Tanzanians. The proposing institutions have the capacity and expertise to adequately undertake the projects. It is expected that by the end of the programme, a comprehensive research and methodology development programme for climate change adaptation and mitigation will have been completed and enable Tanzania to implement the post-2012 climate mitigation and adaptation regimes. It is for this reason that this proposal is tabled for funding.

The programme will target the following key beneficiaries; REDD policy negotiators at both national and international levels, policy makers, future REDD implementers (central government, local government, communities, NGOs and CBOs, private sectors, etc), research and academic institutions

## **1.2 Objectives of the Proposed Programme**

### **Main objective**

To develop and sustain adequacy in national capacity to participate in climate change initiatives and address the effects and challenges of climate change with particular emphasis to the REDD initiatives.

### **Specific objectives**

This programme will address the following specific objectives:

1. To determine and develop appropriate climate change mitigation and adaptation strategies in forestry, other land uses, ecosystems and biodiversity management.
2. To assess climate change impacts and vulnerability on ecosystem services and livelihoods under REDD initiatives.

3. To conduct policy analysis of climate adaptation and mitigation with emphasis on economic efficiency, ecological effectiveness and wider political legitimacy.
4. To develop and undertake capacity building, dissemination and strategic interventions for adaptation and mitigation to climate change.



## **2.0 SUBJECT MATTER REVIEW**

### **2.1 Global and Regional Perspectives on Climate Change**

One of the emerging challenges of the 21<sup>st</sup> century is the intensification of climate change. Climate change is defined as “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (UNFCCC, 1994). According to IPCC (2007), climate change refers to any change in climate over time, due to natural variability or as a result of human activity. Although often equated to global warming, global climate change involves more serious disruptions of the entire world's weather and climate patterns, including impacts on rainfall, extreme weather events, and sea level rise, and not just modest temperature increases (DEAT, 2004; NME, 2005). Thus, increased global warming is just one of the manifestations of climate change.

The main causes of global warming is increased greenhouse gas emissions resulting from the burning of fossil fuels, emissions from manufacturing industries and vehicles, and reduction of C sinks, e.g. by deforestation and continuous cultivation. Except for deforestation which accounts for 20% of the global green house gases (GHGs) emission, the contribution of least developed countries to emissions is small, largely because use of fossil fuels (oil and coal) is still small. Yet both immediate and long-term consequences of global warming are expected to be most severe in these countries.

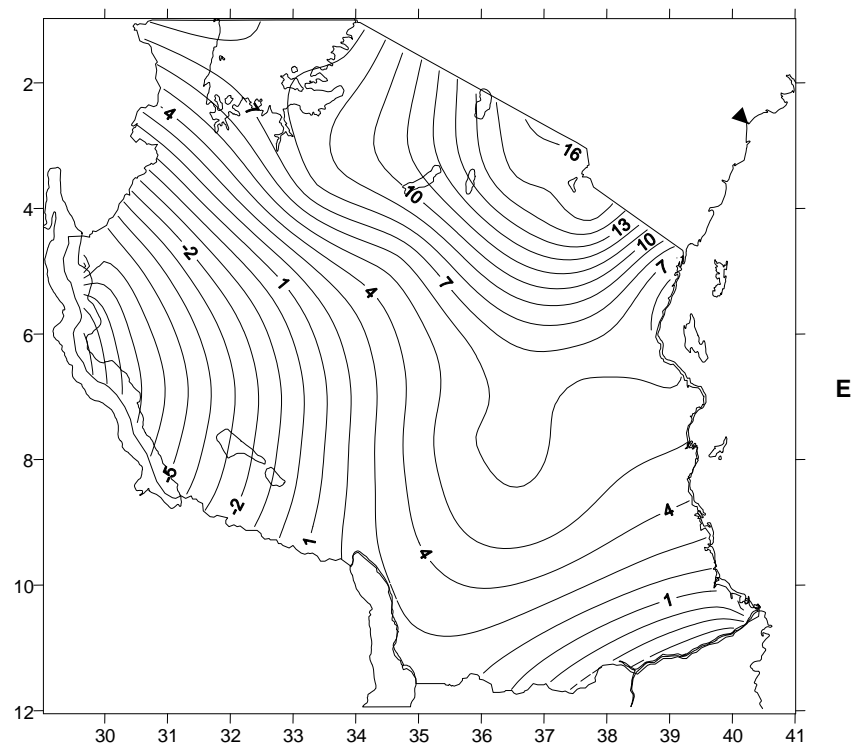
According to Gomme and Petrassi (1996), rainfall patterns in Sub-Saharan countries since 1960 suggest that rainfall is fluctuating with some groups of good and bad years. Generally the period 1960-1993 experienced widely different conditions from year to year. The years from 1960 to 1969 were among the wettest of the period, while the seventies and eighties mostly recorded lower rainfall. The years 1973, 1984 and 1992 were bad, while 1963, and to a lesser extent 1989, were remarkable years in that almost the whole continent experienced above average conditions. The year 1973 is interesting in that it constituted the first poor year after a run of good years. As such, it caught most countries unprepared. In contrast, the impact of 1984, which was more severe than 1973 in climatological terms, was relatively less serious as the economies of many countries (especially in the Sahel) had learnt by then how to cope with such extreme situations. In 1973, and to a less extent in 1984, almost all African countries suffered, north and south alike. In contrast, the 1992 southern African drought was relatively limited in space since the region had one of its good “after 1988” years (with average or above average conditions). Records also show that across Africa the temperature trend is of increasing warming with an average increase of 0.07°C and decadal range of 0.02°C to 0.05°C over most of the continent during the 20<sup>th</sup> Century. It is further reported that the observed rate of warming was about 0.05°C per decade, and the five warmest years in the continent all occurred since 1988, with 1995 and 1998 being the two warmest years.

## 2.2 Tanzanian Context on Climate Change

### 2.2.1 Rainfall trends

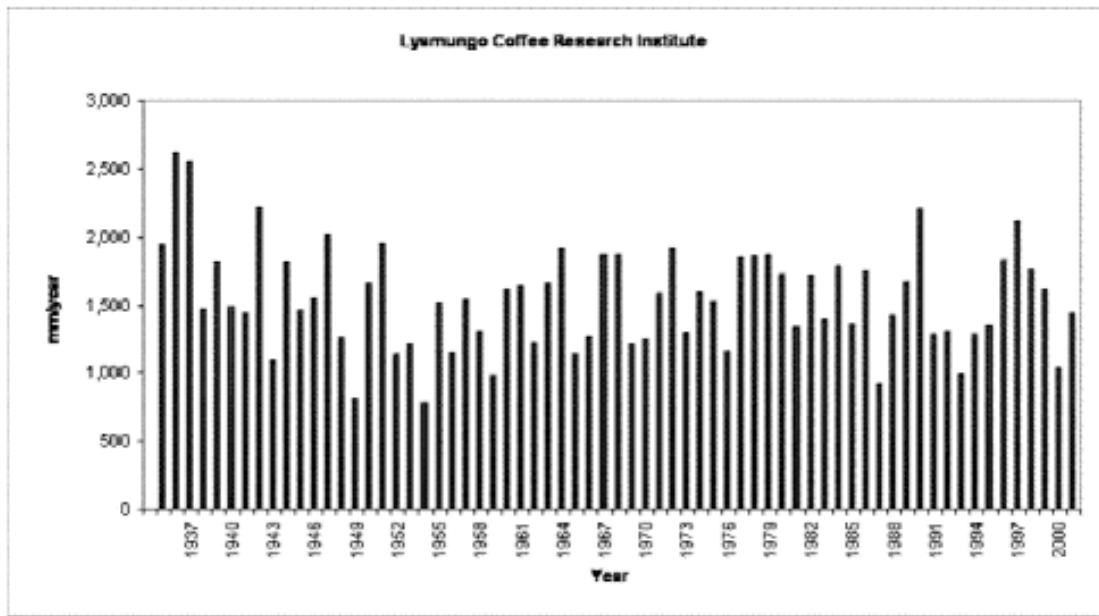
Tanzania is not homogeneous from a climatic point of view. Some areas have bi-modal rains i.e. have two distinct rainfall seasons comprised of the long rains (“Masika”) between March-May and short rains (“Vuli”) between October-December. This pattern of rainfall is typical of north-eastern, north-western (Lake Victoria basin) and the northern parts of the coastal belt. Elsewhere in the country, especially in the southern, central, western, and south-eastern parts rainfall is mainly unimodal, starting from mid-November and running until mid-April. In addition, Tanzania has high elevation climates and, considering the whole country, crop planting and harvesting takes place throughout the year.

According to Mwandosya *et al.* (1998) and URT (2003), there will be increased rainfall in some parts of Tanzania while other parts will experience decreased rainfall (Figure 1). The areas with two rainfall seasons, i.e. the north-eastern, the north-western, the Lake Victoria basin and the northern parts of the coastal belt would experience increase in rainfall for both seasons ranging from 4 percent to 15 percent (Hyera, 2006). The other areas receiving uni-modal rainfall pattern, i.e. the south-western and western parts of the country will experience a decrease in annual rainfall by a range of between 1 percent and 10 percent. These precipitation predictions do offer greater regional specificity, however, the results should be interpreted with caution as they do not include an uncertainty analysis and rely on one or two older climate models (Agrawala *et al.*, 2003). There is an increasing frequency of erratic rainfall pattern throughout the country. For example, in the past decade, Tukuyu (southern highlands of Tanzania) had been receiving rainfall for almost 11 months, except October, but now the rain season had become shorter.



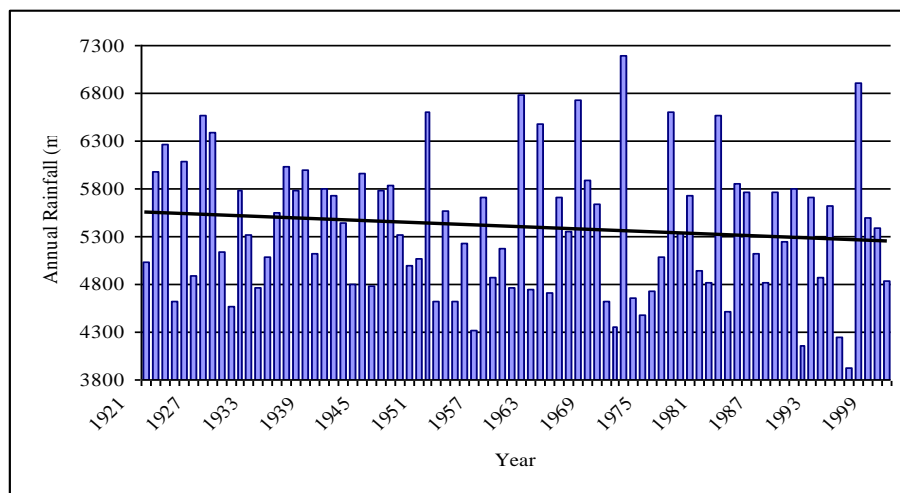
**Figure 1:** Change in mean annual rainfall (%) due to doubling of CO<sub>2</sub> concentration (Source: TMA 2007)

An analysis of proxy data by Agrawala *et al.* (2003) reveals that annual precipitation on Mount Kilimanjaro decreased by 150 mm; this means a lapse rate of 7.5 mm/year between about 1880 and 1900. Annualized rainfall values from Lyamungu Research Institute since 1935 show a decreasing trend (Figure 2).

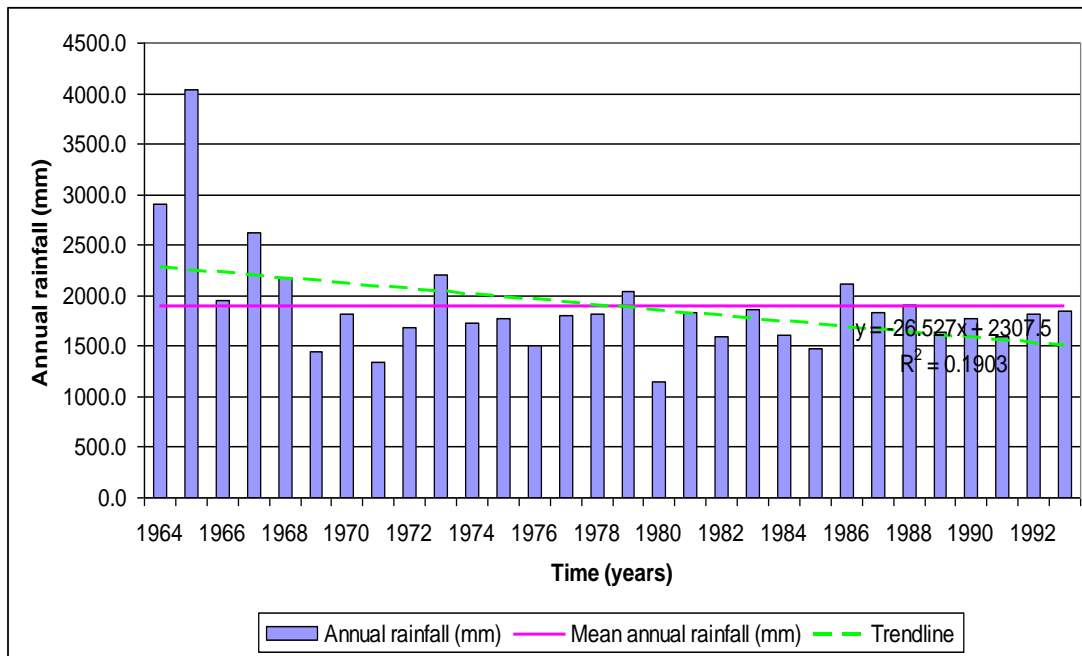


**Figure 2:** Annual precipitation at the Lyamungo Coffee Research Institute, Kilimanjaro, Tanzania (1935-2001). Source: Agrawala *et al.* (2003)

Similarly, there has been a predominant decreasing trend in rainfall in the East Usambara mountains for the period 1921 – 2000 (Figure 3) and the Uluguru mountains for the period 1933 – 2002 (Figure 4) (Yanda and Munishi, 2007).

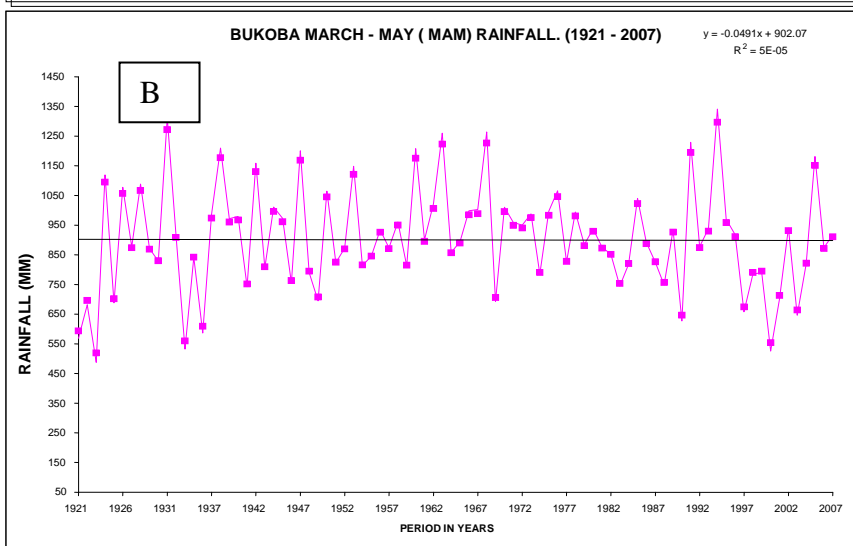
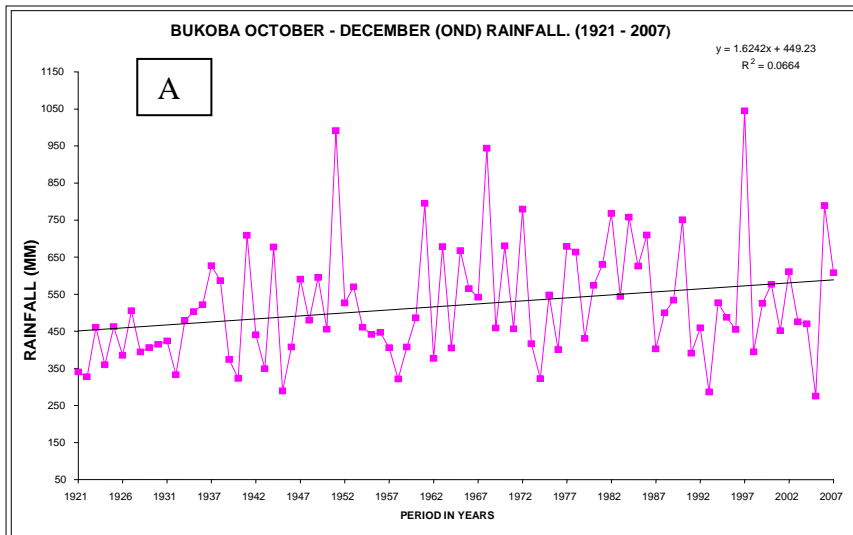


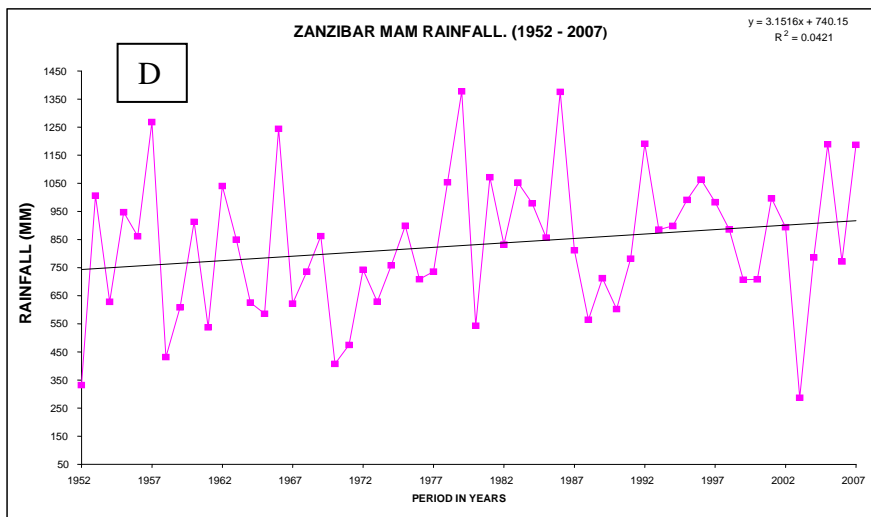
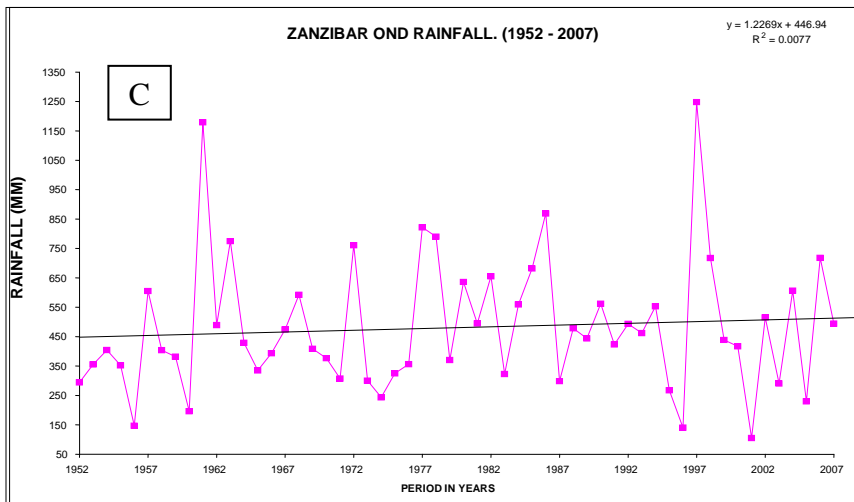
**Figure 3:** Trends in the mean annual rainfall at Amani – Sigi River watershed, East Usambara Mountains, 1921 – 2000.

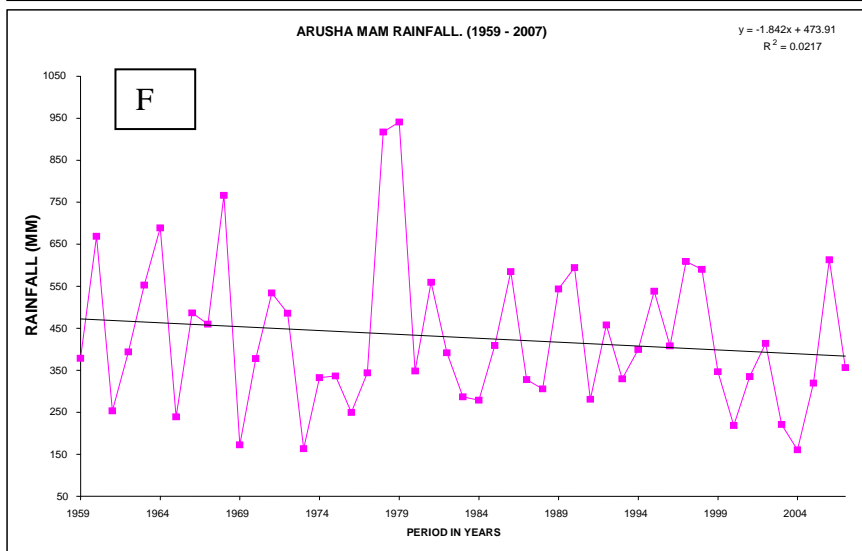
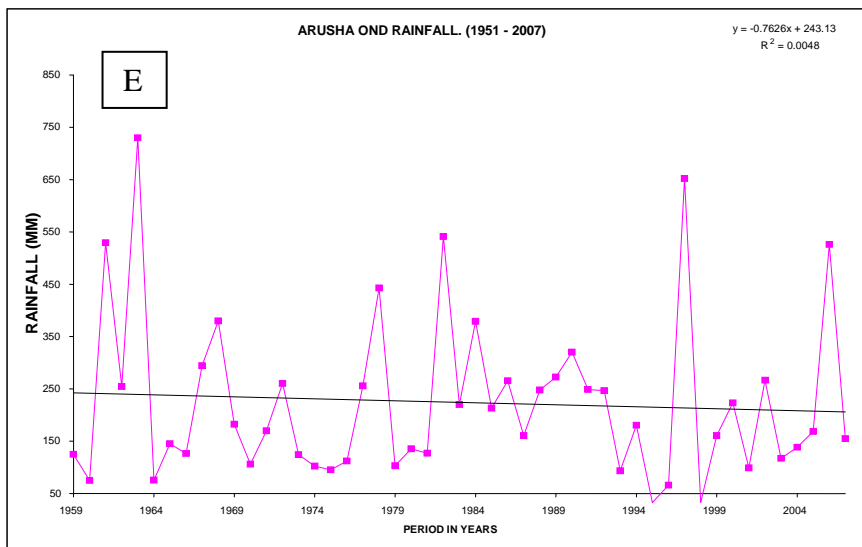


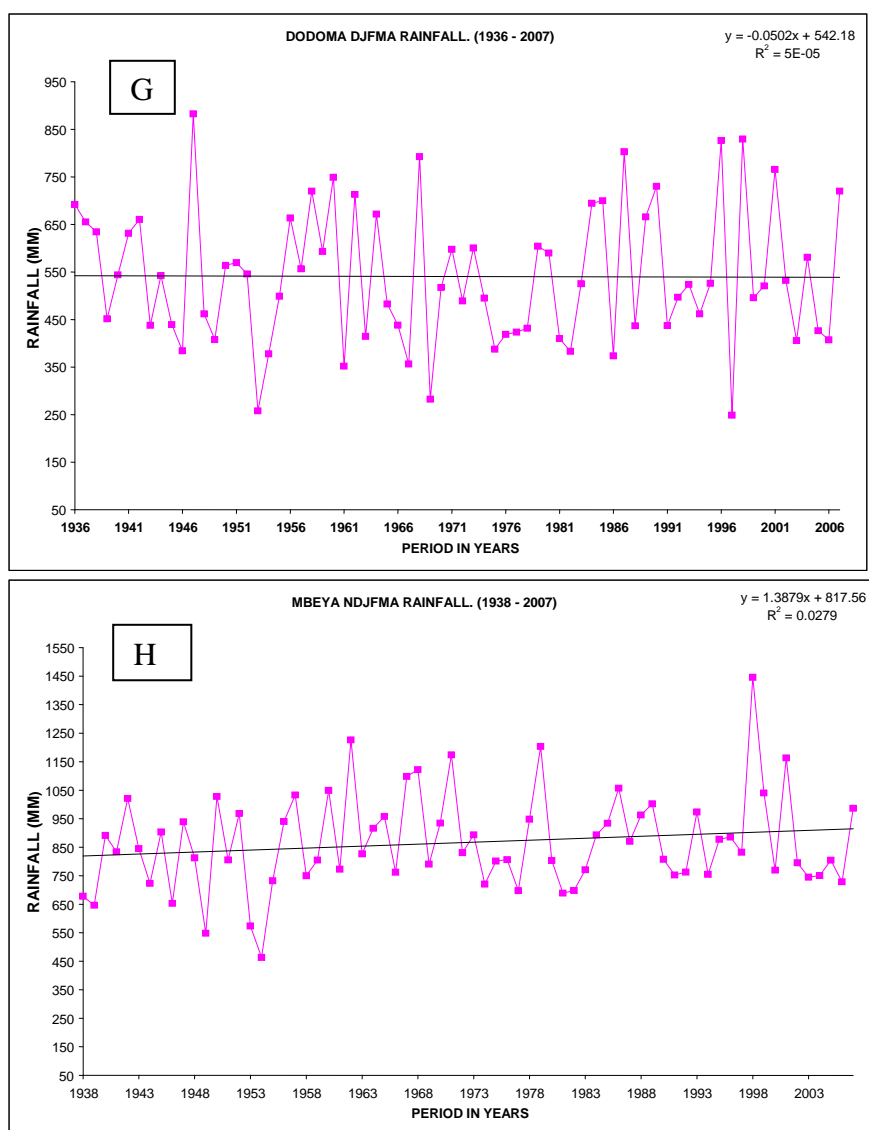
**Figure 4:** Time series and trend line of annual rainfall at Matombo Primary School in the Ruvu River basin in the Uluguru Mountains, (1933 – 2002).

