climate change counts

STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA

Malawi Country Report

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SARUA CLIMATE CHANGE COUNTS MAPPING STUDY

VOLUME 2 COUNTRY REPORT 3 2014

STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA

Malawi Country Report

Series Editor: Piyushi Kotecha

Authors: Heila Lotz-Sisitka and Penny Urquhart

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Note

This is the Malawi Country Report of the Southern African Regional Universities Association (SARUA) ***Climate Change Counts*** *mapping study. It brings together background documentation on climate change in Malawi, insights into knowledge and research needs and capacity gaps (individual and institutional), a mapping of existing university roles and contributions to climate compatible development (CCD); as well as a discussion on possibilities for CCD learning pathways and future collaborative knowledge co-production and use in Malawi.*

This report is one of a set of 12 Country Reports in Volume 2, which inform Volume 1: the integrated regional Knowledge Co-production Framework of the ***Climate Change Counts*** *mapping study, and which includes comparative regional analysis using the outputs of the other SADC countries, as well as the proposed regional framework for collaborative research on climate compatible development.*

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SARUA is a not-for-profit leadership association of the heads of the public universities in the 15 countries of the SADC region. Its mission is to promote, strengthen and increase higher education, research and innovation through expanded inter-institutional collaboration and capacity-building initiatives throughout the region. It promotes universities as major contributors towards building knowledge economies, national and regional socio-economic and cultural development, and for the eradication of poverty.

*The **Climate Change Counts** mapping study is the inception phase of the SARUA Programme for Climate Change Capacity Development. The mapping study was made possible through the professional, financial and in-kind support of multiple partners. The principal study sponsor was the Climate and Development Knowledge Network (CDKN).*

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Acronyms

AFOLU	Agriculture, Forestry and Other Land Uses
APRU	Agricultural Policy Research Unit
BID	Background Information Document
CABMACC	Capacity Building for Managing Climate Change in Malawi
CARD	Centre for Agricultural Research and Development
CARP	Community Action Research Programme
CBO	Community Based Organisation
CCAM	Conformal-Cubic Atmospheric Model
CCD	Climate compatible development
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CEPA	Centre for Environment for Environmental Endowment and Advocacy
CERT	Centre for Educational Research and Training
CGCMs	Coupled Global Climate Models
CISANET	Civil Society on Agriculture Network
CISONECC	Civil Society Network on Climate Change
CSIR	Council for Scientific and Industrial Research
CSR	Centre for Social Research
EA&CCMD	Environmental Affairs and Climate Change Management Department
EAD	Environmental Affairs Department
EAGLOnet	East African Great Lakes Observatory
EEASA	Environmental Education Association of Southern Africa
EIA	Environmental Impact Assessment
FFEWS	Famine and Flood Early Warning System
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GNI	Gross National Income
GoM	Government of Malawi
HEI	Higher Education Institution
HEMA	Higher Education Management Africa consortium
HRD	Human Resources Development
IK	Indigenous Knowledge
IPCC	Intergovernmental Panel on Climate Change
LCBCCAP	Lake Chilwa Basin Climate Change Adaptation Programme
LEAD	Leadership for Environment and Development
LEAD SEA	Leadership for Environment and Development Southern and East African Programme
LUANAR	Lilongwe University of Agriculture and Natural Resources
MA	Masters in Art

MBERU	Molecular Biology and Ecology Research Unit
MEET	Malawi Environment Endowment Trust
MIRTDC	Malawi Industrial Research and Technology Research Centre
MREAP	Malawi Renewable Energy Acceleration Programme
MRERP	Malawi Renewable Energy Research Programme
MSc	Masters in Science
NAPA	National Adaptation Programme of Action
NAREC	Natural Resources and Environment Centre
NAREC	Natural Resources and Environment Centre
NCCP	National Climate Change Policy
NCE	National Council on the Environment
NEP	National Environmental Policy
NGO	Non-Governmental Organisation
NRCM	National Research Council of Malawi
NRM	Natural Resource Management
NSCT	National Commission of Science and Technology
OPC	Office of the President and Cabinet
PCM	Project Citizen Malawi
REDD+	Reducing Emissions from Deforestation and forest Degradation
RFN	Regional Fish Node
SADC	Southern African Development Community
SADC REEP	Southern African Development Community Regional Environmental Education Programme
SANBio	South African Network Biosciences
SARCOF	Southern African Regional Climate Forecasting
SARUA	Southern African Regional Universities Association
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Use
SNC	Second National Communication
SWAps	Sector Wide Approaches
TCE	Technical Committee for the Environment
TVET	Technical Vocational Education and Training
UNDAF	United Nations Development framework for Malawi
UNDP	United Nations Development Programme
UNFCCC	UN Framework Convention on Climate Change
UNIMA	University of Malawi
WASHTED	Centre for Water, Sanitation, Health and Appropriate Technology Development

1 INTRODUCTION

1.1 Regional climate risks and university leadership for climate compatible development in southern Africa

Globally, southern Africa is one of the most vulnerable regions to the impacts of climate change. Current climate variability and vulnerability to extreme events such as floods and droughts is high, and a range of existing stressors, including water availability, land degradation, desertification and loss of biodiversity constrain food security and development. Reduction of the region's structural poverty is further challenged by health threats such as malaria and HIV/AIDS, as well as institutional and governance aspects. Climate change will compound many of these interlinked problems for regional livelihoods, which are often based on subsistence agriculture, and for regional economies, which are often dependent on natural resources. The region's high vulnerability to climate change is a function of the severity of the projected physical climate impacts and this multi-stressor context, which heightens both exposure and sensitivity to the impacts.