Preliminary study of rainfall data from specific stations in Tanzania shows a great variability in trend. The Lake Victoria zone as represented by Bukoba shows increasing rainfall trends in both long and short rain seasons (Figure 5 a & b). On the other hand, rainfalls for Zanzibar (Figure 5 c & d) show a slight increasing trend during October to December (short rain season) and significant increase during March to May (long rains). The central regions of Tanzania as represented by Dodoma (Figure 5 g & h) does not show any change in rainfall while the southern zone represented by Mbeya shows increasing rainfall trends. The northern zone of the country as represented by Arusha shows decreasing trends for both seasons (Figure 5 e & f). These few examples show the variability in weather patterns as influenced by climate variability which may not justify the same adaptation and mitigation measures. This may therefore call for specific adaptation and mitigation measures in different areas depending on the observed variability









**Figure 5:** Rainfall variability in various zones of Tanzania (1920 – 2004)

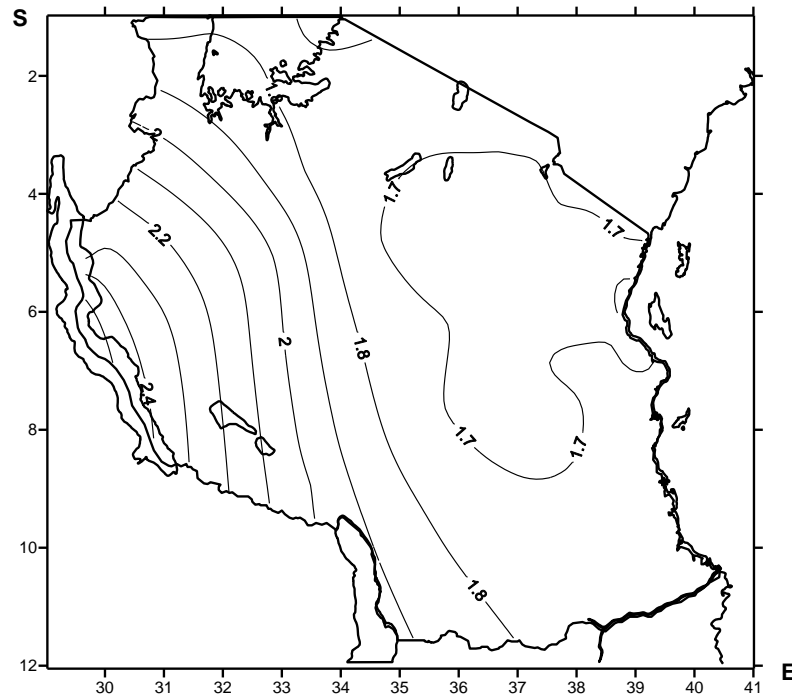
### 2.2.2 Temperature trends

There is a noticeable rise in temperature in Tanzania as noticed by Agrawala *et al.* (2003) in Kilimanjaro region. Observations from neighbouring Amboseli to the north of the Kilimanjaro Mountain indicate a local warming rate of 0.275 °C per decade between 1976 and 2000, significantly higher than global averaged warming.

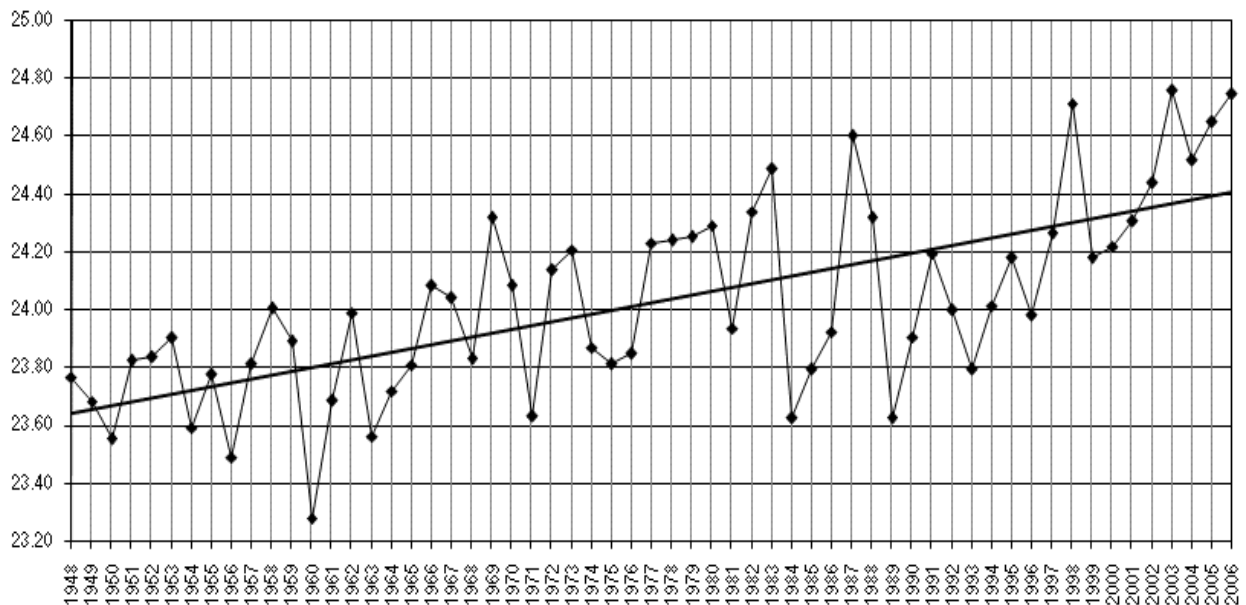
According to Mwandosya *et al.* (1998) and URT (2003), the mean daily temperatures in Tanzania will rise by 3.5°C throughout the country. The increase in temperature will be more during the cool months of June, July and August than during the warm months of December, January and February. The difference between the two periods was predicted to be about 1°C on average. The increase in annual temperature over the whole country is predicted to be between 2.5°C to 3.0°C in the warmest months of December and February and between 3.0°C to 3.9°C in the coolest months of June to August.

A preliminary study of temperature from some stations in Tanzania representing different zones show predominantly increasing annual temperatures suggesting that temperature is bound to increase throughout the country (Figure 6 & 7). Such temperature trends coupled with variations in rainfall are likely to be forceful in designing mitigation and adaptation measures as they will have different impacts on different ecosystems and production





**Figure 6:** Mean temperature change due to doubling of CO<sub>2</sub> concentration by 2100 (Source: TMA 2007).



**Figure 7:** Mean annual surface air temperature variability for the area between 0.0 to 12.5 S and 35.0 to 40.0 E from 1948 to 2006: (Source: NCEP/NCAR Reanalysis)

These changes are therefore expected to vary across the country but will mostly have negative impacts on agriculture and food security, livestock production and health, water resources, energy, human health, forest ecosystems and biodiversity, wetlands integrity, marine coastal ecosystems, and above all the attainment of the millennium development goals. The impact of climate change and climate variability in Tanzania is therefore increasingly threatening the livelihoods of especially rural population with low income, food insecurity, inadequate health services, unstable energy supplies, and fragile natural ecosystems. As such the government has identified agriculture, water, energy, health and forestry as the most vulnerable sectors of the economy under climate change impacts (URT, 2007).

### 2.3 REDD Initiative and climate change

Tanzania has a total of 35.3 million ha of forestland<sup>1</sup> out of which 16 million ha comprise of reserved forests, 2 million ha are forests in national parks and the rest, 17.3 million ha (49% of all forestland), are unprotected forests in General Land<sup>2</sup>. Forests in General Land are 'open access', characterized by insecure land tenure, shifting cultivation, annual wild fires, harvesting of wood fuel, poles and timber, and heavy pressure for conversion to other competing land uses, such as agriculture, livestock grazing, settlements and industrial development.

The rate of deforestation in Tanzania, which is estimated at 412,000 ha per annum (FAO, 2006) is taking place mostly in the general land forests. Efforts towards forest reservation aim at reversing this trend. However, assessments of different forests conditions have revealed a lot of human disturbances also inside forest reserves. Therefore, it is not only forests in General Land that are diminishing but also the condition of reserved forests is deteriorating. Among other things, this is due to limited human and financial resources for the management of the forests.

Investment in some tropical forestry is possible for example through CDM, which enables the investors to invest in projects in developing countries and to use them to offset their reduction commitments. The CDM essentially provides a market mechanism for the sale of carbon credits or CERs, from developing countries. Unfortunately during the first commitment period (2008-2012), CDM project activities are only limited to *afforestation* and *reforestation*. Improved forest management and avoided deforestation are therefore not eligible under current CDM. Reduced deforestation and forest degradation could play a significant role in climate change mitigation and adaptation, and may generate a new financial stream for sustainable forest management and livelihoods enhancement in developing countries. This has prompted re-negotiation of climate change policy for the post-2012 period to include Reduced Emissions from Deforestation and forest Degradation (REDD).

REDD policy negotiations started at eleventh Conference of Parties (CoP 11) in Montreal, Canada in 2005, and continued at CoP 12 in Nairobi in 2006. The discussion continued at CoP 14 in Poznan, Poland in December 2008. The negotiations are envisaged to culminate in agreement on this post-2012 regime at CoP 15 in Copenhagen (December, 2009). During the CoP 13 in Bali in 2007 major advances were made, and there was a clear commitment of Parties to deal with this issue in the context of an overall package for a post-2012 regime. The Decision at CoP13 in Bali expressly focuses on reduced emissions from deforestation and degradation. Other possible options mentioned are 'sustainable forest management', 'forest enhancement' and 'conservation'. The Decision also explicitly recognizes that the needs of local and indigenous communities should be addressed when action is taken to reduce emissions from deforestation and degradation. It was also agreed to start demonstration activities to support REDD as a climate mitigation measure.

The REDD initiative is currently under discussion by Parties to the UNFCCC regarding crediting or rewarding reductions in carbon emission by reducing rates of deforestation and forest degradation. Under REDD initiatives, developing countries would, on a voluntary basis, aim to reduce the rate at which their forests are being lost, and receive compensation in proportion to the carbon emissions saved compared to a baseline which would represent the 'without intervention' case or some other agreed target. However, technical issues with respect to baseline determination for crediting REDD requires further study. Issues that need research attention include: developing methodologies for reference scenarios/baseline of deforestation and forest degradation; legal institutional arrangements and no equitable paying mechanism; ownership of carbon rights; social and environmental impacts; monitoring reporting and verification systems. Other outstanding issues that need to be addressed for the REDD initiative to succeed include: analysis and interpretation of opportunity costs/tradeoff analysis of all stakeholders; risk assessment; potential additional benefits of REDD on livelihoods and biodiversity. In addition, the impact of implementation of large-scale REDDS on food and prices are not known. Also issues of conflicts corruption, accountability and transparency under REDD need to be addressed. The markets for REDD need to be identified. The level of investment and capacity building necessary to implement REDD need to be taken into account.

The government of the United Republic of Tanzania is developing a framework to assist the formulation of National REDD strategy. It is envisaged that this will enable the country to participate in the future REDD policy and provide opportunities for the country to meet its obligations of managing forests and woodlands on a sustainable basis, and at the same time respond to poverty reduction initiatives.

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<sup>1</sup> "Forestland" means an area of land covered with trees, grass and other vegetation but dominated by trees.

<sup>2</sup> General Land as used here means all public land which is not reserved or village land including unoccupied or unused village land.

## 2.4 Trends and Projections on Impacts of Climate Change

### 2.4.1 Climate change impacts on forest ecosystems and biodiversity

Tanzania enjoys one of the highest forest cover in Eastern and Southern Africa, and forest and woodlands were reported to cover 38.8 million ha in 2002 (FAO 2003). However, the country is threatened by increasing deforestation (FAO 2006). The causes of deforestation include clearing for agriculture and settlements, overgrazing, wild fires, charcoal burning and uncontrolled commercial logging. Removal of forest cover contributes to increased concentration of GHGs in the atmosphere, especially CO<sub>2</sub>, CO, NO<sub>x</sub>, CH<sub>4</sub> and aerosols. More significantly, it reduces the large CO<sub>2</sub> sink as subsequent land uses usually store less C and for a shorter period. Moreover, since some forest areas are important water catchments supplying water to different regions, the loss of forest cover, as illustrated by deforestation of mountain forest ecosystems such as Kilimanjaro and West Usambara catchment forests have reduced water supply. Also most of the important wetlands including several Ramsar sites, depend on sustained supply of water from upland forests. Natural forests are also rich depositories of biodiversity of flora (Munishi *et al.*, 2004) and fauna, including both rare and endemic species. Importantly as well, the forests are major sources of wood and non-wood products (e.g. medicinal plants). Deforestation sacrifices these vital services and production functions.

Whereas, increase in temperature and rainfall are likely to improve conditions for forest growth through natural regeneration or reforestation in the areas with a bimodal rainfall pattern, further degradation is expected in the areas with unimodal rainfall pattern.

Another important threat to forests as the climate get hotter and drier is the increasing frequency and intensity of forest fires (Maliendo *et al.*, 2000). Mount Kilimanjaro, the Eastern Arc Mountains and Coastal forests are increasingly being deforested and degraded by fires, with consequent change in vegetation composition. Reasons for these increasing incidences of fire are largely human, but the effects are further compounded by climate change including frequent and severe droughts.

Whereas climate change and variability are expected to decrease wild and cultivated plant biodiversity and productivity, but the magnitude of effects on individual species is difficult to predict with the existing limited knowledge on physiological response of these plants. Predicted decreases are expected to be largely attributed to increasing temperature and frequent droughts. Climate is recognized for the significant role it plays in the global distribution of plants and species diversity. Climate is one of many hypothesized drivers of high tropical diversity (Pennington *et al.*, 2004; Wilf *et al.*, 2005); with temperature and precipitation long recognized for the role they play in defining biomass and influencing global gradients of species richness (Holdridge, 1947; Walter, 1985; Woodward, 1987; Walter and Breckle, 2002). The quantity and seasonality of precipitation clearly distinguishes a desert from a rain forest, and the range and seasonality of temperature distinguishes a temperate rain forest from a tropical one, and climate change could invoke similar shifts depending on the direction and severity of change. However, understanding the influence of climate in shaping the biogeographical distribution of forests at a more local scale is important in understanding possible influence of future climate change on forest biodiversity in Tanzania. This understanding has become increasingly important as ecologists attempt to quantify the effect that future climate change may have on threatened tropical ecosystems (Phillips, 1997; Lewis *et al.*, 2004; Miles *et al.*, 2004).

In Tanzania the impact of climate change on forest ecosystems and biodiversity is expected to vary depending on vegetation type. Overall, Tanzania's NAPA (URT, 2007) forecasts change to drier forests/ecosystems as a result of climate change, but the impacts of change in areas where rainfall is predicted to decrease is less clear. It has been predicted that sub-tropical dry forest and subtropical moist forest life zone will change to tropical very dry forest, tropical dry forest and tropical moist forest; subtropical thorn woodland will be completely replaced or will disappear. Such changes will have far reaching impacts on forest biodiversity and related livelihoods. Species that are expected to be more vulnerable are those with limited geographical range and drought/heat intolerant; low germination rates; low survival rate of seedlings; and limited seed dispersal/migration capabilities. These possible changes in vegetation due to climate variability will however be confounded with anthropogenic pressures on the bio physical systems, including increased land degradation.

Degraded areas due to climate and non-climate factors will also require replanting or restoration. Restoration of forests can assist in meeting the demand for timber and wood fibre, purify water, regulate climate, and yield genetic resources and natural products. River systems depend on well functioning catchment forests to provide freshwater, power, and recreation opportunities. Coastal and inland wetlands function as filters of water pollution, flood mitigation, and act a reservoirs biodiversity, including wildlife. Conservation and restoration of degraded natural forests to increase species diversity will have to take these other important functions, and how they might be affected by climate variability, into account. It is particularly noteworthy that these activities related to establishment of plantations and restoration of degraded natural vegetation offer an opportunity for funding

through CDM or other carbon market mechanisms (Walker *et al.*, 2008). The REDD initiative is currently under discussion as a more attractive option to address issues of deforestation.

Climate change and variability through higher temperature and rainfall changes are likely to impact other livelihoods dependent on forests such as beekeeping, mushroom collection, and fodder collection. Beekeeping, a major livelihood activity in Miombo woodlands is expected to be most vulnerable to climate change, further compounded by increasing fire frequency and intensity. However, not much is known on the extent of vulnerability on various forest related livelihoods.

#### **2.4.2 Climate change impact on ecosystem services**

Ecosystems provide numerous benefits such as forest products, carbon sink, flood mitigation, and nurseries for commercial fisheries. However, human activities are rapidly degrading these and other ecosystems. The Millennium Ecosystem Assessment, the largest audit ever conducted of the condition and trends in the world's ecosystems, found that ecosystems have declined more rapidly and extensively over the past 50 years than at any other comparable time in human history (MEA, 2005). In fact, 15 of the 24 ecosystem services evaluated have degraded over the past half century. The Assessment projected further declines over the coming decades, particularly in light of population growth, economic expansion, and global climate change. If left unchecked, this degradation could jeopardize future economic well-being, creating new winners and losers within the business community. Climate change will aggravate ecosystem degradation further, jeopardising provision of these vital services.

Tanzania is endowed with different ecosystems and a variety of ecosystem services which are predicted to be impacted by climate change. While we are aware of the different ecosystem services that are provided by different ecosystems in Tanzania, knowledge on how these services are vulnerable to climate change and to what extent they will be impacted by climate change are not well known. Through this program investigations on how the different ecosystem services will be impacted by climate change and adaptations thereof will be developed.

Ecosystem degradation is highly relevant to business and society wellbeing because companies and societies not only impact ecosystems and the services they provide but also depend on them. Ecosystem degradation, therefore, can pose a number of risks to corporate and societal performance as well as create new business opportunities.

#### **2.4.3 Climate change impacts on agriculture and food security**

The agricultural sector in Tanzania is central to sustainable development as it is the mainstay of over 75% of the population, accounts for 45% of the GDP and is vital for ensuring food security and alleviating rural poverty (Mngodo, 2008). Tanzania has about 88.6 million hectares suitable for agricultural production, including 60 million hectares of rangeland suitable for livestock grazing, production of bio-fuels or carbon sequestration. The country has been subdivided into 7 agro-ecological zones, based on altitude, precipitation, pattern, dependable growing season, and average water holding capacity of the soils and physiographic features. These form one of the bases for agricultural production planning. Assessing vulnerability of agricultural production to climate change and planning adaptation interventions will have to take account of changes likely to occur within each zone. Impacts caused by climate change will aggravate changes caused by other factors such as soil degradation due to poor land use practices and air pollution including impacts of elevated ozone levels in rural areas.

Under increasing temperature scenarios, it is anticipated that a decrease in amounts of rainfall, increased evapotranspiration and seasonal unpredictability will have serious consequences on crop yields, shifts in agro-biodiversity, increased outbreaks of pest and diseases, reduced germplasm diversity as well as expansion of livestock keeping into farmland as the area under range-land shrinks.

Since agriculture in Tanzania is predominantly rain-fed farming, it is anticipated that where the frequency and intensity of droughts and water scarcity are predicted, this will affect agricultural production, severely reducing the supply of different crops. In addition, if drier conditions occur in areas which now support more water-demanding crops like maize, vegetables, banana and rice will become more marginalized, and replaced by more drought tolerant but less preferred crops like sorghum and millet. As maize is the main staple food crop in the country, and the excess supply is exported to neighbouring countries earning foreign exchange, its falling supply will trigger food insecurity, reduced incomes, and increasing poverty. A decrease in agro-diversity compounded by climate change will have severe consequences on food security as it is an important insurance in events of drought and pest attacks.

If climate change results in increased water scarcity, and reduced river flow and water storage, this will seriously affect crop production of irrigated crops including sugar cane and rice. Therefore a decrease in rainfall, and hence less water available for irrigation, may have far reaching implications on food security, employment, income and balance of trade.

Tanzania's National Adaptation Programme of Action (URT, 2007) cites reports that with increase in temperature and reduced rainfall and change in rainfall patterns, maize yield in Tanzania will decrease by 33%, but regionally the decrease will vary from 10 to 13% in the Southern highlands, and to 84% in central regions. On the other hand, temperature increases of 2 to 4°C are projected to increase cotton production by 16% in unimodal areas and by 18% in the bimodal areas. Increasing competition for agricultural land from livestock grazing pressure is also predicted if traditional rangelands face drier conditions and increase in tsetse fly infested areas increase. This will aggravate conflicts between pastoral and agricultural communities. It is also projected that some of the areas currently suitable for maize will not support this crop, and it will be replaced by sorghum, cassava, and other drought tolerant crops; as sorghum growing zones are expected to get drier and will be converted to grazing areas. Maize suitable areas in southwest and north eastern highlands are expected to be reduced and confined to higher grounds (URT, 2007). Obviously, the livelihoods of people depending on maize in these areas will be affected if early adaptation strategies are not set in place soon.

#### 2.4.4 Climate change impacts on water resources and wetlands

Climate change is projected to have both positive and negative consequences for Tanzania's water-resources, specifically for the three major river basins: Ruvu, Pangani, and Rufiji. The Ruvu basin, of particular importance because it is upstream of Tanzania's major population centre, Dar es Salaam, could experience a 10% decrease in runoff according to the Initial National Communication (URT, 2003). The Pangani river basin supplies water to Tanga, Kilimanjaro, and Arusha regions, supporting a number of economically important activities. These include the Arusha Chini sugar plantations in the Kilimanjaro region, the lower Moshi irrigation scheme, and three important power stations. For the Pangani River, there is some seasonal variation with runoff projected to increase in some months, and decrease in others, with annual basin runoff decreasing by an estimated 6%. The Rufiji basin meanwhile is a large catchment in the south of the country, focused on the Great Ruaha River, which is economically important to the nation in part because of the hydropower it generates at Mtera and Kidatu dams. The national assessment of vulnerability and adaptation (Mwandosya *et al.*, 1998) projects increases in annual runoff of 5% and 11% at Mtera and Kidatu, respectively, most coming in the period from November to March.

In areas where rainfall will decrease as a result of climate change wetlands are also expected to dry out thus reducing the areas under wetlands with consequences on water supply and resident biodiversity as well as fishery resources in these wetlands.

These predicted changes are explained by rise in temperature and consequent increase in evapo-transpiration that will reduce water availability especially that of freshwater. A reduction in water quantity will lead to a reduction in water quality and associated impacts on various aspects such as health and biodiversity. This reduction when put in the perspective of increasing water demand, points to a future where access to water will diminish as water scarcity or stress increase, leading to potential water use conflicts. Increasingly erratic rainfall regimes and higher mean temperatures in upper catchment areas will ultimately lead to less river water discharge and flow, while high evaporation losses downstream will mean less water available for domestic, irrigation and, hydro-power generation.

The severity of water scarcity is starkly illustrated by the rapid melting of the ice cap on Mount Kilimanjaro, which has shrunk by about 82% since 1912, and at current rate is expected to be completely gone within the next 12 years (UNFCCC, 2006). Thompson *et al.* (2002) provide a figure of 2.6 km<sup>2</sup> as the year 2000 glacier surface area, greatly reduced from 12 km<sup>2</sup> in 1912 (Hastenrath and Greischar, 1997).

Generally, air temperature changes are considered to be the most important factors influencing glacier retreat worldwide; however, direct field indications suggest otherwise for Kilimanjaro. Rather, a complex combination of changes in air humidity, precipitation, cloudiness, and incoming shortwave radiation might be the key components in determining tropical high-altitude climate. Another potential factor which is basal melting due to geothermal heat (Kibo is a dormant volcano) has probably had a limited effect on modern glacier retreat (Kaser *et al.*, 2004), but this may only be relevant to the Reusch Crater (RC) which harbours the eruption cone. It is also important to understand how precipitation on the mountain is related to the large-and meso-scale atmospheric circulation, and how changes in this circulation may have altered precipitation, cloud cover, and humidity (Chan *et al.*, 2008).

The reduction of water from the catchment areas and losses along the Pangani river basin has already severely impacted rivers and water bodies that depend on the ice melt for their flow (e.g. Pangani River, and Lake Jipe). It is further forecasted that an increase in temperature of 1.8 - 3.6 °C in the catchment region of Pangani River and a decrease in rainfall will decrease the annual flow of the river by 6 – 9% (URT, 2007).

The impact of climate change on domestic water supplies, both in terms of decreasing quantity and quality is overarching. For instance, the second Vulnerability Assessment Report (URT, 2007) showed that most of the households in Tanzania use more than one source of water supply, and 62% depend on traditional water supply sources. The majority of the population have no access to potable water and rely on surface water supply, and change in precipitation will affect this source most severely. Decrease in water supply will further aggravate conflicts between farmers and livestock keepers as each strives to access the limited water resources.

Increasingly erratic rainfall regimes and higher mean temperatures will in some cases be accompanied by alternating drought and floods, hurricanes and storms with wide-ranging consequences on local livelihoods in these areas. Expected increase in river flooding will damage hydropower stations and human settlements occurring along these basins.

#### 2.4.5 Climate change impacts on livestock production and fisheries

Increasing temperature and frequent droughts are likely to reduce rangeland productivity as a result of decreased rainfall and higher temperatures. Livestock vector borne diseases such as rift valley fever are expected to increase in frequency. The spread of tsetse fly may also narrow the area under rangeland. As a consequence, the already low productivity of grazing livestock could be further diminished. Climate change will negatively affect

fresh water and marine ecosystems reducing fish stocks and plants such as mangroves. This will affect livelihoods based on fisheries.

#### **2.4.6 Climate change impacts on energy**

The reduction of forest cover due to climate change will severely affect the supply of fuel wood which meets 92% of rural energy needs in Tanzania. Similarly, reduced river flow will affect water levels in hydroelectric dams leading to severe power shortage and increase in hydroelectric power prices. The economic impacts of less hydropower generation and escalating prices were particularly evident in 1996 and 2006, when the government was forced to engage in unsustainable power sources including generating electricity from fossil fuel. Shortage of hydropower and expensive fossil fuel have forced industries using these sources to switch to the use of fuelwood, driving deforestation and forest degradation even further (Sauer and Abdallah, 2007; Helmut et al., 2009).

Energy shortage from traditional sources will force people and the government to explore the potential for bioenergy, including biofuels. Biofuels mostly based on feed stocks grown in farmlands including *Jatropha* and sugarcane are likely to increase. However, as the demand for biofuels increase to meet domestic and export markets, the pressure to clear forests and grasslands important for biodiversity and water flow and wood products will increase. This will only not affect the livelihoods of communities depending on these ecosystems, but may lead to more CO<sub>2</sub> emissions translated as biofuel carbon debt (Fargione *et al.*, 2008; Danielsen, 2009).

#### **2.4.7 Climate change impacts on human settlements**

Climate change is affecting human settlements, both large and small, in different ways. According to UN-Habitat (2003), extreme weather events associated with climate change seriously challenge to human settlements especially in developing countries, where both assets and populations are increasingly located in coastal areas, slopes, ravines and other risk-prone regions. One of the response strategies adopted by rural communities to the negative effects of climate change is increased emigrations from the impacted areas, either temporarily or permanently; but the causes of emigration are multiple and complex, and may not be solely attributed to climate variability and change. Informal settlements within urban areas of developing-country cities, including slums and shanty towns are especially vulnerable, as they tend to be built on hazardous sites and to be susceptible to floods, landslides and other climate-related disasters (UN-Habitat, 2003).

The human population in Tanzania covers a wide variety of settlements ranging from indigenous communities of hunters and gatherers (e.g. Wahadzabe), migratory pastoralists and agro-pastoralists, to well organized rural village settlements, and urban areas; found in diverse ecosystems - from mountain areas to lowlands along river basins and coastal areas; from arid and semi-arid areas to humid zones. The high national annual population growth rate of 2.03% means that settlements will in future spread to areas which are considered currently marginal for human settlements or migrate into urban areas (Kangalawe, 2009). In most cases, settlements are located around natural resource-rich zones, which could also be very sensitive to climate variability. For example, the poor in urban areas such as Dar es Salaam tend to settle in flood risky environments or highly polluted areas, and are thus highly vulnerable to various hazards. These include settlements along the coast, flood plains, fragile mountains, and drought or flood prone semi-arid areas. Furthermore, settlements often cluster around economic activity nodes and are often associated with high concentrations of infrastructure systems. These act as nucleus for increased urbanization. The UN-Habitat (2003) projected that by 2030; about 54% of the population in Africa will live in urban areas. This is expected to lead to extensive land use and land cover changes especially from largely uncontrolled urban, semi-urban and rural settlements thus altering existing surface microclimate and hydrology. Climate change will exacerbate the scope and scale of these background change impacts.

The impact of climate change include effects on infrastructure and settlements through for example sea level rise, shortage of water resources, extreme events, food insecurity, security, health risks and temperature related morbidity. Other threats include events such as flooding of rivers (permanent and seasonal) in lowlands, and landslides in elevated areas; strong winds; droughts and tidal waves. The damage to transport infrastructure (roads and rail) are likely to increase the cost of living in both rural and urban areas. Sea-level rise will increase the cost/vulnerability of natural resource-based industries such as fishery.

The vulnerability of settlement economic and social structures to climate change, including impacts on support services such as energy and water supply, transportation, drains, waste disposal vary, are generally evolving faster than the natural environment. Management of these, as well as provision of adequate infrastructure in urban areas, already overstretched could become more difficult and costly under changed climate conditions. Settlements could also be affected indirectly through impacts on the environment, natural resources, and local industries such as tourism or agriculture. Furthermore, these effects on human settlements might lead to consequent impacts including altered land use, redistribution of population and activities to other regions, and altered trade patterns among regions, resulting in still further changes in natural resources and other activities. Some of these effects could be either positive or negative at the regional level.

Other impacts of climate change include increased emigrations as local livelihoods are increasingly impaired by various causes and stresses due to climate change will exacerbate these. Emigration may be long-term or short-term, but has always been a longstanding response to seasonal variability in environmental conditions. It might also be a strategy to accumulate wealth or to seek a route out of poverty. Climate change might also aggravate ethnic conflicts linked to competition over natural resources that are increasingly scarce as a result many other intervening and contributing causes.

#### **2.5 Challenges and Opportunities for Adaptation and Mitigation Strategies**

Climate change and variability already exerts multiple stresses at different spatial and temporal scales on the biophysical as well as the social-economic and institutional environments. The speed of changes may be abrupt or gradual shifts in temperature, precipitation, vegetation cover and fish stocks. The primary stresses include climate risks such as drought, intense rainfall and heat waves, which may in turn trigger secondary stresses such as the spread of pests, increased competition for resources, disruption of ecosystem services, habitat shrinkage and subsequent species migration and biodiversity losses. Further to these there is likely to be major impacts on livelihoods especially those dependent on natural capital such as forests, woodlands and rangelands.

Food security may be at risk in arid, semi-arid, and fragile mountain and coastal ecosystems, small islands, developing and least developed countries of the world. Human settlements both rural and urban are highly



vulnerable to effects of climate change and adaptation strategies to address the anticipated changes are urgently needed.

While there are positive effects of climate change, and these should be capitalized on during adaptation, the negative ones are more important and should be managed through effective adaptation. Adaptation includes adjustments in human and natural systems to respond to actual or expected climate impacts, taking into account that most ecological and social systems have a measure of in-built adaptation capacity (autonomous adaptation). However, the rapid rate of climate change will impose new and potentially overwhelming pressures on existing adaptation capacity. For example, while human communities and ecosystems have the ability to cope with and recover from extreme climate events and other natural hazards, the secondary changes triggered by climate change are expected to undermine this ability.

Each level of society will have to consider adaptation aimed at achieving multiple economic and environmental benefits under current and future conditions. The adaptation strategies must be based on sound scientific assessment. The range of practices that can be used to adapt to climate change is diverse, and includes changes in behaviour, structural changes, policy based responses, technological responses or managerial responses.

### 2.5.1 Adaptation and mitigation strategies in forestry and biodiversity management

Natural resources, particularly forests and related biodiversity form an important linkage and support to the agricultural sector. For example:

- Vegetative cover has an important function in attracting rainfall and enhancing stability in supply of good quality water for domestic use, irrigation farming, livestock keeping, wildlife management and fish production.
- Forests function in stabilizing stream flows and therefore reduce disasters such as landslides, erosion and floods in areas of steep topography and high precipitation and ensure adequate water supply throughout the year.
- Forests are also good repositories of biodiversity and endemism on which many communities depend on for livelihoods and survival.

Despite the importance of catchment forests, the coverage is very small as compared to other “productive forests”. For example, reserved catchment forests occupy only 2% of the total land area or 29% of forested area in Tanzania (URT, 1998).

Tanzania is currently suffering severe environmental degradation due to human activities that are directly associated with maintenance of livelihood including vegetation clearing, improper use of fires for land preparation and tree cutting for domestic and commercial uses, and in particular fuel wood which account for about 92% of total energy consumed in the country. The high dependence on fuel wood is a result of lack of affordable alternative sources of energy. Studies of alternative energy sources will therefore be an important activity of this programme. Such activities may include increased use of gas, biogas and improved utilization of firewood and the potential use of bio-fuels to generate energy.

Natural resource endowments and farming systems interact in different ways. In Tanzania the land under savannah and Miombo woodlands is relatively big but limited in fertile soils for annual cropping, while mountain humid areas are rich in fertile soils but limited in land area. In woodlands for example, which make nearly 96% of forested land (URT, 1998), environmental degradation results from shifting cultivation, which is done due to soil nutrient mining and low fertilizer input. The extensive nature of shifting cultivation has resulted into running out of the land frontier in many villages, increasing further soil mining and hence soil degradation and desertification. Research will be needed to develop better soil management practices including the judicious use of fertilisers, manure, agroforestry and conservation tillage.

Central and local government forest reserves in particular are faced with low institutional capacity to sustainably manage these resources so as to meet the growing demands for forest products and services including provision of good water quality and quantity. The need for Local Government Authorities (LGAs) to generate revenue from their forests often overrides their obligation to conserve such forests. The lack of systematic management and inadequate resources for controlling illegal harvesting and encroachment, the lack of incentives to do so, corruption and the general laxity in enforcing national laws and bylaws (district, municipal or village) on environmental conservation and sustainable agriculture are all blamed for the current situation. Research is required to better understand the causes of poor forest management and how these can be addressed to improve sustainable management of forest resources in a changing climate. Increasing benefit sharing by the local communities has been proposed as a way of encouraging local communities to protect natural forests, and research on potential incentives and their effectiveness will be needed.

The opportunity cost of the stakeholders residing upstream and those devoted in the upkeep of the catchment forests (including the Department of Forestry & Beekeeping and LGAs) has been poorly addressed. Sustainable management of wetlands, which cover about 10% of the total land area, has been proposed in the National Wetland Strategy (MNRT, 2003). Wetlands fulfil several ecological and social economic functions. Most wetlands form part of lowland catchment's areas and are important areas for crop and livestock production. Coastal estuaries and mangrove areas are other ecosystems, which need special environmental attention due to their importance in crop, fish production and sea shore protection. However, some of these areas have been highly degraded and this will be further compounded by climate change. To address the above shortcomings, firm environmental conservation plans are essential.

It has been long recognized that forestry plays an important role in the carbon cycle. Forests are capable of sequestering and storing carbon for long time periods in the form of wood biomass and as organic carbon in forest soils (Lugo and Brown, 1992). They absorb CO<sub>2</sub> and release oxygen into the atmosphere through the natural process of photosynthesis where CO<sub>2</sub> is converted to carbon and stored in the woody tissue of the plant. In this respect, forests have the potential to mitigate greenhouse gases emissions through accumulation of biomass. Changes in the management and use of land greatly affect the extent and biomass density of forests. Aggrading

forests acts as sinks for carbon when their area or biomass density increases, resulting in an increased uptake of CO<sub>2</sub> from the atmosphere. However, they act as a source of carbon when forests or wood products are burned or decay, and the soil is disturbed, resulting in emission of CO<sub>2</sub> and other greenhouse gases to the atmosphere. It is estimated that 17-18% of the global annual emissions of GHG are a result of loss of tropical forest (IPCC, 2007).

FAO (2006) calculated a total stock of carbon of 2,570 million tonnes in living and dead biomass in Tanzanian forests (not including soil carbon) in 2005. Therefore, Tanzania with 33% forest cover has an important role in maintaining carbon that would otherwise be emitted into the atmosphere if the area were deforested. However, the amount of carbon stored in these forests is not yet quantified, and also less known is the effect of gradual forest loss or ground degradation of the forests from stands of large trees to tangled thicket stands where human utilization is high.

The carbon capture within these standing forests is provided for free and there is a potential cost to the world in terms of enhanced emissions from Tanzania if the forests are cut down, or seriously degraded. Hence there is a potential for the Tanzanian forests to be presented as a test case in payments for reduced emissions from deforestation and degradation (REDD). These arguments would be strengthened by the global importance of the standing forests for biodiversity conservation and their nationally important hydrological role. There are claims that REDD payment schemes are already working in Uganda (Bwindi) and Madagascar (the protected area Trust) and that they provide an additional and sustainable source of funding for forest conservation. There is no case study testing this approach in Tanzania. It is also not clear who has the right to own C, hence the mode of benefit-sharing and the welfare of the local communities is not known. The challenge is to ensure that the community do gain access to such services and benefits.

For payments to be introduced, assessment of the carbon stocks and the potential of the forests to sequester C is needed. Hence, a major activity in this programme will be to develop and test various methodologies and procedures for quantifying the carbon sequestration and storage potential in different forest ecosystems and quantification of the potential for forestry based carbon off-sets and carbon trading, to determine and develop appropriate climate change mitigation and adaptation strategies in forestry, other land uses, ecosystems and biodiversity management and further develop tools for reliable monitoring of the forest cover.

According to FAO (2007), the early warning of climate change impacts on forest are manifested as forest decline on former permafrost soils in Canada and Alaska, as decline of cloud forests in the tropics, the increase in global frequency and severity of forest fires, altered timing of seeding and as increased pest and disease outbreaks. Furthermore, long term impact includes increased productivity of some forests in the northern hemisphere while there will be die-back of tropical forests (*ibid*). Adverse climate change will contribute significantly to deforestation thereby increases in green house effects which in turn will contribute to global warming.

There are various approaches that can be used to classify climate change adaptation. The adaptation approaches are divided into two groups i.e. autonomous (short term) and planned (intentional policies/strategies/responses) approaches (FAO, 2007). Preserving species richness, continuity of forest ecosystems and resilience can assist adaptation (Reilly and Schimmelpfennig, 1999; FAO, 2005).

The area currently being afforested/reforested in Tanzania falls far short of the deforestation rate, and is considered grossly inadequate to meet the immediate wood demand. If the supply of wood from natural forests is negatively impacted due to climate change, then Tanzania would face severe wood shortage in the future with consequent decrease in the capacity of the forests to sequester and store carbon. The three highest priority mitigation measures in the forestry sector include (1) protection of existing forests; (2) afforestation, reforestation, and forest productivity improvements; (3) revegetation of degraded lands by tree /shrub planting, and (4) substitution of sustainably produced biofuels for fossil fuels and substitution of wood products for more emission-intensive, non-wood products. The need for supporting local communities under the smallholder forestry practices is a sustainable option and is likely to be successful due to its multiple benefits in supplying wood for domestic consumption and acting as a source of household income (Munishi *et al.*, 2004). According to FORCONSULT (Pers. Comm., 2001) in the southern highlands about 38,000 ha were managed as household woodlots.

A separate pilot study is proposed for monitoring reduced emissions from deforestation and forest degradation in Tanzania. However, planning for this component of the study has not yet been completed. Therefore applicable implementation arrangements for this component will be requested for when the planning and appraisal of the referred study is ready.

### **2.5.2 Adaptation strategies in agriculture and food security**

Sustainable agriculture and natural resource management integrates three main goals of environmental health, economic profitability and social equity. Sustainability rests on the principle that we must meet present needs without compromising the ability of future generations to meet their own needs. Stewardship of land and natural resources involves enhancing this vital resource base for the long term.

Estimates suggest that one third of the people in Africa live in drought-prone areas and extreme events, including floods and droughts, are becoming increasingly frequent and severe (UNFCCC, 2007). Between 1973 and 2002 climatic events constituted 53% of all reported natural and technological disasters in Africa. In some regions, both droughts and floods have been experienced in one year. The situation could be further aggravated by the impacts of expected climatic changes. Climate change models suggest that, the climate in Africa will become more variable, making it necessary to develop, mainstream and sustain readiness and adequacy in capacity to address the effects/challenges due to be brought about by climate change.

Of the most vulnerable crops as a result of climate change are the cereal and legume crops that contribute to high percentage of the type of food the society in Tanzania depends on. There is a need to develop specific strategies that make an agricultural system that will adapt to climate change including design of sustainable crop production and farming systems. Research into optimum nutrient and water use efficiency, use of organic and chemical fertilizers will need to be emphasized.

Other strategies that will impart a sustainable agricultural system for reduction of food insecurity will entail adapting agroforestry farming systems that include planting fruit trees in people's farms. There is a wide range of fruit tree crops that can be grown in Tanzania depending on altitude from low lands to highlands. Both tropical and temperate fruit tree crops can be incorporated in this proposed farming system. The practice will help moderate and develop microclimate in given area and is likely to increase crop diversity and productivity per unit land while converting the farms into greener landscapes.

Among the mitigation measures which can increase C sequestration and increase productivity on farming lands include reduced tillage (minimal cultivation), high carbon crops (fruit or nut orchard, vines, tea, coffee) and agroforestry. Inclusion of fruit trees and multipurpose trees will contribute to carbon sequestration and storage.

### **2.5.3 Adaptation strategies in water management for irrigation and livestock**

Tanzania has an irrigation potential of 29.4 million hectares, but currently the area developed for irrigation is only 200,000 ha. Thus a large number of farmers depend on rain-fed agriculture. Irrigation development and floods control is thus regarded as one of the effective approaches to ensure stable and higher food production and improved food security and alleviation of poverty in rural areas, with or without climate change. However, there are a number of constraints facing irrigation and flood control development. They include, among others, absence of a well-articulated policy and strategy framework on irrigation and flood control development.

The shortage of small, medium and large water storage dams for irrigation and livestock purposes, as well as for control of floods is another factor that constrains agriculture and the environment in the country.

Diminishing water resources pose new challenges to irrigation development. The outcry in the Usangu Plains and the drying up of the Great Ruaha River has raised concern of many stakeholders responsible for water resources management.

Water is no longer available in adequate amounts due to increased demands as a result of increased population and economic activities. In the Great Ruaha River basin for example, water is required to feed the expanding irrigation systems, provide water for livestock, domestic use, wildlife in the Ruaha National Park, fishing at the Mtera Dam and generation of power at the Mtera and Kidatu hydroelectric power stations. To meet these demands requires an integrated water resources management approach, which calls for a multi-stakeholders involvement in order to ensure that water is available for irrigation, and for other economic uses including sustaining biodiversity.

The Tanzania government in its National Strategy for Growth and Poverty Reduction (NSGPR) is determined to increase productivity and incomes of the rural population by revamping the agricultural sector. This will be achieved through implementation of the Agricultural Sector Development Programme (ASDP). In this programme irrigation has been identified as one of the priority areas for investment. Therefore, the National Irrigation Master Plan (NIMP) has been designed for enhancing irrigation development in the country. To hasten implementation of the NIMP a full-fledged Department of Irrigation and Technical Services has been established in the Ministry of Water and Irrigation].

It is therefore being recommended that:

- In order to stabilise agricultural production, water storage dams (small, medium and large) should be constructed. The design and construction of such dams should take into consideration of multiple uses where possible e.g. irrigation, livestock, power generation, and flood control. These dams may be used directly for aquaculture production, as is practised in Israel and India. In 2005 aquaculture production in Israel was 22 000 tons and about half of that took place in the reservoirs. In large reservoirs cage culture could be an appropriate solution. The irrigation water could also first be led through fish ponds and thereafter used for irrigation of vegetables and other crops. If agriculture and livelihoods are to be improved, the water

available to agriculture will have to be used more efficiently. Rainwater harvesting can greatly enhance the productivity of land and water in rain fed areas.

- Embark on water saving husbandry practices, including encouraging mixed agro-pastoral farming systems to create synergy and provide for food security in case of failure of one part (crop or livestock) of the system.
- Livestock systems in Tanzania capable of producing food, energy and protein with low emission of greenhouse gasses per kcal food energy and protein are encouraged.

Possible improvements to be studied include use of by-products from food production as farm animal and fish feed use of manure as fertilizer of fish ponds and biogas, replacing specialized meat production with combined milk and meat production in cattle and goats, reduce mortalities in animal husbandry systems, introduce ex-closures to protect trees thereby stimulating increased reforestation on available land and include controlled grazing and increased use of multipurpose trees including fodder species. Options for improving grasslands and grazing lands productivity include native species restoration, improved grazing management and scrubland restoration

#### **2.5.4 Adaptation strategies in the energy sector**

Adoption of strategies to meet energy needs under climate change must be linked to enhanced forest management as fuel-wood depend on forests, and hydropower generation is affected by the hydrological effects of forests. Since over 92% of the domestic energy in Tanzania is wood-based (fuel-wood and charcoal), any adaptation strategy must consider the sustainability of wood supply in the face of high deforestation and forest degradation. Similarly, hydro-power, the main energy source for industries, mostly depend on the water supply from forest catchment areas, and its future supply will heavily rely on the ability of catchment forests to sustain water supply under variable climate.

To ensure adequate wood-fuel supply, there must be a shift from reliance on indigenous forests and woodlands, leaving these to fulfil more service-oriented functions, to the reliance on man-made forests, including smallholder forestry, private woodlots, agro-forestry, and large scale fuelwood plantations. Considerable investment will have to be channelled to this avenue.

An added advantage of this development is that it can enable communities and the private sector to participate in bio-fuel production and in carbon trade markets. Production of tree biomass as a substitute for fossil energy – where biomass is used for combined heat-electric power generation (CHP), if properly done, can help meet rural energy needs by supplying fuel wood and electricity. Renewably grown biomass is claimed to be a 'carbon-neutral source' of energy that can be converted into electricity, heat, liquid and gaseous fuels through heat/electricity power generation, supply liquid fuel for vehicles and industries, and other marketable by-products. If the perennial biomass can be grown on the same piece of land for many years, apart from earning income from sale of wood and other bio-fuels, the biomass can be used as carbon sinks that may be traded in carbon markets. Under the climate change mechanisms provisions exist to allow communities/private sector to participate in the carbon market, especially in the voluntary market.

Major constraints for communities to participate in biomass-energy market include lack of an organized markets and absence of fiscal incentives for investment and supportive institutions. With respect to markets, participation in the CDM market under the Kyoto mechanism through afforestation/reforestation activities and the voluntary market by developing countries has so far been negligible because of the complicated process/regulations, and high transaction costs (Henman *et al.*, 2008). The absence of a national policy on bio-energy and especially on issues of biofuels and hence a lack of an action programme is a serious bottleneck to the development of the bioenergy sector.

Opportunities are becoming available for 3<sup>rd</sup> world countries to participate under recent changes within the international climate policies (UNFCCC) mainly under land use, land use change, and forestry (LULUCF) or agriculture forestry and land use (AFOLU) mostly through the proposed simplified CDM (e.g. allowing bundling of small projects). Under the proposed Reduced Emissions from Deforestation and forest Degradation (REDD) projects based on proper land use planning and management, better agricultural practices e.g. agroforestry; conservation tillage; sustainable fuelwood plantations; animal husbandry; soil C storage) will be able to participate in the carbon markets (Trines *et al.*, 2008) CDM market. The CDM also allows alternative energy efficiency activities such as solar, hydro, wind, bio-charcoal and biofuels; and the development of these to help Tanzania adjust to climate change should be encouraged.

While the REDD policy is still evolving, both CDM and voluntary carbon markets have serious shortcomings which make them less adoptable by developing countries (Henman *et al.*, 2008). Nevertheless, linking REDD, Afforestation/Reforestation activities, energy efficiency technologies, forest restoration and forest management is one of the most promising strategies to address land use mitigation option. The strategy for increasing forest plantation was covered under section 3.4, and if successful will increase the potential for C sequestration.

The developed world is poised to increase use of to reduce dependence on fossil fuels largely with cheap biofuels produced in the tropics (e.g. palm oil, *Jatropha* for biodiesel, and sugarcane and corn for ethanol), and already many investors are aggressively acquiring fertile land in Tanzania for large-scale biofuels production. However, the issue of biofuels has recently gained national and international prominence, because of world food shortages and increasing food and fossil fuel prices (Cotula *et al.*, 2008).

Unfortunately, Tanzania lacks a biofuels policy, and there is no information on the socio-economic and environmental impacts of biofuels production, especially large scale production competing for prime arable land with agricultural food crops, wetlands and wild biodiversity (FAO, 2008; Danielsen *et al.*, 2009). Research is urgently required to provide information that can guide policy and decisions on this most pressing and strategic issue.

### **2.5.5 Adaptation of human settlements to climate change**

The possibilities and constraints for adaptation to climate change in settled areas in low-and middle-income nations, including Tanzania, should focus on reducing the vulnerability of people and economic activities to climate change and at the same time devise proactive adaptive strategies to minimize the risks to climate change. The devised strategies should address both the direct and indirect impacts of climate change and identify population groups that are particularly at high risk. In rural areas other sustainable livelihoods apart from total reliance on agriculture and livestock production should be developed. Provision of adequate social services (including water, energy) and promotion of alternative income generating activities should be enhanced.

In urban areas, a key part of adaptation concerns infrastructure and buildings. However, most urban centres in Tanzania lack the infrastructure and financial systems to address such problems, including failure to adopt proven innovations in disaster-risk reduction.

One of the emerging challenges in Tanzania is urbanization, but strategies to mainstream climate adaptation strategies into urban development planning are inadequate (Eriksen *et al.*, 2008). Low and unreliable incomes combined with lack of formal rights also increase the vulnerability of most urban residents to the climate change. Because of these factors, small changes in climate variability may have large consequences in urban areas. Increased research, training, awareness, and institutional capacity building should be strengthened to address climate change issues on human settlements. Strategic and long-term adaptation strategies are required since most climate-change-related risks in both urban and rural areas are low-income areas with the least adaptive capacity.

### **2.5.6 Vulnerability assessment for climate change adaptation and mitigation**

The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as “the extent to which climate change may damage or harm a system” (IPCC, 2007). It adds that vulnerability “depends not only on a system’s sensitivity, but also on its ability to adapt to new climatic conditions”. Vulnerability is also defined as the extent to which a natural or social system is susceptible to sustaining damage from climate change, and is a function of the magnitude of climate change, the sensitivity of the system to changes in climate and the ability to adapt the system to changes in climate. Hence, a highly vulnerable system is one that is highly sensitive to modest changes in climate and one for which the ability to adapt is severely constrained (IPCC, 2007). The vulnerability of a region depends to a great extent on its wealth, and that poverty limits adaptive capabilities. Vulnerability depends on the level of economic development and institutions. Vulnerability is highest where there is the greatest sensitivity to climate change and the least adaptability. It has been established that the socio-economic systems are more vulnerable in developing countries where economic and institutional circumstances are less favourable.

Looking at vulnerability from the food security point of view, FAO (1999) defines vulnerability as “the presence of factors that place people at risk of becoming food insecure or malnourished.” Clearly, this definition encompasses causes of food insecurity other than climate change (e.g. poverty, HIV AIDS, armed conflict, drought, landlessness). Moreover, the concept of vulnerability includes hunger vulnerability, which refers to the vulnerability of individuals or households rather than that of regions or economic sectors. In the tropics and subtropics, where some crops are near their maximum temperature tolerance and where dry land, non-irrigated agriculture dominates, yields are likely to decrease for even small changes in climate, especially in Africa and Latin America, where decreases in overall agricultural productivity of up to 40% are projected during the next century (IPCC, 2007). Therefore, there may be increased risk of hunger in some locations in the tropics and subtropics where many of the world’s poorest live. It is believed that climate change, mainly through increased extremes and temporal/spatial shifts, will worsen food security in Africa. (IPCC, 2001) The adverse impacts of climate change will severely undermine the goal of sustainable development in many parts of the world, with developing countries, and the poor in developing countries, being most vulnerable. However, it should be noted that some of these projected adverse effects can, to some degree, be reduced through proactive adaptation measures. Thus, there is a need to assess the vulnerability of different communities and develop strategies to adapt to climate change to assist those communities that are

least able to adapt. Generally speaking, vulnerability and adaptation to climate change are urgent issues among many developing countries.

Vulnerability assessment is an important aspect in climate variability as far as agricultural and natural resources systems are concerned and linked to the social systems. Thus both vulnerability of agricultural production, natural resource sustainability and social dynamics are important considerations in assessing vulnerability to climate change impacts and are considered in detail in this programme.

In the broadest terms, analytical frameworks for the study of climate change impacts and adaptations - and the resulting patterns of social vulnerability and resilience - must incorporate the complex interactions of coupled human-environment systems. Such frameworks should recognize the interactions of multiple environmental and social stressors, assess the resilience of systems rather than mere exposure to perturbations or stressors resulting from climate change, be sensitive to the internal differentiation of vulnerability and resilience within sub-systems, and incorporate the role of institutions in mediating external stressors and responses (IPCC, 2007; Turner *et al.*, 2003). The notion of adaptive capacity has been applied at multiple scales as a means of incorporating each of these imperatives. Adaptive capacity has been defined as “the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences” (Füssel and Klein, 2006). Generally, adaptive capacity relates to ability of a system to manage gradual and incremental changes, but such long-term changes may be punctuated by extreme events that require short-term coping mechanisms.

### **3. FOCUS AREAS AND ACTIVITIES**

This programme is designed to be executed through four strategies; research, capacity building needs, strategic interventions and documentation, communication and dissemination. The log frame in which the programme is organized is shown in Appendix 1.

#### **3.1 Focus Areas for Research**

##### **3.1.1 Development of appropriate climate change mitigation and adaptation strategies in forestry, other land uses, ecosystems and biodiversity management**

- Quantification of the potential for forestry based carbon off-sets and carbon trading
- Development of forest carbon assessment and monitoring system
- Determine effective and efficient payment system for REDD in Tanzania
- Determine appropriate approach to limit deforestation and forest degradation in Tanzania for its participation in REDD
- Modelling of impacts of climate change and management scenarios in forestry, land-use, ecosystem and biodiversity
- Assessment of Small Holder Forestry Potential for Climate Change Mitigation, Adaptation and Rural Development
- Financial analysis of C sequestration
- Development of strategic interventions for adaptation in forestry, and other land uses including human settlements
- Assessment of new and innovative agricultural land use and farming systems for adaptation to and mitigation of climate change to support REDD initiatives
- Development and testing of various range land management strategies for the purpose of reducing pressure on forest resources for adaptation and mitigation to climate change.
- Assessment of effective communication channels in delivery of climate change information
- Information documentation on perception and adaptation strategies to climate change issues among rural communities.

##### **3.1.2 Assessment of climate change impacts and vulnerability on ecosystem services and livelihoods under REDD initiatives:**

- Establishment of trends and projections of ecosystem services due to climate stressors
- Model effects of alternative management options on ecosystem services under changing climate
- Development of methods to describe relationships between ecosystem services, climate stressors and management responses
- Assessment of local vulnerability on biodiversity and forest related livelihoods and adaptation options
- Assessment of macroeconomic impacts in forest resource management and its implication for different ecological zones
- Integrated analysis and synthesis of lessons learned from adaptation options and macroeconomic impacts.

##### **3.1.3 Policy and legal framework analysis of climate change adaptation and mitigation with emphasis on economic efficiency, ecological effectiveness and wider political legitimacy**

- Analysis of climate change related policies and legal framework in Tanzania
- Analysis of land competition in the context of climate change adaptation and mitigation efforts
- Analysis of various REDD initiatives that are addressed through markets, private and public sector management, and civil society



- Determine how institutional arrangements and governance affect various forest management regimes (CBFM, Plantations, Private forests, general land forests and forest reserve) in the context of climate change
- Determine the feasible incentive structures, monitoring mechanisms, controls, leakages and additionality affecting policy formulation and implementation for climate change adaptation and mitigation.

### **3.2 Focus Areas for Capacity Building**

Despite the magnitude of problems associated with climate change, little has been done with respect to adaptation and mitigation strategies in Tanzania. It is obvious that Tanzania alongside other developing countries will need to adapt and participate in climate change challenges and initiatives at various levels. However the ability of the country to adapt and mitigate impacts of climate change is limited by low human capacity, technical and financial resources. Other reasons include:

- Low awareness on climate change issues
- Inadequate data to explain the extent of climate change and its impacts.
- Inadequate knowledge and data on carbon sequestration potential for different land use options
- Inadequate appropriate technologies for quantification of the dynamics of climate change and its impacts.

To address some of these deficiencies, one of the approaches would be to develop human capacity. Capacity building activities will concentrate on efforts to increase the institutions' ability to cope with challenges of climate change. Such capacity will be increased by providing for postgraduate training and relevant short courses among staff from Universities and other relevant research and academic institutions. Thus capacity building will comprise activities like PhD and MSc training, engagement of young and senior professionals in exchange programmes, short courses, development of international networks. Others will include development of short course modules directed towards relevant stakeholders.

Operationalisation of the capacity building activities will be guided by criteria outlined in Appendix 3 any other relevant criteria that may be approved by the Joint steering Committee upon recommendations of the PMT. Among the identified human and physical infrastructure capacity development needs include:

#### **3.2.1 Develop and undertake human capacity building to address adaptation and mitigation to climate change**

- Mainstreaming climate change issues in tertiary institutions curricula
- Conducting specialised climate related training at various levels for Tanzanians, 50 MSc and 17 PhD students with special emphasis on climate and ecological modelling with emphasis on REDD pilot areas
- Developing modules incorporating analytical modelling in socio-economic and ecological issues to be used for analysis of adaptation to climate change and variability
- Developing short courses on different topics on climate change for policy makers and trainers.
- Conducting training and dissemination workshops for various stakeholders
- Developing policy briefs for policy makers to inform on climate change issues
- Enhancement of special skills in modelling for technicians and scientists
- Engagement of 15 young and 12 senior professionals in exchange programmes annually. This will involve Norwegian and Tanzanian postgraduate students and other young researchers in collaborative research projects to acquire skills and/or exposure to experiences that may add value to their study programmes.

#### **3.2.2 Develop/rehabilitate physical infrastructure to address adaptation and mitigation to climate change**

- Establishment of database to pool all information generated by the programme
- Provision of equipment (e.g. weather monitoring equipment (Automatic Weather Stations), data loggers, GIS software and equipment, computers)
- Provide reliable internet services and connectivity in partner institutions to facilitate access of scientific information for research

- Strengthening existing climatologically monitoring station network and communication system by TMA
- Strengthening the existing climate research and modelling laboratory at SUA
- Avail hardware and software for short course training of various participants on modelling climate change effects
- Improvement of field research laboratory at Mazumbai for monitoring of climate change impacts on high forest ecosystems and related biodiversity
- Strengthening of research laboratory for monitoring of climate change impacts on aquatic ecosystems and related biodiversity at UDSM
- Acquire tide gauges for continuous observation reference station for sea level monitoring by ARU.

### **3.3 Focus Areas to Develop and Undertake Strategic Intervention for Climate Change Adaptation and Mitigation**

Some of the strategic intervention needs include:

- Document existing REDD related activities and technologies and report the same to relevant meetings
- Collect and document climate change information in Tanzania
- Assess community-based projects aimed at alleviating poverty through different approaches to climate change adaptation and mitigation developed by NGOs in REDD pilot
- Support CDM and REDD demonstration projects
- Support demonstration projects at community level on biofuels technologies and options to support REDD implementation
- Value chain analysis of farming systems in Tanzania for REDD
- Provision for advisory and developmental services on emerging constraints in adaptation to climate change by small producers.
- Enhanced availability and accessibility of climate change information
- Increased visibility of Tanzania's climate change information (local content) on the web

### **3.4. Focus Area on Documentation, Promotion, Publication and dissemination**

The target groups for this focus area will include researcher, farmers, environmental management committees, extension officers, environmental activists, NGOs, community based organisations, local communities, delegates to UNFCCC meetings, and policy makers at different levels.

#### **Activities**

- Identify climate change information needs of various stakeholders
- Create awareness on climate change and its impacts
- Document research findings, reports , publications and other activities within CCIAM programme

Outputs from this focus area will include:

- Enhanced understanding about climate change and its impacts under REDD initiatives
- Increased awareness of the risks and opportunities associated with climate variability and change under REDD initiatives
- Enhanced understanding of vulnerability of ecosystems to climate change
- Adaptation and mitigation strategies to manage the impacts of climate change using the REDD initiatives
- Enhanced skills and knowledge on climate change among stakeholders for improved natural resource management.
- Information needs among stakeholders on climate change identified

## **4.0 CONTEXTUALIZATION OF THE FOCUS AREAS IN RESEARCH**

In order to address the challenges of climate change, this chapter profiles the pertinent issues in research. The chapter is organised into six main sections, namely, Research into climate change mitigation and adaptation in forestry, land use, ecosystem and biodiversity management; Assessment of climate change impacts on ecosystem services; and Sustainable agricultural production systems for climate change adaptation and mitigation. Furthermore, issues of vulnerability assessment, capacity building and strategic interventions are addressed. The research component of the programme will cover at least three of the seven agro-ecological zones of Tanzania. It is expected that by the end of the programme this will give accurate information regarding climate change and its impacts on vegetation and biodiversity in the selected agro-ecological zones will be determined.

### **4.1 Research of Appropriate Climate Change Mitigation and Adaptation Strategies in Forestry, Other Land Uses, Ecosystems and Biodiversity Management**

#### **4.1.1 Quantification of the potential for forestry based carbon off-sets in selected forests**

Quantification of the potential for forestry based carbon off-sets will include assessment of present carbon stocks, and estimates of sequestration potential in selected forest ecosystems through establishment of historical trends for forest cover, measurement of current C storage in vegetation in different forest types, assessment of current soil carbon in different forest types, quantification of C sequestration potential of forest ecosystems through growth and yield studies in different forest types. Finally, modelling and mapping the spatial and temporal long term changes in the carbon storage by different forest ecosystems will be required.

Outputs under this theme will be:

- Existing C stocks and density in different forest types assessed
- Spatial distribution of C density in different forest types assessed
- Potential for C sequestration and storage in Tanzanian forests estimated
- Models for long-term changes in spatial distribution of Tanzanian forests developed
- Scenario analysis of future C flow and stock in Tanzanian forests developed.

#### **4.1.2 Development of forest carbon assessment and monitoring system in Tanzania**

The monitoring system will employ several methods including use of remote sensing for forest cover change detection, as well as estimates of biomass density in various forest types and agro-ecological zones. This requires field measurements and inventory of individual trees on the ground. Methods to detect biomass degradation apart from crown cover change should be developed. If conditionality is to be implemented as part of payment schemes for REDD, monitoring is required for relatively short time intervals. Cheap, accurate, and reliable systems for such monitoring must be developed.

Outputs under this theme will be:

- Tools and methods for forest carbon assessment, monitoring and verification developed
- Database of available forest carbon stocks developed.

#### **4.1.3 Determine effective and efficient payment system for REDD in Tanzania**

Payment system for reduced emissions from deforestation and forest degradation is a new facility in global carbon trade. Such a system will be implemented nationally. With this system, the country will have to develop a system for use and distribution of payments to different stakeholders. Some of the payments will be spent on setting up the national baseline, monitoring and verification. The rest of the funds will be used to compensate forest practitioners especially rural people managing their own forests. It is likely that the international community funding REDD will insist on some incentive system that is considered fair among forest owners, or people with traditional user rights. For successful implementation of the REDD policy, a system that will ensure effective and efficiency distribution of funds is required. Since some REDD demonstration activities will start in the near future it is important to measure the effects and efficient distribution of funds and control mechanisms.

Outputs under this theme will be:

- Carbon accounting system for measuring, monitoring and verification which will ensure fair distribution of REDD funds proposed
- Payment system to control agents of deforestation and degradation proposed
- Empirical incentives and control mechanisms applied in payment scheme for REDD determined.

#### **4.1.4 Determine appropriate approaches to reduce deforestation and forest degradation in Tanzania through participation in REDD**

It is of particular importance for Tanzania to reduce deforestation and forest degradation to participate in the REDD initiative. Therefore deliberate efforts will be required to establish a system that will reduce deforestation and forest degradation in the country. This will have to be in line with the current Forest Policy which put more emphasis on collaborative management schemes. These collaborative management schemes are at various stages of implementation and there are experiences and lessons to be learnt. However, more studies are needed in order to develop best practices that will reduce deforestation and forest degradation in line with the country's policy.

Outputs under this theme will be:

- Effective collaborative approaches for forest management in relation to REDD proposed
- Effective approaches for reducing deforestation and forest degradation in the country proposed.

#### **4.1.5 Modelling of impacts of climate change and management scenarios in forestry, land-use, ecosystem and biodiversity**

This part of the program will involve quantification of the impact of climate change on ecosystems, biodiversity, wildlife management and related livelihoods. It will include assessment of species abundance and distribution along bioclimatic gradients to determine possible responses of different species under the different climate change scenarios, modelling species response and distribution under different climate change scenarios, vulnerability of different species to climate change and determination of biodiversity based livelihoods and how these livelihoods may be impacted by changes in biodiversity under climate change influences and their sustainable management.

Efforts are needed to diversify crop germplasm with the purpose to enhance biodiversity of those crops that will be adapted to local climate in different locations in the country. Germplasm exchange and evaluation under various agro-ecological conditions (multilocation trials of selected crops in both conventional farming and agroforestry farming systems) need to be conducted.

Outputs under this theme will be:

- Regional climate change projections scenarios developed
- Species abundance and distribution in selected ecosystems from at least three main ecological zones assessed
- Models of species response and distribution under different scenarios of climate change developed
- vulnerability of different species to climate change assessed
- Impact of changes in forest biodiversity and forest based livelihoods assessed
- Germplasm of crop species in face of climate change identified.

#### **4.1.6 Assessment of smallholder forestry potential for climate change mitigation, adaptation and rural development**

The accelerating depletion of natural forests in Tanzania has increased the importance of smallholder forestry including on-farm/off-forest tree planting, smallholder woodlots (e.g. *Ngitiri*), and small-scale natural forest management in sustaining forestry production, conserving the environment and improving people livelihoods. This puts smallholder forestry practices at the forefront in climate change mitigation through carbon emission mitigation. Research in this aspect will determine the potential of smallholder forestry in addressing climate change issues while contributing to rural development. It includes determination of the potential of the practice for GHG emission reduction credits, and the relevant carbon finance mechanisms. Furthermore, there is a need to map smallholder forests in Tanzania and assess their contribution to carbon emission mitigation and related socio-economic and rural development impacts.

Outputs under this theme will be:

- The potential of smallholder forestry to address climate change issues assessed.
- The potential of the smallholder forestry for GHG emission reduction and the possible carbon finance mechanisms determined
- Contribution of smallholder forestry to carbon emission mitigation and associated socio-economic and rural development effects assessed.

#### **4.1.7 Financial analysis of C sequestration**

Estimates of C stocks in the forests and carbon sequestration will be undertaken for estimates of the potential carbon benefits of the project in forest management in Tanzania and estimates of potential revenues. Deforestation avoided business cases will be based on detailed analysis of investment costs and administrative costs including costs related to the management of the forests e.g. staff salaries and a preparation of an investment model showing costs, revenues and other returns for each option of C sequestration/storage with detailed budget and finance plan. The major issues to address here include the project profitability and the costs of the carbon stored or being sequestered. Further under deforestation avoided business case a determination of the potential of forests for GHG emission reduction credits and the possible carbon finance mechanisms that may apply to forest management (Carbon Market Options) will be determined. This will aim to explore and outline the potential mechanisms for carbon finance through which deforestation avoidance carbon can be traded (REDD). Such mechanisms may be those which concurrently address biodiversity conservation and rural livelihoods.

Outputs under this theme will be:

- Investment model for each option of C sequestration developed and tested
- The potential of forests for reduced GHGs emission, credits distribution and possible carbon finance mechanisms established.

#### **4.1.8 Development of strategic interventions for adaptation in forestry and other land uses**

Under climate change, an increase in temperature and rainfall in some areas are likely to improve conditions for forest growth through natural regeneration or reforestation in the areas with a bimodal rainfall pattern, whereas further degradation is expected in the areas with unimodal rainfall pattern. Strategic areas of research for adaptation in forestry and other land uses include research on trees that have high growth potential but use less water for afforestation and land use practices that maximize water retention and conserve moisture levels in order to reduce the impact of afforestation/reforestation on water resources while increasing the potential for forestry to mitigate climate change.

One of the important land uses is human settlement. Under changing climate, human settlements are vulnerable to extreme climatic events such as floods. However the expected impacts, degree of vulnerability and adaptation strategies are not well known. This programme will address some of these deficiencies.

Other areas of focus will include conservation tillage, better options for soil fertility and soil conservation, water conservation strategies may include adapting Sahel region agricultural farming systems in areas where drought will persist. Other options will include crop production adapted to climate change scenarios such as developing and evaluating suitable crops /varieties that are location specific and adapted to current climate change scenarios, various cropping systems developed for agroforestry in relation to adaptation to climate changes, benefits for inclusion of windbreaks in large farms identified and increased farm production efficiency.

Outputs under this theme will be:

- Tree species with high growth potential and less water use for afforestation/reforestation identified
- Land use practices that maximise soil and water conservation, energy and carbon sequestration identified
- Best practices for afforestation/reforestation developed
- Human settlement vulnerability and adaptation strategies to climate change established.

#### **4.1.9 Assessment of new and innovative agricultural land use and farming systems for adaptation to and mitigation of climate change to support REDD initiatives**

This component will include development of land capability maps, vulnerability mapping, crop diversification for enhanced carbon storage and sequestration and promotion of urban nurseries for fruits, ornamental and shade or avenue trees.

These objectives will be achieved through development of baseline methodology for quantification of carbon storage under new land use systems, development of vulnerability maps based on models and predictions under different land use systems, undertaking economic analysis and opportunity costs for use of a given land for carbon storage use systems, vulnerability maps based on models and predictions under different land use systems and C sequestration. Assessment of the potential for intensified inclusion of fruit trees and other plantation crops in land use systems for carbon storage and sequestration, promotion and enhancement of small urban nurseries for ornamental landscaping plants and fruit trees.

Outputs under this theme will be:

- Baseline methodology for quantification of carbon storage under new land developed
- Economic analysis and opportunity costs for use of a given land for carbon storage and sequestration undertaken
- The potential for intensified inclusion of fruit trees and other plantation crops in land use systems for carbon storage and sequestration and promotion assessed
- Small urban nurseries for ornamental landscaping plants and fruit trees promoted.

#### **4.1.10 Development and testing of various range land management strategies for the purpose of reducing pressure on forest resources for adaptation and mitigation to climate change**

This research component will involve development of rangeland management strategies for adaptation and mitigation.

Output under this theme will include:

- Rangeland management strategies for adaptation and mitigation developed.

#### **4.1.11 Assessment of effective communication channels in delivery of climate change information**

Communications are necessary for informing, gathering, reporting, and promoting and disseminating information on various aspects of the climate change mitigation and adaptation. Timely, substantive, and informative communications are necessary to notify participants, partners, and stakeholders. The communication channels to be used for climate change information transfer should be the ones which are appropriate and effective and thus have the potential to increase stakeholders' knowledge base and make them active participants in adaptation and mitigation to climate change.

#### **4.1.12 Information documentation on perception and adaptation strategies to climate change issues among rural communities**

Climate change is an environmental social and economic challenge that is aggravated by human influenced actions through various activities. Particularly poor and marginalized people are the ones who are main victims of climate change.

Potential affirmative expectations for devastating circumstances of climate change are predisposed to people who can prevent deforestation and effectively manage natural resources. It is therefore crucial to get local peoples' knowledge and perceptions on climate change and their preference of strategies for adaptation.

Outputs under this theme will be;

- Identify and acquire insight on how local people conceive , interpret and adapt climate change
- Identify options for information that will help policy makers for positive impact on the livelihood of rural communities

### **4.2 Assessment of Climate Change Impacts and vulnerability on Ecosystem Services Under REDD Initiatives**

Ecosystems provide numerous benefits such as forest products, services such as carbon sink, flood mitigation, aesthetic value including ecotourism, and nurseries for commercial fisheries. As climate change will affect ecosystem structure and functions to varying degrees, we need to monitor trends and make projections of provisioning of ecosystem services under different climate stressors. Ecosystems should be managed in ways that take into account the varying impacts of and adaptation to anticipated climate change scenarios under different management options. The management options must therefore be developed and tested for their ability to increase ecosystem resilience against climate change stressors. In addition, ecosystem services interacts with each other and hence in analysing their responses of ecosystem services to climate stressors and management options, their interrelationships among need to be elucidated.

The assessment on climate change impact on ecosystems services will aim at providing a scientific framework for informing societal decisions regarding the effects of climate stressors on ecological services. Such a framework would likely include innovative methods such as those derived from Geographic Information Systems (GIS), multi-objective attribute analysis, and systems analysis, as well as means to estimate errors inherent in projections.

It is important to recognise also that designing effective adaptation strategies requires understanding on how vulnerability varies at different scales from the level of local communities to national economies. Despite the consensus in the scientific literature that vulnerability to climate change is highly scale-dependent, few studies to date have examined how local vulnerability assessments can be integrated with top-down, or national-level assessments. A number of authors and studies therefore propose the development of a methodology that brings together “bottom-up” and “top-down” approaches to climate change vulnerability assessments (O’Brien *et al.*, 2003; O’Brien *et al.*, 2004; Aall & Nordland, 2005; Tyler *et al.*, 2007). This work package integrates these approaches, exploring how national policies frame adaptation in local communities and at the same time what implications responses in local communities may have on the national scale, thereby enabling an analysis of adaptation responses across scales. Main activities, with their outputs, are as elaborated in subsequent sections.

#### **4.2.1 Establishment of trends and projections of ecosystem services due to climate stressors**

Deliverable under this theme will be:

- Trends and projections of ecosystem services due to climate stressors established.

#### **4.2.2 Model effects of alternative management options on ecosystem services under changing climate**

Deliverable under this theme will be:

- Effects of alternative management options on ecosystem services under climate change stressors determined
- Model on effects of alternative management options on ecosystem services under changing climate developed

#### **4.2.3 Development of methods to describe relationships between ecosystem services, climate stressors and management responses**

Deliverable under this theme will be:

- Methods for analysing relationships among ecosystem services, climate stressors and management responses developed.

#### **4.2.4 Assessment of local vulnerability on biodiversity and forest related livelihoods and adaptation options**

The purpose of the assessment is to a) advance understanding of community vulnerability and adaptation to climate change in Tanzania by considering the contexts of peoples’ interactions with their natural environments at the local level, and what the implications of this are for adaptation planning at local, regional and national levels, b) to explore local factors that complement, contest, or modify vulnerability and adaptation indicators suggested in the macro-economic assessment (4.5.2).

The proposed research takes its starting point in the concept of vulnerability as broadly defined in the human dimensions of climate change literature, which recognizes that human vulnerability is a function of exposure, or sensitivity to climate change, as well as the capacity to respond to climate-related changes, also referred to as adaptive capacity (IPCC, 2001). Adaptive capacity varies across individuals, regions, sectors and social groups; those that possess the necessary resources (wealth, technology, education, skills, employment options, access to resources, or others) to respond to climate change are likely to be less vulnerable than those that lack access to the resources and capacities necessary for effective adaptation (McCarthy *et al.*, 2001). The research also recognizes that climate change – and peoples’ responses to it – does not occur in isolation from other change processes that simultaneously affect them. Changes in societal, cultural, economic, environmental, and political conditions are occurring around the globe. While these changes will be experienced at all levels of society, they pose particular challenges for local communities, who must respond to their manifestations in their everyday lives.

At a local level, adaptive capacity is reflected in the ability of a community to manage current and past stresses, its ability to anticipate and plan for future changes, and its resilience to perturbations, climate and otherwise. In conducting a vulnerability assessment, there is therefore a clear need to identify the factors that influence local vulnerability and adaptation to climate change. Identifying the factors that influence local vulnerability and adaptation in turn requires knowledge of the priorities and perspectives of local people experiencing this change. Environmental, economic, social, cultural and institutional factors (among others) affect peoples’ vulnerability to climate change. These factors are crucial for the social and economic evaluation of the impacts of climate change also in developing national strategies, but poorly described in planning tools for national policies, such as macroeconomic models. In this part of the project, lessons from local vulnerability assessments focused on the agricultural sector in different communities will be used to improve the representation of adaptation in the macroeconomic model.

The proposed research explores vulnerability and adaptation options and constraints at the local level, in Tanzania with a focus on agricultural systems and the socio-economic contexts in which they are embedded, and evaluates their functioning under current and future climate stress. We suggest a focus on (i) vulnerability assessment in selected case study sites combined with (ii) an assessment of adaptation options, focusing on institutional constraints and opportunities across scales.

The case studies will explore among others, the following factors:

- Past, current and future climate risks (biophysical exposure)
- Livelihood support resources to current and future climate risks (biophysical and social sensitivity)
- Perceptions of climate risks and vulnerability, and how these have changed over time, at the individual, community and institutional levels
- Options for adaptation to current and future climate risks and the ability to implement them, given socio-economic constraints and opportunities.

#### **4.2.5 Assessment of macroeconomic impacts in forest resource management and its implication for different ecological zones**

The Purpose here is to forecast implications of climate change to the Tanzanian economy through its impacts on economic sectors and factors of production in Tanzania. Impacts on agriculture and forestry will be emphasised to reflect possible land-use changes resulting from combinations of climate changes and adaptation and mitigation strategies.

It has been emphasised that adaptive capacity and vulnerability to climate change is strongly dependent on non-climatic factors, such as economic and social development and other structural changes. Assessments of vulnerability therefore have to include considerations of other changes than those driven purely to climatic factors, such as social and economic conditions on the national scale. These national drivers are also subject to climate change, and the vulnerability of humans and ecosystems on the local level should therefore be considered as a simultaneous process of change both on the national and on the local levels. In most assessments of vulnerability these national drivers are considered external or exogenous. At the same time, national planning tools, such as macroeconomic models, fails to sufficiently take variation in local conditions into account. The case studies in other work packages of this project provide, however, a unique opportunity to improve the representation of these local variations. Applying an integrated macroeconomic model thus enables a more comprehensive analysis of vulnerability by providing a simultaneous assessment of climate induced changes on the local and the national levels.

The model to be used is a computable general equilibrium model GRACE, which can be used optionally for one or more countries (Aaheim and Rive, 2005). Computable general equilibrium models are relatively standard tools for macroeconomic analyses of growth processes. In the present version of GRACE, the economy is represented by eleven sectors, and the choice of sectors is optional. Impacts of climate change are represented by effects on factors of production (such as productivity of agricultural land) and on cross sector deliveries throughout the economy (such as demand for energy). In economic terms, climate change thereby affects the resource constraints and the “technology” of the economy, and these changes spur shifts in supply and demand to which economic agents adapt.

A weakness in applying macroeconomic models to address adaptation to climate change is their use of national accounts data, which in principle means that all activities take place in one fully mobile market. By consequence, available resources therefore switch spontaneously between sectors as the need for adaptation occurs. In reality, a main challenge in adapting to climate change is related to the fact that resources are immobile: people get unemployed, capital equipment can be used for a limited range of appliances, and natural resources have to be utilized where they are. To take these limitations into account, the GRACE model splits the national economy into regions for which immobile resources and activities are subject to regional markets. This allows variability in climatic changes and vulnerability to be analysed by the model.

Finally, impacts and adaptation in the forestry sector is represented by a module that relates harvest partly to the standing stock of the forest and partly on the economic investments needed to access the forest. “Economical” forests are thereby distinguished from “non-economical” forests, and the question of harvesting is subject to economic conditions such as timber prices, the price of land and the value of other services provided by forests, such as the price of carbon.

The model will be adjusted and improved for the analyses of this project. It will have to be adapted to the Tanzanian economy by means of input-output data from the national accounts for Tanzania. Moreover, two more basic extensions will be made:



First, impacts on climate change and alternative ways of adaptation in agriculture will be represented by a separate module, and based on the outcomes of other work-packages in the project. As of now, the impacts on agriculture are described simply as a change in the productivity of land. By adapting the present forestry module in the model to Tanzania, analyses of competition between agriculture and forestry can be carried out for the national scale.

Second, an informal sector representing farming only partially integrated in the economy will be included in the model. Applying general equilibrium models in developing countries is problematic because the welfare for a large part of the population is not, or only slightly, related to traditional economic activities, such as income from wages. At the same time the welfare of people in the informal sectors may be strictly dependent on natural resources, which also has a value in real economic terms. A competition about the resources between economic businesses and the informal sector thereby occurs. The local studies of adaptation and vulnerability aim at a better understanding of possible conflicts arising from this competition, and to suggest ways out. Based on the results of these local studies, a separate module will be established to address issues related to welfare and distribution in subsistence farming.

Outputs under this theme include:

- Macroeconomic model with extension of impacts on climate change established
- Alternative ways of adaptation in different ecological zones integrated in the economy developed.

#### **4.2.6 Integrated analysis and synthesis of lessons learned from adaptation options and macroeconomic impacts**

Local adaptation and vulnerability assessments will be made with reference for specific climate scenarios for each of the case study areas. The relevance of the case study results will be discussed in relation to local adaptation and vulnerabilities in other parts of Tanzania, also in order to implement relationships between climatic changes and local conditions in the macroeconomic model. Based on the same climate scenarios, forecasts of the Tanzanian economy will be made with reference to different adaptation strategies both on the national and the local scale.

Deliverable under this activity will be adaptation options to reduce macroeconomic impacts proposed.

### **4.3 Policy and Legal Framework Analysis of Climate Adaptation and Mitigation with Emphasis on Economic Efficiency, Ecological Effectiveness and Wider Political Legitimacy**

This part will focus on the following areas: Analysis of Tanzania climate related policies; main goals, measures, instruments and policy institutions and frameworks on both adaptations to climate change and to mitigation. Consistency, multifunctionality, efficiency, effectiveness, legitimacy are as important policy criteria concerns.

Land in Tanzania is under continuous siege from a variety of user interests, actors and segments including land for subsistence forestry, NTFPs, agriculture and livestock, commercial export production and biofuels, biodiversity protection and urban development. Land competition is also prevalent both in climate change adaptation and mitigation efforts and also between the purposes. How are such competing interests balanced in the present policies and policy implementations?; Analysis on how various REDD initiatives are politically addressed through markets, private and public sector management, and through civil society in its various forms; How may choice of implementation arenas impact on policy delivery. In relation to mitigation efforts, natural forest management, plantations and community based forests are possible avenues. These options are different concerning a number of important governance aspects; such as the distribution of local and national powers and resources, the involvement of different policy structures and processes including institutional arrangements such as rights and tenure; Assessment of cost-efficiency and transaction costs, issues of legitimate governance and distribution in different institutional arrangements, challenges relating to incentive structures and motivational factors, and problems of monitoring, controls, leakages and additionality. These are all factors of concern in a policy formulation and implementation context.

- Analysis of climate change related policies and legal framework in Tanzania; main goals, measures, instruments and policy institutions and frameworks on both to climate change adaptation and mitigation. Consistency, multi-functionality, efficiency, effectiveness, legitimacy are as important policy criteria concerns.
- Analysis of land competition in the context of climate change adaptation and mitigation efforts and how the competing interests are balanced in the present policies and policy implementations. Land in Tanzania is under continuous siege from a variety of user interests, actors and segments including land for

subsistence forestry, NTFPs, agriculture and livestock, commercial export production and biofuels, biodiversity protection and urban development.

- Analysis of various REDD initiatives that are addressed through markets, private and public sector management, and civil society.
- Determine how institutional arrangements and governance affect various forest management regimes (CBFM, Plantations, Private forests, general land forests and forest reserve) in the context of climate change. How may choice of implementation arenas impact on policy delivery? In relation to mitigation efforts, natural forest management, plantations and community based forests are possible avenues. These options are different concerning a number of important governance aspects; such as the distribution of local and national powers and resources, the involvement of different policy structures and processes including institutional arrangements such as rights and tenure.
- To determine the feasible incentive structures, monitoring mechanisms, controls leakages and additionality to influence policy formulation and implementation for climate change adaptation and mitigation. There are also issues around cost-efficiency and transaction costs, issues of legitimate governance and distribution in different institutional arrangements, challenges relating to incentive structures and motivational factors, and problems of monitoring, controls, leakages and additionality. These are all factors of concern in a policy formulation and implementation context.

The potential for climate change mitigation and adaptation greatly hinges on local, regional and international legal and policy frameworks. It also depends much on the awareness of stakeholders and policy makers with regard to climate change issues. In this respect, awareness on climate change initiatives among stakeholders will be one of the focus areas of the program. Furthermore, the program will undertake a detailed analysis of policies and other legal instruments that relate to climate change mitigation and carbon financing. Such analysis will include issues related to land ownership, change of use and reallocation/reassignment, the appropriateness of the forest policy to address climate change issues, land tenure aspects that may well influence the potential for climate change mitigation and adaptation through forest management. The program will also review contemporary global instruments and agreements that are related to C markets and their operation in Tanzania. Further the analysis will include establishment of climate change policy linkages at sectoral, national, regional and global levels. Assessment of constraints and opportunities in regard to global carbon financing mechanisms such as CDM & REDD and voluntary markets, assessments of potential incentive systems and risks for implementing REDD and CDM programme/projects for Tanzania with emphasis on community participation is also required. This analysis will help build a legal case for establishing 'deforestation avoided' carbon service payments in Tanzania as well as potentials for CDM and voluntary markets.

Outputs under this theme include:

- The balances between competing interests over the land in the present policies and policy implementations identified
- How various REDD initiatives are politically addressed through markets, private and public sector management, and through civil society in its various forms identified
- Policy linkages at different levels in regard to climate change mitigation and adaptation determined
- Constraints, risks and opportunities for global carbon financing mechanisms and potentials determined.

## **5.0 CONTEXTUALIZATION OF THE FOCUS AREAS ON CAPACITY BUILDING**

Experiences from the various training institutions indicate that very few institutions provide courses that address climate change issues in various degree programmes. Even where these training programmes exist, each course is taught separately, and often without sufficient linkages to biodiversity and ecosystems services. The purpose of this programme is to provide courses on climate change at postgraduate level. In addition, the programme will support short courses on climate change issues. The training programme will among other issues capture aspects of interactions between climate, vegetation, biodiversity, soils, livelihoods, and the associated dynamics. Another key component of training programme would be to make use of established linkages to address issues of adaptation and mitigation aspects of climate change.

Considerable skills on climate change, vulnerability, adaptation and mitigation exists within the partner institutions. An example of such experience is the education programme on Climate Change and Biodiversity Conservation that was implemented by the IRA-UDSM. Such experience will be exploited to ensure effective implementation of the capacity building programme. SUA has vast experience on issues of forest and general ecosystem management and climate change mitigation which could be used to build further capacity at various levels. These experiences will as well be completed by other partner institutions.

The contribution of developing countries including Tanzania, to climate change initiatives is limited by inadequate climate data and data processing equipment. Insufficient and ineffective observational station network, lack of instruments and equipment, infrastructure, telecommunications systems, and information dissemination facilities hamper efforts to conduct climate change studies. Limited access to climatological data from global centres running climate models also contribute to the inability of third world countries to effectively participate in the climate change initiatives. Results of both simulation and prediction from Global Circulation Models have a lot of uncertainties over tropical Africa because of inadequate climate data and less effort to fine tune these models in the region. Inadequacies of data and data processing capabilities make it difficult to effectively analyze the risks and potential impacts of climate change so as to develop viable mitigation and adaptation solutions. This programme is expected to address issues of data availability and climate modelling by facilitating infrastructure and human capacity development.

### **5.1. Develop and Undertake Human Capacity Building to Address Adaptation and Mitigation to Climate Change**

- Train more people (professionals, technocrats and smallholder farmers/producers) to create, strengthen and sustain the requisite critical mass of informed role players in management of climate change effects
- Development and implementation of Short Courses for policy makers, training of trainers and special skills for scientist in climate change (mitigation and adaptation strategies)
- Given the serious deficiencies in qualified manpower to address climate change issues, this programme will put much emphasis on training of Tanzanians to develop the capacity. Training will focus on the following key areas: forestry, land use, biodiversity and ecosystem services, sustainable agriculture and farming systems, modelling and vulnerability assessment
- Therefore, training will focus on two postgraduate degree categories i.e. MSc and PhD. Priority will be given to qualified female applicants and relevance to the research themes. Fifty percent of the candidates in each degree category will be trained in themes related to climate change in forestry, land use, biodiversity and ecosystem services, while 30% of the students will be trained in themes related to climate change in sustainable agriculture and farming systems. The remaining 20% of the students for each degree category shall be trained in themes addressing modelling and vulnerability with respect to climate change. The number of students will depend on national and institutional requirements
- There shall be two calls for MSc students where each call will enrol 25 students. The first and second call will be in year one and two respectively. PhD scholarships will comprise of one local call for 14 applicants and one call for 3 Norwegian applicants. At least 40% of the applicants from Tanzania for both MS and PhD degrees will be females
- Postgraduate students to be trained under this Programme will be required to undertake research projects that address mitigation and adaptation to the impacts of climate change
- In addition to the postgraduate training identified above, specialized training courses will be conducted in areas such as atmospheric and ecological modelling in relation to climate change. This training component shall target both technicians and scientists for upgrading their skills

- Enhancement of special skills in modelling for technicians and scientists
- Engagement of young professionals in exchange programmes. This will involve Norwegian and Tanzanian postgraduate students and other young researchers in collaborative research projects to acquire skills and/or exposure to experiences that may add value to their study programmes
- The exchange programme will also involve senior scholars for retooling and undertaking special studies to enhance their understanding on climate change issues of particular relevance to the REDD initiative. Exchange of senior scholars will involve both Tanzanians and international scholars with special emphasis to Norwegian scholars.

Outputs for capacity building will be:

- Human resource capacity to address technical and socio-economic challenges of climate change strengthened
- The process of operational and technical capacity of national institutions and key stakeholders to develop, disseminate and make use of climate knowledge, products and adaptation plans enhanced
- A core team of research and extension experts within the region for development and dissemination of climate information for providing advisory support for rural communities built.

## **5.2 Develop/Rehabilitate Physical Infrastructure to Address Adaptation and Mitigation to Climate Change**

- Establishment of database to pool all information generated by the programme
- Provision of equipment (e.g. weather monitoring equipment (Automatic Weather Stations), data loggers, GIS software and equipment, computers)
- Provide reliable internet services and connectivity in partner institutions, including subscription to e-resources applicable to this programme, to facilitate access of scientific information for research
- Strengthening existing climatologically monitoring station network and communication system by TMA
- Strengthening the existing climate research and establish modelling laboratories
- Avail hardware and software for short course training of various participants on modelling climate change effects
- Improvement of field research laboratory at Mazumbai Montane natural rain forest for monitoring of climate change impacts on high forest ecosystems and related biodiversity
- Strengthening of research laboratory for monitoring of climate change impacts on aquatic ecosystems and related biodiversity at UDSM
- Acquire tide gauges for continuous observation reference station for sea level monitoring by ARU.

## **6.0 CONTEXTUALIZATION OF THE FOCUS AREAS ON STRATEGIC INTERVENTION FOR CLIMATE CHANGE ADAPTATION AND MITIGATION**

Strategic interventions will address issues of cross-cutting nature including supporting NGOs and grass root operators on considered interventions to reduce carbon emissions and save forests. This will allow the Programme to respond to needs emerging in the course of the implementation of the Programme. It may contain advisory services, programme owned pilot or demonstration projects and exchange of postgraduate students. Some of these issues are highlighted below.

Some of the strategic intervention needs include:

- Document existing REDD related activities and technologies and report the same to relevant meetings
- Develop and deliver community-based projects aimed at alleviating poverty through different approaches to climate change adaptation and mitigation
- Support CDM and REDD demonstration projects
- Support demonstration projects at community level on biofuels technologies and options to support REDD implementation
- Value chain analysis of farming in Tanzania for reduction of Green House Gasses (GHG) emissions
- Provision for advisory and developmental services on emerging constraints in adaptation to climate change by small producers.

Detailed and context specific knowledge of the consequences of climate change is vital for mitigating against the negative effects of climate change. A number of research studies on forestry, environmental, land use and other climate change related subjects have been undertaken in Tanzania. The results of these studies are kept in the institutions and are not easily accessible to stakeholders.

Therefore, in order to facilitate access of research results from existing and future research on climate change, strategic intervention will also address

- collection and documentation of climate change information in Tanzania
- creation of an online open access climate change information repository

This intervention will enhance availability and accessibility of climate change information as well as increasing the visibility of Tanzania's climate change information (local content) on the web.

## **7.0 CONTEXTUALIZATION OF THE FOCUS AREAS ON DOCUMENTATION, COMMUNICATION AND DISSEMINATION**

The output from this research programme is expected to inform various stakeholders including scientific community, policy developers and key decision makers; and environmental managers and communities on issues relevant to climate change impacts, vulnerability, adaptation and mitigation needs and practices. Furthermore the dissemination will entail issues of sustainable utilization and management of various natural resources and ecosystems in Tanzania while responding to people's livelihoods in general. Emphasis will be on addressing particularly strategic interventions and cross-cutting issues of relevance to the policy and decision makers.

Dissemination of the research results will be in form of publications targeting various stakeholder groups, including local communities in the respective study areas, as well as district, regional national stakeholder and the international global change groups. Results will also be disseminated through participatory workshops, presentations in conferences and seminars, as well as publications in form of books, journal articles, leaflets and policy briefs and popular prints for the media. In addition, each research project will provide its own dissemination strategy. However, outreach activities will involve existing organizations in REDD pilot areas such as NGOs, and research institutions including TAFORI.

In addressing matters of documentation, communication and dissemination use will be made of various communication media including printed matter, audio and visual programmes as well as electronic media.

Further, enhancement of information resource bases in participating institutions will involve building and sharing of electronic information resources as well as building and sharing capacity in development and maintenance of institutional repositories relevant to CCIAM programme and other challenge of climate change.

Awareness creation on climate change will be done using posters, news papers, radio, television (News Media), advertisements as well as other forms of entertainments including contemporary music , traditional songs and dances.

Outputs from the dissemination and out reach shall include:

- Enhanced understanding about climate change and its impacts under REDD initiatives
- Increased awareness of the risks and opportunities associated with climate variability and change under REDD initiatives
- Enhanced understanding of vulnerability of ecosystems to climate change
- Adaptation and mitigation strategies to manage the impacts of climate change using the REDD initiatives
- Skills to identify climate information needs of various stakeholders for improved natural resource management.

## **8.0 PROGRAMME STRUCTURE, MANAGEMENT AND COORDINATION**

The programme organisational structure is shown in Figure 8 and items of the organisation structure are described in the following sections.

### **8.1 Institutions Involved**

#### **8.1.1 TANZANIA**

##### **Sokoine University of Agriculture (SUA)**

- Directorate of Research and Postgraduate Studies (DPRGS)

##### **University of Dar es Salaam (UDSM)**

- Directorate of Research and Publications

##### **Ardhi University (ARU)**

- Postgraduate Research and Publications

##### **Tanzania Meteorological Agency (TMA)**

- Director Research and Training

### **8.1.2 NORWAY**

#### **Norwegian University of Life Sciences (UMB)**

- UMB will serve as an anchoring institution in the north for the purpose of identifying and engaging participating Norwegian institutions as sought by the programme
- UMB shall coordinate a visit for the collaborating institutions to Norway in order for them to acquaint themselves with Norwegian science and research organisations for further collaboration.

### **8.2 Programme Administration and Management**

#### **8.2.1 Programme Co-ordination**

There shall be a Programme Director responsible for overall programme guidance. However, for effective day to day administration follow-up of activities, there shall be a programme coordinator who shall have the overall executive responsibilities. In this respect, the programme coordinator shall be the secretary for the Programme Management team where as the programme director shall be the chair person. For smooth linking and networking between participating institutions, there shall be designated Institutional Programme Co-ordinators (IPC) for each of the participating institution (in the office of Director responsible for Research). There shall also be one Coordinator at UMB for the collaborating institutions in Norway.

Organisation and administration of the Programme shall be governed by the Grant Contract Agreement between the Government of the United Republic of Tanzania and the Government of the Kingdom of Norway. The overall governance of the programme shall be vested in the Annual Meeting which is a summit organ of the programme that brings together representatives of the Government of the United Republic of Tanzania and the Government of the Kingdom of Norway. The overall responsibility for guidance of the programme/projects shall rest on the Joint Programme Steering Committee which shall have representation from all the Tanzanian and Norwegian institutions participating in the programme.

The Committee shall be referred to as the Steering Committee for Climate Change Impacts, Adaptation and Mitigation (CCIAM) Programme. The execution of day to day activities of the programme/projects shall be administered by the Coordinator and Institutional Coordinators and shall be guided by the Programme Management Team chaired by the SUA Director for Research and Post Graduate Studies as the Programme Director.

The coordination hub of the programme shall be located at SUA which is the programme main contract holder. For purposes of ownership and accountability, the participation of each side and each institution shall be guided by a subcontract to be drafted between the Principal Contract holder and the other participating institutions. This programme shall operate under the following organizational set-up:

- Annual Meeting
- Joint Steering Committee
- Programme Management Team (PMT)
- Institutional Programme Coordinators.

#### **8.2.1.1 Annual Meeting**

There shall be an Annual meeting chaired by the Permanent Secretary, Ministry of Education and Vocational Training (MEVT). Other members shall include:

- SUA Management
- Representatives from Collaborating Institutions (UDSM, TMA, ARU)
- Representative from the Ministry of Natural Resource and Tourism (Forestry and Beekeeping Division)
- Representatives from the Vice President's Office (Division of Environment), Ministry of Finance and Economic Planning, Ministry of Foreign Affairs, Ministry of Agriculture, Food Security and Cooperatives, and COSTECH
- Representatives from RNE
- UMB Rector or his representative and One Norwegian Institutions Representative

The Programme Coordinator shall be the Secretary to the meeting and shall ensure that the following are undertaken:

- Meeting documents together with the notice of the meeting are made available to members one month before the meeting
- Minutes of the meeting are drafted and sent to the Chairman and RNE for comments not later than two weeks after the meeting
- Agreed Minutes are signed by both parties and distributed to members not later than one month after the meeting.

Annual meetings shall be held in November and their main functions (TOR) shall be to:

- Review the progress and overall performance of the programme
- Discuss and approve proposals for extension of on going or new projects
- Approve work plans and budgets for the next financial year
- Receive and discuss issues of special concern for implementation or for future action.

#### **8.2.1.2 Joint Programme Steering Committee**

Based on the nature of the proposed programme, that include multi-disciplines and coordinated activities from different participating institutions, the joint steering committee shall be designed to accommodate this nature. It is proposed that three members from each of the participating institutions will be required. The three members will include a representative of the management (VC/DG-TMA), Directors responsible for research in each of the participating institutions, and a subject matter specialist. The Programme Coordinator will have the duty to advise the Steering Committee on technical matters. The committee will also incorporate one member each from MNRT, VPO-ENVIRO, MoAFSC and COSTECH. From the Norwegian side, members to the Joint Steering Committee shall include one representative from UMB and one representative from the other collaborating institutions in Norway on a rotating basis.

The Terms of reference for Joint Steering Committee shall be:

- Have oversight and overall ownership of the programme
- Provide guidance and review implementation of the programme
- Review, consider and approve research projects, progress reports, work-plans and budget prior to submission to Annual meetings
- Approve concept notes, research proposals and grant awards to winning proposals
- Discuss and approve proposals for extension of on going or new projects
- Approve changes/deviations on approved work-plans and budgets
- Receive, discuss and Approve any appropriate recommendations from the PMT for enhancing performance of the programme
- Monitor overall strategic direction of the programme and assess alignment with and progress towards programme goal
- review annual budgets and expenditures and advise the Annual Meeting on the course of the programme
- review program progress and verify that program objectives are being met

Decisions of the Steering Committee shall be binding unless revoked or amended by the Annual meeting.



### **8.2.1.3 Programme Management Team**

The PMT will be responsible for technical coordination of the programme. The PMT composition shall be as follows:

- Programme Director who will also be the Director for Research and Postgraduate Studies at SUA who will chair the PMT meetings and also be responsible for the overall governance of the programme.
- Programme Coordinator will be responsible for technical coordination of the overall programme.
- Institutional Programme Co-ordinator (IPC) at UDSM
- Institutional Programme Co-ordinator (IPC) at ARU
- Institutional Programme Co-ordinator (IPC) at TMA
- Institutional Programme Co-ordinator in Norway –NORAGRIC- UMB

### **8.2.1.5 Terms of Reference for PMT**

The Terms of reference for PMT, which shall meet at least once every three months, shall be:

- To implement and/or preside over implementation of all decisions of the Steering Committee
- To monitor and evaluate progress of all Programme components
- To receive and discuss progress reports from Component and Sub Component leaders for the appropriate reference term
- To receive and discuss work plans and budgets before they are submitted to the Steering Committee for the appropriate reference term
- To ensure that decisions made by the Steering Committee or Annual meetings are implemented
- To ensure that Programme/Project activities are known and reported to appropriate stakeholder organs
- Approve names and members forming Research Management Team (RMT)
- To undertake other duties aimed at enhancing programme performance
- To prepare and recommend to the Steering Committee for approval annual budgets, annual reports and subsequent annual plans

### **8.2.1.6 The Programme Director**

The Director responsible for Research at SUA shall be the Programme Director (PD). The Programme Director (PD) will be the overall in-charge on matters of implementation of the programme. The PD shall be assisted by one Programme Coordinator. The Programme Coordinator shall be appointed by the Vice Chancellor of SUA from amongst SUA staff, upon recommendation of the Programme Director to the Chairman of the Joint Steering Committee. One Institutional Programme Co-ordinator (IPC), shall be appointed by each of the collaborating institutions. The organisation structure is summarized in the organogram attached in Figure 8. The Programme Director (PD) Terms of Reference shall include:

- Chairing the Programme Management Team
- Following up on recommendations of THEDC
- Liaises with IPCs on matters relating to implementation of their respective sub-components
- Monitoring overall project implementation and its adherence to the project objectives
- Reviewing annual implementation and procurement plans submitted by participating institutions, prior to their submission to the PMT and the Joint Steering Committee.
- Ensuring compliance to programme document and programme agreement.
- Submitting half yearly expenditure statements to the RNE

- Requesting for disbursements of programme funds from the RNE and apportioning them to different components or cost centres as guided by the approved Work plans and Budgets, Programme document and Contract Agreement.
- Ensure that programme accounts are properly maintained and annual auditing of accounts is done on time

#### **8.2.1.7 Program Coordinator**

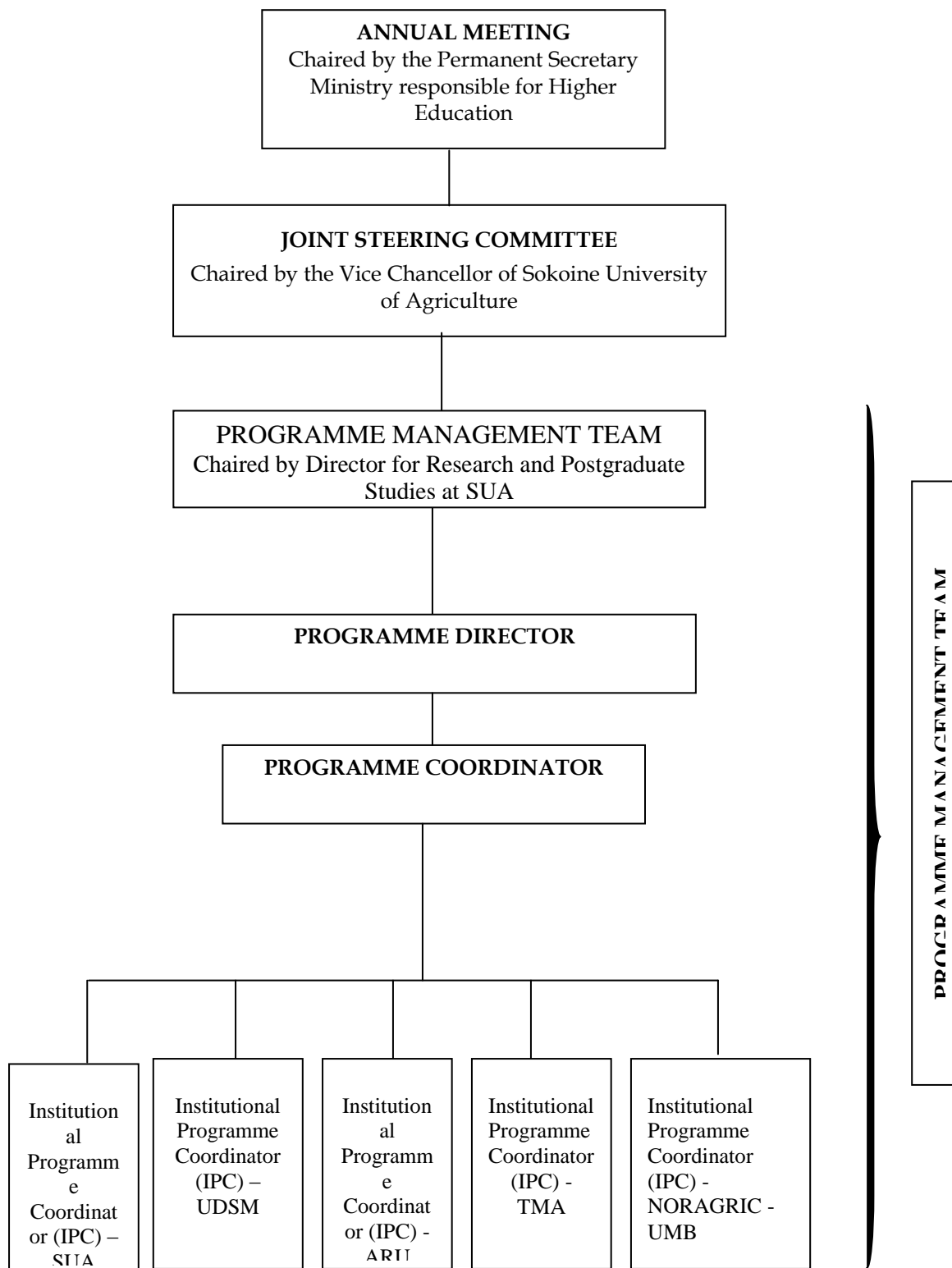
There shall be a Programme Coordinator (PC) appointed from amongst academic staff of SUA to assist the Project Director to undertake day to day management and administration of the project. The Terms of Reference for the Programme Coordinator shall include to:

- Monitor and coordinate overall program execution
- Coordinate research, capacity building & training and Outreach and Documentation activities from collaborating institutions
- Coordinate and compiling together reports received from the Institutional Programme Co-ordinator (IPC) before they are submitted to the PMT, Steering Committee or Royal Norwegian Embassy (RNE)
- Ensure that documentation required by the PMT for purposes of monitoring, evaluation and decision making are prepared and provided on time
- Collect and review project M&E reports
- Prepare budget estimates for the program, for approval by the Director and for consideration by the steering Committee and ultimately the Annual Meeting
- Review and consolidate progress reports submitted by project leaders and participating institutions
- Prepare programme's progress reports to be submitted to the Joint Steering Committee
- Liaise with IPC on technical matters of the program
- Be the Secretary to the PMT and Annual Meetings.

#### **8.2.1.6 Institutional Programme Co-ordinator (IPC)**

There shall also be one Institutional Programme Co-ordinator (IPC) from each of the four collaborating institutions in Tanzania. There shall also be one Coordinator at UMB in Norway for all the collaborating institutions in Norway. The TOR for Institutional Programme Co-ordinator (IPC) shall include:

- to ensure that institutional objectives for program components are being met
- to ensure that yearly implementation and procurement plans are prepared by the end-users within the institution
- to monitor implementation activities to be carried out by end-users, in accordance with their respective implementation plans
- providing the coordinator with information necessary for the preparation of the project progress reports
- IPC chairs Program Implementation Group made up of project leaders of various activities being undertaken in the respective institution
- Ensuring that project and institutional activities are undertaken or implemented as planned
- Undertaking continuous monitoring and evaluation of institutional activities
- Preparing semi, mid-term and annual progress reports and submit them to the Programme Coordinator.



**Figure 8:** Organization Chart for the Programme

## **9.0 PROGRAMME IMPLEMENTATION, MONITORING AND EVALUATION**

### **9.1 Application Procedures, Reporting Mechanisms and Information Flow**

Research proposals by scientists from collaborating institutions have to be formulated and endorsed by collaborating researchers before they are forwarded through Institutional Programme Co-ordinator (IPC) to the Programme Co-ordinator (PC). To facilitate collaboration with researchers from partner institutions, a list of researchers in various institutions will be prepared and circulated to all potential collaborators and a mechanism to enable researchers interact will be planned at the beginning of the project.

### **9.2 Call for proposal/ Concept Note and Review Process**

In order to ensure that research projects are undertaken collaboratively, each project leader must make sure that research members come from at least two of the collaborating Institutions.

#### **9.2.1 Call for research proposals**

There shall be three calls for research proposals i.e. 2009, 2010 and 2011. The guidelines and format for research grants are attached in Appendix 2.

Received concept notes will be reviewed based on the following criteria:

- Relevance to goals/themes of the programme with special emphasis to addressing REDD initiatives
- The research must address at least one of the three research focus areas stated in the programme.
- Emphasizing the role of gender in REDD
- Emphasis on multidisciplinary approach with involvement of partners from; institutions, NGOs, institution (s) in Norway, and target communities in REDD pilot areas
- Research issues that should have a priority to capacity building through provision for training PhDs and MSc. degree students
- Research subjects should be innovative leading to technology development relevant to climate change adaptation and mitigation
- Provision for basic research ideas related to Climate Change issues
- Biotechnology applied research leading to conservation of genetic resource threatened by climate change
- At least 50% of the research projects should be related to forestry and forestry related focus areas
- For concept note regarding strategic interventions among other issues, the following will apply:
  - should have technological innovations that turns scientific knowledge into products
  - Should encompass research and innovation, product development and technological diffusion
  - Should generate research output with potential commercial values and quantifiable emissions reduction
  - Should allow for small and large-scale pilot testing, scale up the production of the product and setting up demonstration plots/pilot plants
  - Should promote technology/process generated from high quality and strategic research that have potential reduction of emissions.

#### **9.2.2 Review and awarding procedures for research Concept Notes/Proposals**

- Review of concept notes and full proposals will be judged by an independent panel of experts in the field
- The criteria for review will directly reflect the information requested in the concept notes/full proposals
- Each focus area will be allocate a number of projects with reference to the number of themes, the coordination will ensure that each focus area is covered
- Each participating institution shall assume project leadership for at least one project in their area (s) of competence
- Nominal budget will be awarded to all projects, however increase of the operational budget is possible based on extent to absorb students - especially female students and publications
- Incentive will be awarded to projects that demonstrate participation in IPCC related workshops and conferences.

#### **9.2.3 Concept notes /proposals for strategic interventions should demonstrate:**

- There will be two types of selections: one will be by application based on demand driven need, another whereby the coordination will solicit teams to address special needs. Selection of these types of strategic intervention will be based on the following criteria:
  - technological innovations that turns scientific knowledge into products
  - product development and technological diffusion
  - output with potential commercial values and quantifiable emissions reductions

- small and large-scale pilot testing, scale up the production of the product and setting up demonstration plots/pilot plants
- technology/process generated from high quality and strategic research that have potential reduction of emissions
- The third type of strategic interventions will be based on emerging cross-cutting issues related to GHG reduction. The coordination will identify actors to address these issues.

### **9.3 Enrolment of PhD and MSc Students and Young Professionals**

There will be one call for 17 PhD students in year 2009 and two calls for 25 MSc students each in year 2009 and 2010. The guidelines for dispensing postgraduate students are attached in Appendix 3.

#### **9.3.1 Selection criteria for PhD and MSc. students**

- Students shall be selected by the coordination with consultation with the approved research projects
- Students will be selected based on the following criteria and as detailed in the score sheet in Appendix 4.
  1. Academic merit
  2. Validity of employment/studentship at participating institutions (SUA, UDSM, ARU and TMA)
  3. Validity of employment with Agricultural Sector Lead Ministries (ASLM) and the Ministry of Natural Resources and Tourism (MNRT)
  4. Relevance of the study focus areas to the goal and purpose of the programme.
  5. Relevance of the proposed activities to the overall goal of the CCIAM Programme
  6. Gender – all female applicants who meet the minimum requirement will receive priority.
  7. At least 1/2 of the opportunities will be dedicated to staff of the participating institutions (SUA, UDSM, ARU and TMA)
  8. Applicants may be stratified into categories according to disciplines of specialization or institution of affiliation so as to diversify awards and distribute them within and between institutions/disciplines of specialization.
  9. Relevance of the selected topic to the targeted research project
  10. Originality of thoughts and ability to formulate research proposal
  11. Performance during interview
  12. Relevance of the Academic Qualifications
  13. Research experience for PhD applicants

#### **9.3.2 Selection criteria for short courses**

Candidates for training shall be selected by collaborating institutions and relevant national Institutions based on needs. Admission requirement and courses to be offered by each institution shall follow regulations of each institution. To avoid duplication, collaborative course involving partner institution will be priority. The courses to be taken by students shall be identified from collaborating institutions but will have to be channelled through the collaborating Institutional Programme Co-coordinator (IPC) and to the Programme Management Team for endorsement. In case of short training courses, course content and duration shall will be prepared and circulated to all potential collaborating institutions endorsed by the PMT.

### **9.4 Monitoring and Evaluation**

The monitoring and evaluation (M&E) shall cover all research and training activities, strategic interventions, funding, financial management and research infrastructure.

The compositions and size of the monitoring and evaluation teams, as well as the durations of the M&E missions will be guided by the Programme Management Team of the programme depending on the nature and size of the projects to be monitored and evaluated. The PMT secretariat shall prepare the standard format for instruments to be used for M&E and shall present the instruments for approval by the Programme Management Team (PMT).

The monitoring and evaluation will be conducted at least once a year, preferably in early June in order to allow planning for items to be incorporated in Steering Committee and Annual Meetings normally to be held in October. All the institutions involved in Tanzania shall be visited by the M&E teams for the purpose of monitoring and evaluation for duration not exceeding 7 days for each.

## **9.5 Expected Outputs of Project Monitoring and Evaluation**

The Project Monitoring and Evaluation will generate the following information:

- i. An overview of research, capacity building and strategic intervention activities
- ii. The project will be steered in the right direction
- iii. A list of problems and possible solutions for each project activity
- iv. A list of new ideas emerging from success or failure of the project or as a result of external factors
- v. Recommendations to ensure efficiency, effectiveness and impact of project activities
- vi. Conclusions of the review and recommendations for the future
- vii. A follow up schedule for the recommendations

## **10.0 ADMINISTRATION AND ACCOUNTING OF FINANCIAL DISBURSEMENTS**

The programme is estimated to cost about NOK 94.9 million (NOK ninety four point nine million) over a period of five years as summarized in Table 1 and detailed in Appendix 5

The funds for the Programme shall be disbursed from RNE to SUA through the Ministry of Finance and Ministry of Higher Education. At SUA the funds shall be administered through the Directorate of Research and Postgraduate Studies (DRPGS), as is the case for all other financial grants.

Funds for collaborating institutions in Tanzania shall in turn be disbursed from SUA as will be guided by the programme document, annual budgets/work plans and Contract/Subcontract Agreements.

Similarly, funds for collaborating institutions in Norway shall be disbursed from SUA to NORAGRIC-UMB. NORAGRIC-UMB shall in turn disburse the funds to other collaborating institutions in Norway. Funds disbursed shall be expended according to the respective government and institutional financial regulations.

SUA will disburse the funds to researchers or institutional administrators in accordance with the prescribed research activities and institutional support of the projects approved by SC and Annual Meeting using the SUA accounting system.

The programme budget is summarized in Table 1.

**Table 1 Summary of the Proposed Programme Budget for the period of Five Years (2009 - 2014)**

**Sokoine University of Agriculture  
Programme for Climate Change, Impacts, Adaptation and Mitigation in Tanzania (CCIAM)  
Five Year Programme Budget (2009 – 2014)**

<b>Sn</b>	<b>Component 1</b>	<b>Year 2009/10</b>	<b>Year 2010/11</b>	<b>Year 2011/12</b>	<b>Year 2012/13</b>	<b>Year 2013/14</b>	<b>Total Cost (NOK)</b>
	<b>1.1 Research</b>						
1.1.1	Development of Research groups and proposal	500,000	500,000	-	-	-	1,000,000
1.1.2	Research Group Meetings	600,000	600,000	600,000	600,000	600,000	3,000,000
1.1.3	Research Projects	2,384,000	3,152,000	5,072,000	5,072,000	3,920,000	19,600,000
1.1.4	Research Projects Norwegian Researchers	596,000	788,000	1,268,000	1,268,000	980,000	4,900,000
1.1.5	Research Project Proposal Review Panel	118,250	118,250	-	-	-	236,500
1.1.6	Monitoring and Evaluation	300,000	300,000	300,000	300,000	300,000	1,500,000
1.1.7	Baseline studies and impact assessment	200,000	-	400,000	-	400,000	1,000,000
1.1.8	Support for Programs absorbing PhD Students	350,000	350,000	350,000	350,000	350,000	1,750,000
1.1.9	Support for Programs absorbing Masters Students	200,000	200,000	200,000	200,000	200,000	1,000,000
1.1.10	Support for Research Projects' Publications	100,000	200,000	300,000	300,000	300,000	1,200,000
1.1.11	Scientific Conferences Local and International	300,000	460,000	640,000	640,000	700,000	2,740,000
	<b>Sub total</b>	<b>5,648,250</b>	<b>6,668,250</b>	<b>9,130,000</b>	<b>8,730,000</b>	<b>7,750,000</b>	<b>37,926,500</b>
	<b>1.2 Strategic Interventions</b>						
1.2.1	Advisory and Developmental services	240,000	240,000	240,000	240,000	240,000	1,200,000
1.2.2	Transfer of best practices in climate management	240,000	360,000	360,000	360,000	360,000	1,680,000
1.2.3	Young professionals exchange activities	-	585,000	585,000	585,000	-	1,755,000
1.2.4	Senior Scholar Exchange Activities	417,520	417,520	417,520	417,520	417,520	2,087,600
1.2.5	Improvement of Internet connectivity	300,000	300,000	300,000	300,000	300,000	1,500,000
1.2.6	Documentation, Communication and Publicity Administration	250,000	450,000	450,000	450,000	750,000	2,350,000
1.2.7	Participation of Norwegian Researchers	384,000	384,000	384,000	384,000	384,000	1,920,000
	<b>Sub total</b>	<b>1,831,520</b>	<b>2,736,520</b>	<b>2,736,520</b>	<b>2,736,520</b>	<b>2,451,520</b>	<b>12,492,600</b>
	<b>Component 2</b>						
	<b>2.Capacity Building:</b>						
	<b>2.1 Training</b>						
2.1.1	Masters Scholarships (25) first call -2009/10	1,500,000	1,500,000	-	-	-	3,000,000
2.1.2	Masters Scholarships (25) second call 2010/11		1,500,000	1,500,000	-		3,000,000

2.1.3 PhD local Scholarships 1 call -2009 (12)	720,000	720,000	720,000	720,000		<b>2,880,000</b>
2.1.4 PhD International scholarships 1 call - 2009 (5)	780,000	780,000	780,000	780,000	1,000,000	<b>4,120,000</b>
2.1.5 Short Courses - Policy Makers( 2-12 weeks long)	-	150,000	150,000	150,000	150,000	<b>600,000</b>
2.1.6 Special Skills for Scientists, Trainers and Policy Makers	-	250,000	250,000	250,000	250,000	<b>1,000,000</b>
<b>Sub total</b>	<b>3,000,000</b>	<b>4,900,000</b>	<b>3,400,000</b>	<b>1,900,000</b>	<b>1,400,000</b>	<b>14,600,000</b>
<b>2.2 Infrastructure</b>						
2.2.1: Strengthening GIS Laboratories/databank	400,000	400,000	400,000	400,000		<b>1,600,000</b>
2.2.2 Construction of short courses/seminar facilities at SUA	300,000	400,000	400,000	400,000	400,000	<b>1,900,000</b>
2.2.3 Strengthening of wheather laboratories/stations at TMA		600,000	600,000	600,000		<b>1,800,000</b>
2.2.4 Climate Change Research and modelling laboratories at SUA	-	400,000	400,000	400,000	-	<b>1,200,000</b>
2.2.5 Tide gauges for continuous observation reference station for sea level monitoring at ARU	500,000	-	-	-	-	<b>500,000</b>
2.2.6 Strengthening of Research Laboratories for monitoring of climate change impacts on aquatic ecosystems and related biodiversity at UDSM	450,000	450,000	450,000	-	-	<b>1,350,000</b>
2.2.7 Improvement of Field Research Laboratory at Mazumbai Mountain Natural Forest	200,000	200,000	200,000			<b>600,000</b>
2.2.8 Procurement of Vehicles	750,000	500,000	-	-	-	<b>1,250,000</b>
2.2.9 Equipment	350,000	350,000	350,000	350,000	350,000	<b>1,750,000</b>
<b>Sub total</b>	<b>2,950,000</b>	<b>3,300,000</b>	<b>2,800,000</b>	<b>2,150,000</b>	<b>750,000</b>	<b>11,950,000</b>
<b>3. Coordination</b>						
3.1 Overall Programme Coordination	250,000	250,000	250,000	250,000	250,000	<b>1,250,000</b>
3.2 Coordination at SUA	150,000	150,000	150,000	150,000	150,000	<b>750,000</b>
3.3 Coordination at UMB	500,000	500,000	500,000	500,000	500,000	<b>2,500,000</b>
3.4 Coordination (University of Dar es Salaam)	150,000	150,000	150,000	150,000	150,000	<b>750,000</b>
3.5 Coordination - (Ardhi University Dar es Salaam)	150,000	150,000	150,000	150,000	150,000	<b>750,000</b>
3.6 Coordination - TMA	150,000	150,000	150,000	150,000	150,000	<b>750,000</b>
3.7 Programme Meetings	252,000	252,000	252,000	252,000	252,000	<b>1,260,000</b>
<b>Sub total</b>	<b>1,602,000</b>	<b>1,602,000</b>	<b>1,602,000</b>	<b>1,602,000</b>	<b>1,602,000</b>	<b>8,010,000</b>
<b>Others</b>						
3.1.4 Institutional overheads - SUA and Partner Institutions	750,000	750,000	750,000	750,000	750,000	<b>3,750,000</b>



3.11 Programme Audit	320,000	320,000	320,000	320,000	320,000	<b>1,600,000</b>
3.15 Unallocated Funds (Contingency)	710,000	710,000	710,000	710,000	710,000	<b>3,550,000</b>
<b>Sub total</b>	<b>1,780,000</b>	<b>1,780,000</b>	<b>1,780,000</b>	<b>1,780,000</b>	<b>1,780,000</b>	<b>8,900,000</b>
<hr/>						
GRAND TOTAL IN NORWEGIAN KRONE	<b>16,811,770</b>	<b>20,986,770</b>	<b>21,448,520</b>	<b>18,898,520</b>	<b>15,733,520</b>	<b>93,879,100</b>
<hr/>						
<b>AVERAGE PER YEAR</b>	<b>18,775,820</b>					-

## 11.0 PROGRAMME DURATION, SCHEDULE AND RISKS MITIGATION

Initially five years duration (July 2009 – June 2014) is being sought. However, considering the long term nature of the challenge at hand, prospects to extend the programme could be examined during the mid-term and end-term reviews. After 24 months, a mid-term review will take place to assess progress and overall performance and make recommendations to be taken into consideration for the subsequent period of 3 years.

We do not foresee major risks affecting the programme implementation. However, if the recent global economic recession continues it might alter international attention from novel climate change mitigation initiatives. There is also a risk that REDD might not be accepted as the major climate change mitigation tool post 2012. Nevertheless, in the event that REDD is not accepted as the main climate mitigation tool, it is expected that Tanzania will have achieved better forest conservation and management through this initiative. Furthermore, if REDD is not approved under the post-2012 mechanism, the proposed programme has in-built flexibility to respond to this highly unlikely scenario. For example, the 2<sup>nd</sup> call for research proposals and MSc. Student applications, this will be taken into account. In addition, there are several efforts by developed countries to mitigate the economic down surge and Tanzania, because of its programmatic economic policies, might be a major beneficiary. Detailed risks and possible mitigation measures associated with the implementation of this programme are presented in Appendix 6.

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# Appendix 1: Log Frame for Programme on Climate Change, Impacts, Adaptation and Mitigation

LOG FRAME	Objectively verifiable indicators	Means of verification	Important assumptions
<b>Goal</b>			
Better management of natural resources and the environment through appropriate adaptation and mitigation strategies and participation in climate change initiatives	<ul style="list-style-type: none"> <li>By 2014, Tanzania become a lead country in Africa in addressing REDD and climate change challenges.</li> <li>Natural resource management policy and practices reflect integration of climate change adaptation and mitigation measures by 2014.</li> <li>Trained individuals take up posts relevant to climate change and REDD decision-making and management after 2014.</li> <li>Tanzania playing a leadership role within Africa on REDD at regional and international policy levels, including UNFCCC by 2013.</li> </ul>	<ul style="list-style-type: none"> <li>CoP reports, NAPA reports, National Communication to the UNFCCC</li> </ul>	<ul style="list-style-type: none"> <li>Political stability prevails</li> <li>Increased public and private sector involvement</li> <li>Favourable government policies and legislation</li> <li>Collaboration between institutions prevails</li> <li>CoP 15 supports REDD initiatives</li> <li>Global support to climate change mitigation and adaptation prevails</li> </ul>
<b>Purpose</b>			
Develop and sustain adequacy in national capacity to address the effects and challenges of climate change in Tanzania.	<ul style="list-style-type: none"> <li>By 2014, research capacity of Tanzania institutions on REDD issues becomes among the best in Africa and contribute to policy development at national and international level.</li> <li>By 2014, Tanzanian research institutions recognized as centres of REDD expertise within Africa.</li> <li>Project influences national policy and positions at UNFCCC and it related Protocol(s) by 2012.</li> <li></li> </ul>	<ul style="list-style-type: none"> <li>Publications, thesis and dissertations</li> <li>Policy briefs</li> <li>Impact Assessment Reports</li> <li>Monitoring and Evaluation Reports</li> <li>Programme terminal report</li> </ul>	<ul style="list-style-type: none"> <li>Favourable government policies and legislation</li> <li>Adequate and timely disbursement of funds</li> </ul>
<b>Objectives</b>			
<ul style="list-style-type: none"> <li>To determine and develop appropriate climate change mitigation and adaptation strategies in forestry, other land uses, ecosystems and biodiversity management</li> <li>To assess climate change impacts on and vulnerability of ecosystem services and livelihoods under REDD initiatives</li> <li>To conduct policy and legal framework analysis of climate adaptation and mitigation with emphasis on economic efficiency, ecological effectiveness and wider political legitimacy</li> <li>To develop and undertake capacity building, dissemination and strategic interventions for adaptation and mitigation to climate change</li> </ul>			

Outputs	Objectively verifiable indicators	Means of verification	Important assumptions
1. Appropriate climate change mitigation and adaptation strategies in forestry, other land uses, ecosystems and biodiversity management developed	<ul style="list-style-type: none"> <li>By 2012, appropriate climate change mitigation and adaptation strategies in forestry and other land uses documented</li> <li>By 2014, appropriate climate change mitigation and adaptation strategies and technologies developed</li> </ul>	<ul style="list-style-type: none"> <li>Impact Assessment Reports</li> <li>Monitoring and Evaluation Reports</li> <li>Publications, thesis, dissertations,</li> <li>policy briefs</li> <li>documents on climate change mitigation and adaptation strategies</li> </ul>	<ul style="list-style-type: none"> <li>Policies emphasis on climate change issues sustained</li> <li>Funding availability</li> <li>Active public participation</li> </ul>
2. Climate change impacts on and vulnerability of ecosystem services and livelihoods under REDD initiatives assessed	<ul style="list-style-type: none"> <li>By 2012, climate change impacts on and vulnerability of ecosystem services and livelihoods under REDD initiatives in Tanzania better understood and documented</li> <li>By 2014, technologies to address climate change impacts on and vulnerability of ecosystem services and livelihoods under REDD initiatives in Tanzania developed</li> </ul>	<ul style="list-style-type: none"> <li>Impact Assessment Reports</li> <li>Monitoring and Evaluation Reports</li> <li>Publications, thesis, dissertations,</li> <li>policy briefs</li> </ul>	
3. Policy and legal framework of climate change adaptation and mitigation with emphasis on economic efficiency, ecological effectiveness and wider political legitimacy analysed	<ul style="list-style-type: none"> <li>By 2012, analysis of at least three policies and legal frameworks of climate change adaptation and mitigation completed.</li> <li>By 2014, at least three policies and legal frameworks of climate change adaptation and mitigation recommended.</li> </ul>	<ul style="list-style-type: none"> <li>Impact Assessment Reports</li> <li>Monitoring and Evaluation Reports</li> <li>Publications, thesis, dissertations,</li> <li>Policy review reports</li> <li>Policy briefs</li> </ul>	
4. Capacity building, dissemination and strategic interventions for adaptation and mitigation to climate change developed and undertaken	<ul style="list-style-type: none"> <li>By 2014, the expertise in climate change issues of the participating institutions in Tanzania increased</li> <li>By 2014, climate change issues mainstreamed in the curricula of tertiary institutions</li> <li>By 2014, best practices and lessons learnt on climate change issues disseminated and awareness raised</li> </ul>	<ul style="list-style-type: none"> <li>Impact Assessment Reports</li> <li>Monitoring and Evaluation Reports</li> <li>Publications, thesis, dissertations,</li> <li>Policy review reports</li> <li>Policy briefs</li> <li>Extension materials</li> <li>Technologies</li> </ul>	

<b>Output 1. Appropriate climate change mitigation and adaptation strategies in forestry, other land uses, ecosystems and biodiversity management developed</b>	
<b>Activities</b>	<b>Results</b>
1.1 Quantify the potential for forestry based carbon off-sets in selected forests	<ul style="list-style-type: none"> <li>• Carbon stocks and sequestration in REDD pilot areas from at least three main ecological zones quantified by 2014.</li> <li>• Scenario analysis of future carbon flow and stock in forests established by 2014.</li> </ul>
1.2 Develop forest carbon assessment, monitoring and verification system	<ul style="list-style-type: none"> <li>• Tools and methods for forest carbon assessment, monitoring and verification developed by 2014.</li> <li>• Database of available forest carbon stocks developed by 2014.</li> </ul>
1.3 Determine effective and efficient payment system for REDD in Tanzania	<ul style="list-style-type: none"> <li>• Effective and efficient payment system for REDD in Tanzania developed and in use by 2014</li> </ul>
1.4 Determine appropriate approach to limit deforestation and forest degradation in Tanzania for its participation in REDD	<ul style="list-style-type: none"> <li>• Appropriate approach to limit deforestation and forest degradation in Tanzania determined by 2014</li> <li>• Participation of Tanzania in REDD initiatives enhanced by 2014</li> </ul>
1.5 Model the impacts of climate change and management scenarios in forestry, land-use, ecosystem and biodiversity	<ul style="list-style-type: none"> <li>• Models of impacts of climate change on forestry management and other land-uses developed by 2014.</li> <li>• Downscaled climate change projections scenarios developed in the third year of the programme</li> <li>• Species abundance, distribution and potential dynamics with a changing climate in selected ecosystems from at least three main ecological zones assessed by end of the programme.</li> <li>• Models of species response and distribution under different scenarios of climate change developed by the end of the programme</li> </ul>
1.6 Assess the potential of smallholder forestry for climate change mitigation, adaptation and rural development	<ul style="list-style-type: none"> <li>• Potential of smallholder forestry for climate change mitigation, adaptation and rural development determined by mid of the programme</li> </ul>

1.7 Perform financial analysis of carbon sequestration and storage	<ul style="list-style-type: none"> <li>• Financial analysis of carbon sequestration and storage performed in at least three main ecological zones by the third year of the programme</li> <li>• Investment model for each option of carbon sequestration developed and tested by end of the programme</li> <li>• Potential of forests for reducing GHGs emission, credit distribution and possible carbon finance mechanisms established by end of the programme.</li> </ul>
1.8 Develop strategic interventions for adaptation in forestry, and other land uses including human settlements.	<ul style="list-style-type: none"> <li>• Strategic interventions for adaptation in forestry, and other land uses including human settlements developed.</li> <li>• Tree species with high growth potential and less water use for afforestation/reforestation identified recommended at the end of the programme.</li> <li>• Best practices for afforestation/reforestation and agroforestry developed by the end of the programme</li> <li>• Land use practices that maximise soil and water conservation, energy and carbon sequestration identified by the end of the programme.</li> <li>• Human settlement vulnerability and adaptation strategies to climate change established</li> </ul>
1.9 Assess innovative agricultural land use and farming systems for adaptation to and mitigation of climate change to support REDD initiatives.	<ul style="list-style-type: none"> <li>• Innovative agricultural land use and farming systems for adaptation to and mitigation of climate change to support REDD initiatives determined by the end of the programme.</li> <li>• Suitable crops and varieties that are adapted to climate change scenarios determined by the end of the program</li> <li>• Better plant variety selection strategies using biotechnology and other innovative systems developed by the end of the programme</li> <li>• Crop diversity in face of climate change increased by the end of the programme</li> <li>• Various sustainable agricultural systems adapted to climate change developed by the end of the programme</li> </ul>
1.10 Develop and test various rangeland management strategies for the purpose of reducing pressure on forest resources for adaptation and mitigation to climate change	<ul style="list-style-type: none"> <li>• Inventory of existing rangeland management strategies undertaken in at least three agro-ecological zones.</li> <li>• At least three rangeland management strategies for adaptation and mitigation developed by end of the programme.</li> </ul>
<b>Output 2. Climate change impacts on and vulnerability of ecosystem services and livelihoods under REDD initiatives assessed</b>	
<b>Activities</b>	<b>Results</b>



2.1 Establish trends and projections of ecosystem services associated with climate stressors	<ul style="list-style-type: none"> <li>• Trends of ecosystem services associated with climate stressors established by the third year of the programme.</li> <li>• Projections of ecosystem services associated with climate stressors established by the third year of the programme.</li> </ul>
2.2 Model effects of alternative management options on ecosystem services under changing climate	<ul style="list-style-type: none"> <li>• Effects of alternative management options on ecosystem services under climate change stressors modelled by the end of the program.</li> </ul>
2.3 Develop methods to describe relationships between ecosystem services, climate stressors and management responses	<ul style="list-style-type: none"> <li>• Methods for analysing relationships among ecosystem services, climate stressors and management responses developed by the mid of the programme.</li> </ul>
2.4 Assess local climate change vulnerability of biodiversity and forest related livelihoods and adaptation options	<ul style="list-style-type: none"> <li>• Local vulnerability and adaptation options to climate change identified by the end of programme.</li> <li>• Understanding of local vulnerability and adaptation options to climate change enhanced by year one.</li> <li>• Vulnerability of different ecosystems and biodiversity to climate change assessed by the end of the programme.</li> <li>• Impact of changes in ecosystem and biodiversity on livelihoods assessed by the end of the programme.</li> <li>• Vulnerability indicators documented by the mid of the programme</li> <li>• Local factors that compliment, contest or modify vulnerability and adaptation indicators explored and documented by the mid of the programme</li> </ul>
2.5 Assess macroeconomic impacts of climate change in forest resource management and its implication for different ecological zones	<ul style="list-style-type: none"> <li>• Macroeconomic model of impacts of climate change on forest resource management developed in at least three agro-ecological zones by end of the programme</li> </ul>
2.6 Conduct integrated analysis and synthesis of lessons learned from adaptation options and macroeconomic impacts	<ul style="list-style-type: none"> <li>• Lessons learned from adaptation options and macro-economic impacts documented for at least three different ecological zones by end of the programme.</li> </ul>

<b>Output 3. Policy and legal framework of climate change adaptation and mitigation with emphasis on economic efficiency, ecological effectiveness and wider political legitimacy analysed</b>	
<b>Activities</b>	<b>Results</b>
3.1 Analyse climate change related policies and legal framework in Tanzania.	<ul style="list-style-type: none"> <li>Competing land-use and land-use policies and related policies and legal framework impacting on REDD activities identified by 2012.</li> </ul>
3.2 Analyse land competition in the context of climate change adaptation and mitigation efforts.	<ul style="list-style-type: none"> <li>Role of different actors on REDD initiatives identified by 2011.</li> </ul>
3.3 Analyse various REDD initiatives that are addressed through markets, private and public sector management, and civil society.	<ul style="list-style-type: none"> <li>Incentive mechanism for REDD implementation identified by 2011.</li> </ul>
3.4 Determine how institutional arrangements and governance affect various forest management regimes (CBFM, Plantations, Private forests, general land forests and forest reserve) in the context of climate change	<ul style="list-style-type: none"> <li>Institutional arrangements and governance affecting forest management regimes documented by 2012</li> </ul>
3.5 Determine the feasible incentive structures, monitoring mechanisms, controls, leakages and additionality affecting policy formulation and implementation for climate change adaptation and mitigation	<ul style="list-style-type: none"> <li>Feasible incentive structures, monitoring mechanisms, controls, leakages and additionality affecting policy formulation and implementation for climate change adaptation and mitigation determined and documented by 2012.</li> </ul>
<b>Output 4. Capacity building, dissemination and strategic interventions for adaptation and mitigation to climate change developed and undertaken</b>	
<b>Activities</b>	<b>Results</b>
4.1 Mainstream climate change issues in tertiary institutions curricula	<ul style="list-style-type: none"> <li>Package of climate change issues to be included in curricula developed by 2011</li> <li>Curricula with climate change topics in place by end of the programme</li> </ul>
4.2 Conduct specialised climate related training at MSc and PhD levels for Tanzanians	<ul style="list-style-type: none"> <li>50 MSc and 17 PhD students with special emphasis on climate and ecological modelling with emphasis on REDD pilot areas trained by the end of the programme</li> </ul>
4.3 Develop modules incorporating analytical modelling in socio-economic and ecological issues to be used for analysis of adaptation to climate change and variability.	<ul style="list-style-type: none"> <li>Training modules developed by 2011</li> <li>Analytical models developed by 2011</li> </ul>
4.4 Develop short courses on different topics on climate change for policy makers and trainers.	<ul style="list-style-type: none"> <li>Training modules developed by 2011</li> </ul>
4.5 Conduct short-term training for various stakeholders	<ul style="list-style-type: none"> <li>Training modules developed by 2011</li> <li>At least three short courses conducted by 2013</li> </ul>
4.6 Enhance special skills in modelling for technicians and scientists	<ul style="list-style-type: none"> <li>Training modules developed by 2010</li> <li>At least 30 trainees per year up to year 2013</li> </ul>

4.7 Engage young professionals in exchange programmes	<ul style="list-style-type: none"> <li>• At least 15 young professionals per year involved</li> </ul>
4.8 Engage senior scholars in exchange programme	<ul style="list-style-type: none"> <li>• At least 12 senior scholars per year involved</li> </ul>
4.9 Develop extension/outreach materials on REDD initiatives	<ul style="list-style-type: none"> <li>• At least 15 extension materials developed and produced annually</li> </ul>
4.10 Transfer best practices on REDD initiatives for climate change mitigation	<ul style="list-style-type: none"> <li>• At least 15 best practices developed/transferred by 2014</li> </ul>
4.11 Conduct workshops/seminars on climate change and REDD initiatives.	<ul style="list-style-type: none"> <li>• At least two seminars/workshops conducted annually for stakeholders</li> </ul>
4.12 Disseminate extension materials on climate change and REDD initiatives	<ul style="list-style-type: none"> <li>• At least 15 different types of extension materials disseminated to target stakeholders annually</li> <li>• At least 20% of the population in target areas reached</li> </ul>
4.13 Support exhibitions and publicity activities on climate change and REDD initiatives	<ul style="list-style-type: none"> <li>• At least 2 exhibitions and publicity activities/fora supported annually</li> </ul>
4.14 Improve physical infrastructure to address adaptation and mitigation to climate change	<p>By 2014;</p> <ul style="list-style-type: none"> <li>• Internet bandwidth increased by 50% in the participating Tanzania institutions</li> <li>• GIS Laboratories/databank facilities in the participating Tanzania institutions strengthened</li> <li>• At least one short courses/seminar facilities constructed at SUA</li> <li>• At least two weather Laboratories/Stations at TMA strengthened</li> <li>• One climate change field research and modelling laboratory at SUA established</li> <li>• One tide gauges for continuous observation reference station for sea level monitoring installed at ARU</li> <li>• Research laboratory for monitoring of climate change impacts on aquatic ecosystems and related biodiversity at UDSM strengthened</li> <li>• Field research laboratory at Mazumbai Montane natural forest strengthened</li> </ul>

## **Appendix 2: Guideline and Format for Application of Research Grants**

### **Formats for Application of Research Grants and Progress Reports**

The formats for application of research funds and preparation of progress report and research monitoring sheets will be as outlined below.

#### **Format of Application of Research Grant**

1. Name(s) of research(s)
2. Nationality
3. Academic qualifications
4. Institution and address
5. Research Theme
6. Title of research project
7. Objectives of the proposed research project
8. What has already been done
9. What remains to be done
10. Methodology
11. Probable duration of the project
12. Expected outputs from the project
13. Measurable indicators of the outputs
14. Details breakdown of budget, equipment, travel, subsistence, chemicals, others
15. State whether this research proposal is under consideration for funding from another source and where
16. Declaration of the applicant, I ..... have read and understood the rules and regulations governing the granting of research funds from the programme and SUA/UDSM/ARU/TMA (depending on the institutional affiliation of the applicant) and undertake to abide by them if my application is successful
17. Remarks by the respective Head of Department/Section  
Date and Signature
18. Remarks by the respective Dean/Director of Faculty/Institute  
Date and Signature
19. Remarks by respective Institutional Coordinator  
Date and Signature
20. Recommendation by Assistant Coordinator for Research and Strategic Interventions  
Date and Signature
21. Recommendation by Programme Management Team to the Joint Steering Committee as guided by outcome of the proposal evaluation  
Date and Signature

#### **Format for Preparing Research Project Annual Progress Reports**

1. Name(s) of research(s)
2. Nationality
3. Academic qualifications
4. Institution and address
5. Research Theme (under current project)
6. Title of research project
7. Objectives of the proposed research project

8. What has already been done
9. What remains to be done
10. Expected date of completion
11. Output already realised
12. Financial statement
13. Additional remarks
14. Remarks by the Head of Department/Section  
Date and Signature
16. Declaration of the applicant, I ..... Have read and understood the rules and regulations governing the granting of research funds from the programme and SUA/UDSM/ARU/TMA (depending on the institutional affiliation of the applicant) and undertake to abide by them if my application is successful
17. Remarks by the respective Head of Department/Section  
Date and Signature
18. Remarks by the respective Dean/Director of Faculty/Institute  
Date and Signature
19. Remarks by respective Institutional Coordinator  
Date and Signature
20. Recommendation by Assistant Coordinator for Research and Strategic Interventions  
Date and Signature
21. Recommendation by Programme Management Team to the Joint Steering Committee as guided by outcome of the proposal evaluation  
Date and Signature

**Project Monitoring Sheet for the Period from.....to ..... (Specify date range)**

1. Project reference number

2. Project title

3. Theme

4. Project leader

5. Research location

6. Implementation

Target	Status implementation	Problem encountered	Corrective measures employed

7. Amount of funds released

1. Expenditure and commitments

2. Balance

3. Date and Signature

## Appendix 3: Guidelines for Dispensing Postgraduate Scholarships, Short Courses, and Physical Facilities

### i. **SCHOLARSHIPS AND OTHER TRAINING OPPORTUNITIES**

#### (a) **General guidance**

In general, equal opportunity principles shall apply. The dispensing of scholarships and other training opportunities provided for under the programme will be governed by equal and fair competition for the same as will be approved by the Joint Steering Committee of the programme upon recommendations by the PMT with respect to advertisement, eligibility criteria, evaluation and selection criteria, as well as award terms and conditions.

#### (b) **Advertisements**

These training opportunities shall be advertised both within the institutions and in public media depending on the beneficiaries to be targeted.

With respect to training opportunities for capacity building within the participating institutions, advertisements will be made within and between the institutions under guidance that all institutions will have possibilities to have their staff benefit from such opportunities for as much as they are in line with the goal and purpose of the programme.

Opportunities for which candidates from outside the participating institutions are encouraged to apply will be advertised in the public media particularly newspapers. Deadlines will be set in a manner that allows a fair amount of time for potential beneficiaries wishing to respond to respond. All awards will be approved by the Joint Steering Committee.

#### (c) **Selection and award criteria**

1. Academic merit
2. Validity of employment/studentship at participating institutions (SUA, UDSM, ARU and TMA)
3. Validity of employment with Agricultural Sector Lead Ministries (ASLM) and the Ministry of Natural Resources and Tourism (MNRT)
4. Relevance of the study focus areas to the goal and purpose of the programme.
5. Relevance of the proposed activities to the overall goal of the CCIAM Programme
6. Gender
7. At least 1/2 of the opportunities will be dedicated to staff of the participating institutions (SUA, UDSM, ARU and TMA)
8. Applicants may be stratified into categories according to disciplines of specialization or institution of affiliation so as to diversify awards and distribute them within and between institutions/disciplines of specialization.
9. Relevance of the selected topic to the targeted research project
10. Originality of thoughts and ability to formulate research proposal
11. Performance during interview
12. Relevance of the Academic Qualifications
13. Research experience for PhD applicants

### ii. **OFFERING OF SHORT COURSES AND TRAINING OF TRAINERS**

Calls for offering and participation in Short Courses and Training of Trainers Courses shall be coordinated by the PMT. The hosting and participation in such courses shall also be monitored by PMT to ensure that all participating institutions are given chances to offer courses to identified beneficiaries in turns based on the nature of the subject matter, the disciplines of specialization and availability of resource persons. Inter-institutional collaboration in offering such courses will be given priority to optimise performance. The PMT will develop and bring to the Steering Committee guidelines administering such opportunities.

### iii. **INFRASTRUCTURE AND OTHER PHYSICAL FACILITIES**

This is designed to build and/or strengthen institutional physical and infrastructural capacities in research, training and development for participation in climate change initiatives and address the effects and challenges of climate change.

Activities in this aspect will to a large extent be guided by the programme document, the budget and special institutional needs especially in connection with securing the soft and hardware facilities for strengthening research laboratories and field stations related to the programme goal and purpose. The mode of operation will further be guided by the Steering Committee as may be recommended by the PMT.

#### Appendix 4: Score Sheet for Postgraduate Students Selection

Attribute	Score grade	Max Score	Score awarded
1. Relevance of the selected topic to the project	Very relevant	10	
	Moderate,	8	
	Low	2	
2. Originality of thoughts and ability to formulate research proposal	Very good	12	
	Moderate	8	
	Low	2	
3. Ability to express himself/herself well in presenting the subject matter	Very good	10	
	Good	8	
	Poor	2	
4. Ability to Answer questions correctly with confidence	Very good	10	
	Good	6	
	Poor	2	
5. Relevance of the Academic Qualifications	Very relevant	5	
	Moderate,	3	
	Irrelevant	2	
6. Research Experience	Very good	5	
	Moderate	3	
	Low	2	
<b>Highest total score 100</b>			



**Appendix 5: Programme Budget for the period of Five Years (2009 - 2014) and Budget Notes**

**Sokoine University of Agriculture  
Programme for Climate Change, Impacts, Adaptation and Mitigation in Tanzania (CCIAM)  
Five Year Programme Budget (2009 – 2014)**

<b>Sn</b>	<b>Component 1</b>	<b>Year 2009/10</b>	<b>Year 2010/11</b>	<b>Year 2011/12</b>	<b>Year 2012/13</b>	<b>Year 2013/14</b>	<b>Total Cost (NOK)</b>
	<b>1.1 Research</b>						
1.1.1	Development of Research groups and proposal	500,000	500,000	-	-	-	1,000,000
1.1.2	Research Group Meetings	600,000	600,000	600,000	600,000	600,000	3,000,000
1.1.3	Research Projects	2,384,000	3,152,000	5,072,000	5,072,000	3,920,000	19,600,000
1.1.4	Research Projects Norwegian Researchers	596,000	788,000	1,268,000	1,268,000	980,000	4,900,000
1.1.5	Research Project Proposal Review Panel	118,250	118,250	-	-	-	236,500
1.1.6	Monitoring and Evaluation	300,000	300,000	300,000	300,000	300,000	1,500,000
1.1.7	Baseline studies and impact assessment	200,000	-	400,000	-	400,000	1,000,000
1.1.8	Support for Programs absorbing PhD Students	350,000	350,000	350,000	350,000	350,000	1,750,000
1.1.9	Support for Programs absorbing Masters Students	200,000	200,000	200,000	200,000	200,000	1,000,000
1.1.10	Support for Research Projects' Publications	100,000	200,000	300,000	300,000	300,000	1,200,000
1.1.11	Scientific Conferences Local and International	300,000	460,000	640,000	640,000	700,000	2,740,000
	<b>Sub total</b>	<b>5,648,250</b>	<b>6,668,250</b>	<b>9,130,000</b>	<b>8,730,000</b>	<b>7,750,000</b>	<b>37,926,500</b>
	<b>1.2 Strategic Interventions</b>						
1.2.1	Advisory and Developmental services	240,000	240,000	240,000	240,000	240,000	1,200,000
1.2.2	Transfer of best practices in climate management	240,000	360,000	360,000	360,000	360,000	1,680,000
1.2.3	Young professionals exchange activities	-	585,000	585,000	585,000	-	1,755,000
1.2.4	Senior Scholar Exchange Activities	417,520	417,520	417,520	417,520	417,520	2,087,600
1.2.5	Improvement of Internet connectivity	300,000	300,000	300,000	300,000	300,000	1,500,000
1.2.6	Documentation, Communication and Publicity Administration	250,000	450,000	450,000	450,000	750,000	2,350,000
1.2.7	Participation of Norwegian Researchers	384,000	384,000	384,000	384,000	384,000	1,920,000
	<b>Sub total</b>	<b>1,831,520</b>	<b>2,736,520</b>	<b>2,736,520</b>	<b>2,736,520</b>	<b>2,451,520</b>	<b>12,492,600</b>

**Component 2**

## 2.Capacity Building:

### 2.1 Training

2.1.1 Masters Scholarships (25) first call -2009/10	1,500,000	1,500,000	-	-	-	3,000,000
2.1.2 Masters Scholarships (25) second call 2010/11		1,500,000	1,500,000	-		3,000,000
2.1.3 PhD local Scholarships 1 call -2009 (12)	720,000	720,000	720,000	720,000		2,880,000
2.1.4 PhD International scholarships 1 call - 2009 (5)	780,000	780,000	780,000	780,000	1,000,000	4,120,000
2.1.5 Short Courses - Policy Makers( 2-12 weeks long)	-	150,000	150,000	150,000	150,000	600,000
2.1.6 Special Skills for Scientists, Trainers and Policy Makers	-	250,000	250,000	250,000	250,000	1,000,000
<b>Sub total</b>	<b>3,000,000</b>	<b>4,900,000</b>	<b>3,400,000</b>	<b>1,900,000</b>	<b>1,400,000</b>	<b>14,600,000</b>

### 2.2 Infrastructure

2.2.1: Strengthening GIS Laboratories/databank	400,000	400,000	400,000	400,000		1,600,000
2.2.2 Construction of short courses/seminar facilities at SUA	300,000	400,000	400,000	400,000	400,000	1,900,000
2.2.3 Strengthening of wheather laboratories/stations at TMA		600,000	600,000	600,000		1,800,000
2.2.4 Climate Change Research and modelling laboratories at SUA	-	400,000	400,000	400,000	-	1,200,000
2.2.5 Tide gauges for continuous observation reference station for sea level monitoring at ARU	500,000	-	-	-	-	500,000
2.2.6 Strengthening of Research Laboratories for monitoring of climate change impacts on aquatic ecosystems and related biodiversity at UDSM	450,000	450,000	450,000	-	-	1,350,000
2.2.7 Improvement of Field Research Laboratory at Mazumbai Mountain Natural Forest	200,000	200,000	200,000			600,000
2.2.8 Procurement of Vehicles	750,000	500,000	-	-	-	1,250,000
2.2.9 Equipment	350,000	350,000	350,000	350,000	350,000	1,750,000
<b>Sub total</b>	<b>2,950,000</b>	<b>3,300,000</b>	<b>2,800,000</b>	<b>2,150,000</b>	<b>750,000</b>	<b>11,950,000</b>

### 3. Coordination

3.1 Overall Programme Coordination	250,000	250,000	250,000	250,000	250,000	1,250,000
3.2 Coordination at SUA	150,000	150,000	150,000	150,000	150,000	750,000
3.3 Coordination at UMB	500,000	500,000	500,000	500,000	500,000	2,500,000
3.4 Coordination (University of Dar es Salaam)	150,000	150,000	150,000	150,000	150,000	750,000

3.5 Coordination - (Ardhi University Dar es Salaam)	150,000	150,000	150,000	150,000	150,000	<b>750,000</b>
3.6 Coordination - TMA	150,000	150,000	150,000	150,000	150,000	<b>750,000</b>
3.7 Programme Meetings	252,000	252,000	252,000	252,000	252,000	<b>1,260,000</b>
<b>Sub total</b>	<b>1,602,000</b>	<b>1,602,000</b>	<b>1,602,000</b>	<b>1,602,000</b>	<b>1,602,000</b>	<b>8,010,000</b>
<b>Others</b>						
3.14 Institutional overheads - SUA and Partner Institutions	750,000	750,000	750,000	750,000	750,000	<b>3,750,000</b>
3.11 Programme Audit	320,000	320,000	320,000	320,000	320,000	<b>1,600,000</b>
3.15 Unallocated Funds (Contingency)	710,000	710,000	710,000	710,000	710,000	<b>3,550,000</b>
<b>Sub total</b>	<b>1,780,000</b>	<b>1,780,000</b>	<b>1,780,000</b>	<b>1,780,000</b>	<b>1,780,000</b>	<b>8,900,000</b>
<b>GRAND TOTAL IN NORWEGIAN KRONE</b>	<b>16,811,770</b>	<b>20,986,770</b>	<b>21,448,520</b>	<b>18,898,520</b>	<b>15,733,520</b>	<b>93,879,100</b>
<b>AVERAGE PER YEAR</b>						
	<b>18,775,820</b>					-

## Sokoine University of Agriculture: Programme on climate change impacts, adaptation and mitigation in Tanzania

### Budget details:

This budget has been prepared on:

1. The exchange rate of 1 Norwegian Krone to Tanzania Shillings being 250
2. 1 US dollar fetching Tanzania shillings 1,300
3. The rate of Per Diem being 80 US Dollars for Researchers as per Research guidelines of Sokoine University of Agriculture
4. The rate of Per Diem being 40 US Dollar (or government rate whichever is higher ) for Supporting Staff
5. Transportation (Hire Vehicle) being USD 0.70 per kilometre (SUA Research guidelines)

### DEVELOPMENT OF RESEARCH GROUPS AND PROPOSAL (Budget Item Number 1.1.1)

Item	Unit cost (000 NOK)	Quantity	Total Cost (000 NOK)	Yr.2009 (000 NOK)	Yr.2010 (000 NOK)	Yr. 2011 (000 NOK)	Yr. 2012 (000 NOK)	Yr. 2013 (000 NOK)
Regular Meetings			100	50	50		-	-
Field Trips (Per Diem)			300	150	150		-	-
Stationery			70	35	35		-	-
Facilitation			50	25	25		-	-
Vehicle hire			100	50	50		-	-
Fuel			200	100	100		-	-
Other Operational costs			180	90	90		-	-
<b>Total</b>			<b>1000</b>	<b>500</b>	<b>500</b>		-	-

#### Budget Notes:

During the phase of Proposal development Several Meetings between Researchers are expected. Researchers may come from various parts of the country and transportation costs will be expected.

Field trips to Research sites before proposals are fully developed will necessitate costs for the 1<sup>st</sup> and 2<sup>nd</sup> Year of the Project

### RESEARCH GROUP MEETINGS (Budget Item Number 1.1.2)

Item	Unit cost (000 NOK)	Quantity	Total Cost (000 NOK)	Yr.2009 (000 NOK)	Yr.2010 (000 NOK)	Yr. 2011 (000 NOK)	Yr. 2012 (000 NOK)	Yr. 2013 (000 NOK)
Regular Meetings			400	80	80	80	80	80
Field Trips – per diems			600	120	120	120	120	120
Stationery			175	35	35	35	35	35
Facilitation			125	25	25	25	25	25
Transportation			800	160	160	160	160	160
Fuel			500	100	100	100	100	100
Other operational costs			400	80	80	80	80	80
<b>Total</b>			<b>3000</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>	<b>600</b>

Research Group Meetings are expected throughout the Programme lifetime. Travel is expected by Researchers staying outside the Main Researcher station.

**RESEARCH PROJECTS (Budget Item Number 1.1.3)**Researchers Subsistence Allowance

Number of Days Research is outside station per year	84
Number of Researchers outside per project	3
Number of Projects	20
Unit cost (per Diem)	90,111.12
Total per Diem per annum	454,160,000
Rate of Exchange to NOK	250
<b>Sub total in NOK</b>	<b>1,816,640</b>

Research Projects Transportation

Rate Per Kilometre	875
Estimated travel km per yr	19,485.71
Number of Projects	20
Amount in TAS	341,000,000
Rate of Exchange to NOK	250
<b>Sub total in NOK</b>	<b>1,364,000.00</b>

Research Projects Other Costs

Stationery	15,000,000
Tools	38,000,000
Laboratory Analyses	39,182,400
Chemicals	50,000,000
Support Staff Subsistence	42,657,600
Total Amount in TAS	184,840,000
Rate of Exchange to NOK	250
<b>Sub total in NOK</b>	<b>739,360</b>
<b>GRAND TOTAL IN NOK</b>	<b>3,920,000.00</b>

**Costs of Norwegian Institution participation, per trip at 2 weeks**

Travel expenses	11,800
Per diem: NOK 1310/day * 15 days	19,650
Facilitation, Tanzania: Professional fee 450 NOK/h * 84 h.	37,800
Facilitation, Norway: Professional fee 450 NOK/h * 75 h.	33,750

**SUMMARY**

Item	Amount in Tshillings	Exchange rate to 1 NOK to Tshillings	Amount in NOK
Researchers Subsistence Allowances	454,160,000	250	1,816,640.00
Research Projects Transportation	341,000,000	250	1,364,000.00
Research Projects Others Costs	184,840,000	250	739,360.00
<b>TOTAL</b>	<b>980,000,000</b>		<b>3,920,000.00</b>

**NOTES:**

Although the workings of Research Project figures have been averaged at 3,920,000 NOK per year, actual disbursement is not expected to be uniform. Year 1 is not expected to have many activities but Year 2 and 3 will have more activities followed with gradual decrease in year 4 and 5 as shown below:

# **MODALITY OF DISBURSEMENT OF RESEARCH FUNDS**

Item	Total In NOK	Yr1	Yr2	Yr3	Yr4	Yr 5
Projects	19,600,000	1,920,000	4,920,000	4,920,000	3,920,000	3,920,000

## **RESEARCH PROJECTS NORWEGIAN RESEARCHERS (Budget item Number 1.1.4)**

### **Modality of Disbursement**

Item	Total In NOK	Yr1	Yr2	Yr3	Yr4	Yr 5
Travel	300,000	60,000	60,000	60,000	60,000	60,000
Per Diem	2,580,000	396,000	396,000	596,000	596,000	596,000
Other Costs	2,020,000	140,000	332,000	612,000	612,000	324,000
<b>TOTAL</b>	<b>4,900,000</b>	<b>596,000</b>	<b>788,000</b>	<b>1,268,000</b>	<b>1,268,000</b>	<b>980,000</b>

## **MONITORING AND EVALUATION (Budget Item Number 1.1.6)**

Item	Total Cost (000 NOK)	Yr.2009 (000 NOK)	Yr.2010 (000 NOK)	Yr. 2011 (000 NOK)	Yr. 2012 (000 NOK)	Yr. 2013 (000 NOK)
Meetings	200	40	40	40	40	40
Stationery	100	20	20	20	20	20
Facilitation	100	20	20	20	20	20
Transportation	200	40	40	40	40	40
Fuel	500	100	100	100	100	100
Per Diems	400	80	80	80	80	80
<b>Total</b>	<b>1500</b>	<b>300</b>	<b>300</b>	<b>300</b>	<b>300</b>	<b>300</b>

## **BASELINE AND IMPACT ASSESSMENT (Budget Item Number 1.1.7)**

Item	Total Cost (000 NOK)	Yr.2009 (000 NOK)	Yr.2010 (000 NOK)	Yr. 2011 (000 NOK)	Yr. 2012 (000 NOK)	Yr. 2013 (000 NOK)
Meetings	100	20	-	40	-	40
Stationery	50	10	-	20	-	20
Facilitation	100	20	-	40	-	40
Transportation	250	50	-	100	-	100
Fuel	200	40	-	80	-	80
Per Diems	250	50	-	100	-	100
Equipment	50	10	-	20	-	20
<b>Total</b>	<b>1000</b>	<b>200</b>	<b>-</b>	<b>400</b>	<b>-</b>	<b>400</b>

**SUPPORT FOR STUDENTS ABSORPTION IN RESEARCH PROJECTS AND PUBLICATIONS (Budget Item Number 1.1.7 up to 1.1.10)**

Item	Total Cost (000 NOK)	Yr.2009 (000 NOK)	Yr.2010 (000 NOK)	Yr. 2011 (000 NOK)	Yr. 2012 (000 NOK)	Yr. 2013 (000 NOK)
Support for Programs absorbing PhD Students	1750	350	350	350	350	350
Support for Programs absorbing Masters Students	1000	200	200	200	200	200
Support for Publications	1200	100	200	300	300	300
<b>Total</b>	<b>3950</b>	<b>650</b>	<b>750</b>	<b>850</b>	<b>850</b>	<b>850</b>

**NOTES**

Research Projects absorbing PhD students will be supported by 50,000 NOK per student while those absorbing Masters students will be supported by 20,000 NOK. It is expected that at least 7 PhD students will be supported every year. 20 Masters students will be supported per year. Research Projects with publications will be supported by 20,000 NOK per publication. It is projected that the number of Publications will increase from 5 in the first year to 15 in the last year

**SCIENTIFIC CONFERENCES (INTERNATIONAL) (Budget Item Number 1.1.11)**

Item	Total cost (000) NOK	Yr 2009 (000) NOK	Yr 2010 (000) NOK	Yr 2011 (000) NOK	Yr 2012 (000) NOK	Yr 2013 (000) NOK
Travel	600	50	100	150	150	150
Per Diem	1100	150	200	250	250	250
<b>Total</b>	<b>1700</b>	<b>200</b>	<b>300</b>	<b>400</b>	<b>400</b>	<b>400</b>

This item will allow Researchers to participate in international conferences abroad on climate change and allied subjects. The Programme will also organise in country conferences on Climate change in which participants from abroad will be allowed to attend. Actual costs will depend on where conferences are held and where necessary, some costs of key facilitators will be met by the Programme.

**STRATEGIC INTERVENTIONS (Budget Item Number 1.2.1 up to 1.2.5)**

Item	Total Cost (000 NOK)	Yr.2009 (000 NOK)	Yr.2010 (000 NOK)	Yr. 2011 (000 NOK)	Yr. 2012 (000 NOK)	Yr. 2013 (000 NOK)
Advisory and Developmental services	1500	300	300	300	300	300
Transfer of Best practices in climate change	1800	200	400	400	400	400
Young Professionals Exchange Programme	1755	-	585	585	585	-
Senior Scholar Exchange	2087.6	417.52	417.52	417.52	417.52	417.52
Improvement of Internet Connectivity	1500	300	300	300	300	300
<b>Total</b>	<b>8642.6</b>	<b>1217.52</b>	<b>2002.52</b>	<b>2002.52</b>	<b>2002.52</b>	<b>1417.52</b>

### **Advisory and Developmental Services (Budget Item Number 1.2.1)**

The Programme will provide intervention and advisory services where required. Such interventions/advisory services require movement of individuals from one station to the other. The costs are estimated at 3,000,000 NOK per annum

#### **Total cost per annum in NOK (000)**

1. Field Travels (Vehicle hire/Fuel)	1,600
2. DSA (Professionals and Drivers)	400
3. Contingency costs	1,000
<b>Total Cost per Annum</b>	<b>3,000</b>

### **Transfer of Best Practices in Climate Management (Budget Item Number 1.2.2)**

Demonstrations units at selected campus will be constructed and facilitated. The units will have the objective of showing best practices in climate change to students and other interested groups. The costs are estimated at 1,800,000 NOK per annum

Demonstration Units at Campus	Total Cost per annum NOK (000)
1. Engagement of Labourers	800
2. Consultancy honorariums	500
3. Research/Construction Materials	500
<b>Overall Total Cost</b>	<b>1,800</b>

### **Young Professionals (Budget Item Number 1.2.3)**

The Programme will allow 12 students from Tanzania to visit Norway once every year for a period of 5 months. Students exchange programmes increasingly enhance the awareness of students in Climate change issues and allied subjects. It is expected that the total cost for each student will be as shown below:

Cost Item	Amount in NOK	No of Students	Total Cost per annum in NOK (000)
Air Ticket	10,000	12	120
5 Months Allowances	34,500	12	414
Local Transportation (Tanzania/Norway)	3,250	12	39
Settling Allowance (Warm/Light Clothes)	1,000	12	12
<b>Total Costs per year</b>			<b>585</b>

### **Senior Scholars (Budget Item Number 1.2.4)**

The Programme will allow 10 Senior Scholars from Tanzania to visit Other Countries once every year for a period not exceeding 2 weeks. It is expected that the total cost for each Scholar will be as shown below:

Item	Rate	Number of People	Total in NOK (000)
Travel Expenses	10	10	100
Accommodation/Meals/Offpocket	31	10	317
<b>TOTAL</b>			<b>417</b>



**Improvement of Internet Connectivity (Budget Item Number 1.2.5)**

The Programme will contribute to Internet Connectivity and especially to improve connectivity at Sokoine University of Agriculture at the rate of NOK 300,000 Per annum. The amount will be used to top up subscription and/or buy equipment and upgrades subject to approval of the Programme Implementation Team.

**DOCUMENTATION, COMMUNICATION AND PUBLICITY ADMINISTRATION (Budget Item Number 1.2.6)**

Item	Total cost (000) NOK	Yr 2009 (000) NOK	Yr 2010 (000) NOK	Yr 2011 (000) NOK	Yr 2012 (000) NOK	Yr 1013 (000) NOK
Documentation	1000	50	200	200	200	350
Communication and Publicity	1350	200	250	250	250	400
<b>Total</b>	<b>2350</b>	<b>250</b>	<b>450</b>	<b>450</b>	<b>450</b>	<b>750</b>

NOTES: Costs involved under this budget line include 1. Production costs for materials 2. Incentive and motivation for individuals producing such materials 3. Hiring of Media consultants

**RESEARCH PROJECTS NORWEGIAN RESEARCHERS IN STRATEGIC INTERVENTIONS (Budget item Number 1.2.7)****Modality of Disbursement**

Item	Total In NOK	Yr1	Yr2	Yr3	Yr4	Yr 5
Travel	420,000	84,000	84,000	84,000	84,000	84,000
Per Diem	1,000,000	200,000	200,000	200,000	200,000	200,000
Other Costs	500,000	100,000	100,000	100,000	100,000	100,000
<b>TOTAL</b>	<b>1,920,000</b>	<b>384,000</b>	<b>384,000</b>	<b>384,000</b>	<b>384,000</b>	<b>384,000</b>

**TRAINING (Budget Item Number 2.1.1 up to 2.1.7)**

Scholarship	Unit cost (000 NOK)	Quantity	Total Cost (000 NOK)	Yr.2009 (000 NOK)	Yr.2010 (000 NOK)	Yr. 2011 (000 NOK)	Yr. 2012 (000 NOK)	Yr. 2013 (000 NOK)
M.Sc Scholarship (1 <sup>st</sup> Call)	120	25	3,000	1,500	1,500	-	-	-
M.Sc Scholarship (2 <sup>nd</sup> Call)	120	25	3,000	-	1,500	1,500	-	-
PhD Local Scholarship	240	12	2,880	720	720	720	720	-
PhD International Scholarship	824	5	4,120	780	780	780	780	1000
Short Courses - Policy Makers( 2-12 weeks long)	-	-	600	-	150	150	150	150
Short Courses - Training of Trainers	-	-	600	-	150	150	150	150
Special Skills for Scientists and Policy Makers	-	-	400	-	100	100	100	100
<b>TOTAL</b>			<b>14,600</b>	<b>3000</b>	<b>4,900</b>	<b>3,400</b>	<b>1900</b>	<b>1400</b>

**1.Cost of training 1 PhD student at Sokoine University of Agriculture – 2008**

Year	Fees in TAS	Research (TAS)	Allowances- TAS	Books-TAS	Stationery- TAS	Settling-TAS
Yr. 1	1,470,000.00	3,500,000.00	4,320,000.00	500,000.00	400,000.00	300,000.00
Yr. 2	1,395,000.00	6,000,000.00	4,320,000.00	500,000.00	400,000.00	-
Yr. 3	1,395,000.00	6,000,000.00	4,320,000.00	500,000.00	400,000.00	-
Yr. 4	2,670,000.00	4,000,000.00	4,320,000.00	500,000.00	400,000.00	-
Extension 6 months	378,000.00	2,000,000.00	2,160,000.00	250,000.00	200,000.00	-
Total	7,308,000.00	21,500,000.00	19,440,000.00	2,250,000.00	1,800,000.00	300,000.00
<b>Grand total</b>	<b>52,598,000.00</b>	<b>43,000,000.00</b>	<b>38,880,000.00</b>	<b>4,500,000.00</b>	<b>3,600,000.00</b>	<b>600,000.00</b>

## 2. Cost of training 1 Masters Student at Sokoine University of Agriculture – 2008

Year	Fees in TAS	Research (TAS)	Allowances	Books-TAS	Stationery-TAS	Settling-TAS
Yr. 1	1,728,750.00	4,500,000.00	4,320,000.00	500,000.00	400,000.00	300,000.00
Yr. 2	2,480,750.00	4,500,000.00	4,320,000.00	500,000.00	400,000.00	-
Extension 6 months	450,000.00	2,250,000.00	2,160,000.00	-	-	-
Total	4,659,500.00	11,250,000.00	10,800,000.00	1,000,000.00	800,000.00	300,000.00
<b>GRAND TOTAL</b>	<b>28,809,500.00</b>	<b>22,500,000.00</b>	<b>21,600,000.00</b>	<b>2,000,000.00</b>	<b>1,600,000.00</b>	<b>600,000.00</b>

3. The figures quoted for training have also taken into consideration possible changes in fees payable, inflation rate and the possibility that a student will be sponsored in a sister University where rates are much higher.

### **INFRASTRUCTURE (Budget Item Number 2.2.1 up to 2.2.7)**

Particulars	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yr. 5
Total Infrastructure	1,850,000	2,450,000	2,450,000	1,800,000	400,000
Total budget	16,829,520	21,294,520	21,624,520	19,134,520	16,021,020
Infrastructure (%)	11%	12%	11%	9%	2%

#### **Notes:**

Infrastructure is budgeted not to exceed 15 percent of the total budget of the Programme. Overall infrastructure is 9 percent of the total budget.

### **OVERALL PROGRAMME COORDINATION (Budget Item Number 3.1)**

Item	Total Cost (000 NOK)	Yr.2009 (000 NOK)	Yr.2010 (000 NOK)	Yr. 2011 (000 NOK)	Yr. 2012 (000 NOK)	Yr. 2013 (000 NOK)
Programme Coordination	200	40	40	40	40	40
Meetings						
Equipment	200	40	40	40	40	40
Stationery	100	20	20	20	20	20
Facilitation	150	30	30	30	30	30
Transportation	100	20	20	20	20	20
Fuel	200	40	40	40	40	40
Per Diems	200	40	40	40	40	40
Other	100	20	20	20	20	20
Operational costs						
<b>Total</b>	<b>1250</b>	<b>250</b>	<b>250</b>	<b>250</b>	<b>250</b>	<b>250</b>

#### **Budget Details:**

Overall Programme coordination will cater for activities of the Programme Implementation Team. This will hold regular meeting at least once every month and any other time when special meetings are needed to attend to ad hoc matters. It is expected that participants in the PIT will come from the 4 institutions (SUA, UDSM, TMA and ARDHI)

**PROGRAMME COORDINATION- AT SUA (Budget Item Number 3.2)**

<b>Item</b>	<b>Total Cost (000 NOK)</b>	<b>Yr.2009 (000 NOK)</b>	<b>Yr.2010 (000 NOK)</b>	<b>Yr. 2011 (000 NOK)</b>	<b>Yr. 2012 (000 NOK)</b>	<b>Yr. 2013 (000 NOK)</b>
Program coordination	150	30	30	30	30	30
Meetings						
Equipment	100	20	20	20	20	20
Stationery	50	10	10	10	10	10
Facilitation	100	20	20	20	20	20
Transportation	50	10	10	10	10	10
Fuel	100	20	20	20	20	20
Per Diems	150	30	30	30	30	30
Other costs	50	10	10	10	10	10
<b>Total</b>	<b>750</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>

All costs of coordination of all training activities will be met by this code  
Any constructions will also be coordinated from here.

**COORDINATION UMB (Budget Item Number 3.3)**

<b>Item</b>	<b>Total Cost (000 NOK)</b>	<b>Yr.2009 (000 NOK)</b>	<b>Yr.2010 (000 NOK)</b>	<b>Yr. 2011 (000 NOK)</b>	<b>Yr. 2012 (000 NOK)</b>	<b>Yr. 2013 (000 NOK)</b>
Participation	500	100	100	100	100	100
– Annual Meetings						
Participation	500	100	100	100	100	100
– Steering Meetings						
Professional fees	1000	200	200	200	200	200
International Travel	500	100	100	100	100	100
<b>Total</b>	<b>2500</b>	<b>500</b>	<b>500</b>	<b>500</b>	<b>500</b>	<b>500</b>

Budget: Coordination activities at UMB are reimbursable from this budget.  
Professional fees are paid to respective department of the Institution/University for time spent on matters of the Programme by the individual.

**PROGRAMME COORDINATION – UNIVERSITY OF DAR ES SALAM (Budget Item Number 3.4)**

<b>Item</b>	<b>Total Cost (000 NOK)</b>	<b>Yr.2009 (000 NOK)</b>	<b>Yr.2010 (000 NOK)</b>	<b>Yr. 2011 (000 NOK)</b>	<b>Yr. 2012 (000 NOK)</b>	<b>Yr. 2013 (000 NOK)</b>
Program coordination	250	50	50	50	50	50
Equipment	100	20	20	20	20	20
Stationery	50	10	10	10	10	10
Facilitation	50	10	10	10	10	10
Transportation	100	20	20	20	20	20
Fuel	150	30	30	30	30	30
Per Diems	200	40	40	40	40	40
Other costs	100	20	20	20	20	20
<b>Total</b>	<b>1000</b>	<b>200</b>	<b>200</b>	<b>200</b>	<b>200</b>	<b>200</b>

**COORDINATION ARDHI UNIVERSITY (Budget Item Number 3.5)**

<b>Item</b>	<b>Total Cost (000 NOK)</b>	<b>Yr.2009 (000 NOK)</b>	<b>Yr.2010 (000 NOK)</b>	<b>Yr. 2011 (000 NOK)</b>	<b>Yr. 2012 (000 NOK)</b>	<b>Yr. 2013 (000 NOK)</b>
Regular Meetings	150	30	30	30	30	30
Office Equipment	100	20	20	20	20	20
Stationery	50	10	10	10	10	10
Facilitation	100	20	20	20	20	20
Transportation	50	10	10	10	10	10
Fuel	100	20	20	20	20	20
Per Diems	150	30	30	30	30	30
Other Operational costs	50	10	10	10	10	10
<b>Total</b>	<b>750</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>

**COORDINATION TMA (Budget Item Number 3.6)**

<b>Item</b>	<b>Total Cost (000 NOK)</b>	<b>Yr.2009 (000 NOK)</b>	<b>Yr.2010 (000 NOK)</b>	<b>Yr. 2011 (000 NOK)</b>	<b>Yr. 2012 (000 NOK)</b>	<b>Yr. 2013 (000 NOK)</b>
Regular Meetings	150	30	30	30	30	30
Office Equipment	100	20	20	20	20	20
Stationery	50	10	10	10	10	10
Facilitation	100	20	20	20	20	20
Transportation	50	10	10	10	10	10
Fuel	100	20	20	20	20	20
Per Diems	150	30	30	30	30	30
Other Operational costs	50	10	10	10	10	10
<b>Total</b>	<b>750</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>	<b>150</b>

**PROGRAM MEETINGS (Budget Item Number 3.7)**

<b>Item</b>	<b>Total Cost (000 NOK)</b>	<b>Yr.2009 (000 NOK)</b>	<b>Yr.2010 (000 NOK)</b>	<b>Yr. 2011 (000 NOK)</b>	<b>Yr. 2012 (000 NOK)</b>	<b>Yr. 2013 (000 NOK)</b>
Annual Meeting	250	50	50	50	50	50
Steering Committee Meeting	485	97	97	97	97	97
Stationery	25	5	5	5	5	5
Facilitation	100	20	20	20	20	20
Transportation	200	40	40	40	40	40
Fuel	100	20	20	20	20	20
Per Diems	100	20	20	20	20	20
<b>Total</b>	<b>1260</b>	<b>252</b>	<b>252</b>	<b>252</b>	<b>252</b>	<b>252</b>

**COORDINATION (OTHERS) (Budget Item Number 3.8 up to 3.13)**

<b>Item</b>	<b>Total Cost (000 NOK)</b>	<b>Yr.2009 (000 NOK)</b>	<b>Yr.2010 (000 NOK)</b>	<b>Yr. 2011 (000 NOK)</b>	<b>Yr. 2012 (000 NOK)</b>	<b>Yr. 2013 (000 NOK)</b>
Equipment	1750	350	350	350	350	350
Vehicles	1800	1050	750	0	0	0
Maintenance						
Audit	1600	320	320	320	320	320
Programme	1040	100	160	240	240	300
Scientific Conferences						
Annual Review	2000	400	400	400	400	400
Workshops						
Institutional overheads	4750	950	950	950	950	950
Unallocated funds (Contingency)	1500	300	300	300	300	300
<b>Total</b>	<b>14440</b>	<b>3470</b>	<b>3230</b>	<b>2560</b>	<b>2560</b>	<b>2620</b>

- **TOTAL NUMBER OF VEHICLES IS 5 EACH COSTING 350,000 NOK WITHOUT TAX**
- **AT LEAST 10 MEMBERS OF STAFF WILL ATTEND 2 CONFERENCES PER ANNUM EACH COSTING NOK 24,000**
- **INSTITUTIONAL OVERHEADS TO BE ALLOCATED IN ACCORDANCE WITH THE VOLUME OF FUNDS BEING HANDLED BY EACH INSTITUTION**
- **UNALLOCATED FUNDS TO BE DECIDED UPON WHEN REQUIRED BY THE STEERING COMMITTEE OF THE PROGRAMME**

## Appendix 6: Programme Risk Analysis and Mitigation

Threats	Risk description	Risk estimation	Risk management
Human	<ul style="list-style-type: none"> <li>Retirement of qualified staff</li> <li>Staff illness, death</li> <li>Movement of staff</li> <li>Change of interest among collaborating institutions</li> </ul>	<ul style="list-style-type: none"> <li>10%</li> <li>5%</li> <li>&lt; 1%</li> <li>&lt; 1%</li> </ul>	<ul style="list-style-type: none"> <li>Training, retooling &amp; contract employment</li> <li>Improved health care through health insurance schemes</li> <li>Improved coordination &amp; transparency</li> </ul>
Operational	<ul style="list-style-type: none"> <li>Irregularities in disbursement of funds</li> <li>Delay in procurement of supplies</li> </ul>	<ul style="list-style-type: none"> <li>1%</li> <li>5%</li> </ul>	<ul style="list-style-type: none"> <li>Streamlined disbursement of funds</li> <li>Streamlined procurement procedures</li> </ul>
Economic	<ul style="list-style-type: none"> <li>Global economic recession</li> </ul>	<ul style="list-style-type: none"> <li>5%</li> </ul>	<ul style="list-style-type: none"> <li>Budget contingency</li> </ul>
Procedural	<ul style="list-style-type: none"> <li>Misallocation of funds by collaborating institutions</li> <li>Fraudulent activities</li> </ul>	<ul style="list-style-type: none"> <li>&lt; 1%</li> <li>&lt; 1%</li> </ul>	<ul style="list-style-type: none"> <li>Tightening of financial control</li> <li>Strict auditing of finances</li> </ul>
Programme	<ul style="list-style-type: none"> <li>REDD not accepted as the main climate mitigation mechanism</li> <li>Cost over runs</li> <li>Activities taking too long</li> <li>Low research output</li> <li>Poor coordination</li> </ul>	<ul style="list-style-type: none"> <li>5%</li> <li>&lt; 5%</li> <li>&lt; 5%</li> <li>&lt; 1%</li> <li>&lt; 1%</li> </ul>	<ul style="list-style-type: none"> <li>In-built mechanism to address this during the 2<sup>nd</sup> call for Research proposal and MSc. enrolment</li> <li>Streamlined expenditure of funds</li> <li>Strict adherence to work plans</li> <li>Strict adherence to log frame outputs</li> <li>Participatory/transpare nt coordination in place</li> </ul>
Financial	<ul style="list-style-type: none"> <li>Inflationary tendencies</li> <li>Tax increases</li> </ul>	<ul style="list-style-type: none"> <li>13 %</li> <li>5%</li> </ul>	<ul style="list-style-type: none"> <li>Budget contingency</li> <li>Budget contingency</li> </ul>
Technical	<ul style="list-style-type: none"> <li>Inadequate baseline data</li> <li>Accessibility to latest technology</li> <li>Outdated equipment/technology</li> </ul>	<ul style="list-style-type: none"> <li>20%</li> <li>5%</li> <li>10%</li> </ul>	<ul style="list-style-type: none"> <li>Collaboration with regional &amp; international partners</li> <li>Procurement of state of the art equipment</li> </ul>
Natural	<ul style="list-style-type: none"> <li>Threats from extreme weather</li> <li>Natural disasters</li> <li>Accidents</li> </ul>	<ul style="list-style-type: none"> <li>5 %</li> <li>&lt; 1%</li> <li>&lt; 1%</li> </ul>	<ul style="list-style-type: none"> <li>Prepare contingency plans</li> </ul>
Political	<ul style="list-style-type: none"> <li>Changing tax regime</li> <li>Public opinion</li> <li>Foreign influence</li> </ul>	<ul style="list-style-type: none"> <li>5 %</li> <li>&lt; 1%</li> <li>10%</li> </ul>	<ul style="list-style-type: none"> <li>Negotiate with tax authority</li> <li>Participatory approaches &amp; timely dissemination of results</li> <li>Negotiation</li> </ul>