In addition to its role as a risk multiplier, climate change introduces new climate risks. Already the observed temperature changes for southern Africa are higher than the increases reported for other parts of the world (IPCC 2007); projections indicate a 3.4°C increase in annual temperature (up to 3.7°C in spring), when comparing the period 1980–1999 with the period 2080–2099. Mean warming over land surfaces in Southern Africa is likely to exceed the average global land surface temperature increases in all seasons.[1] Further projections are for overall drying for southern Africa, with increased rainfall variability; a delay in onset of the rainy season with an early cessation in many parts; and an increase in rainfall intensity in some parts. [See Figures 1 and 2.[2]] Additional climate-driven risks, in addition to the direct effects of increased temperature and increased incidence and/or severity of extreme events like floods and droughts, include more wind storms, hot spells and wild fires. Both the heightened and the new risks will act at the local level to compound other stressors and development pressures faced by people, and at the national level on the region's natural resource-dependent economies. The all-encompassing nature of the impacts highlights the fact that climate change is not a narrow environmental problem, but a fundamental development challenge that requires new and broad-based responses.

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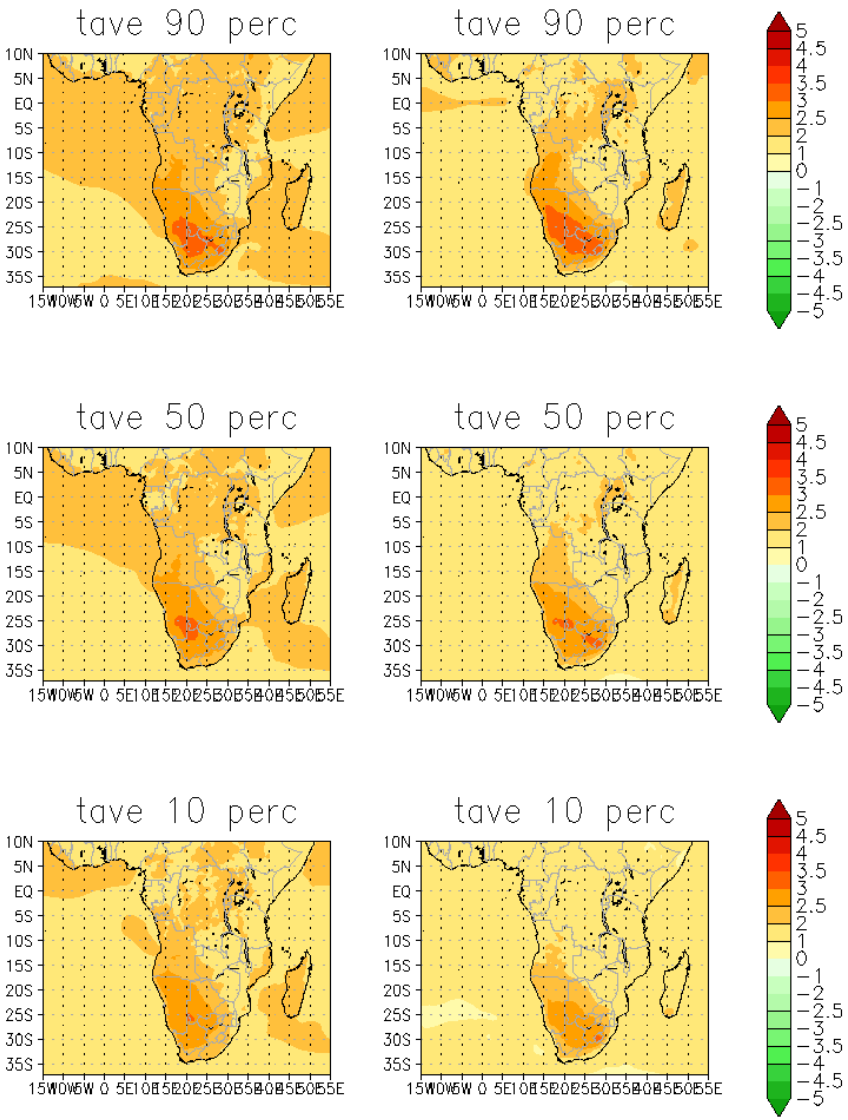
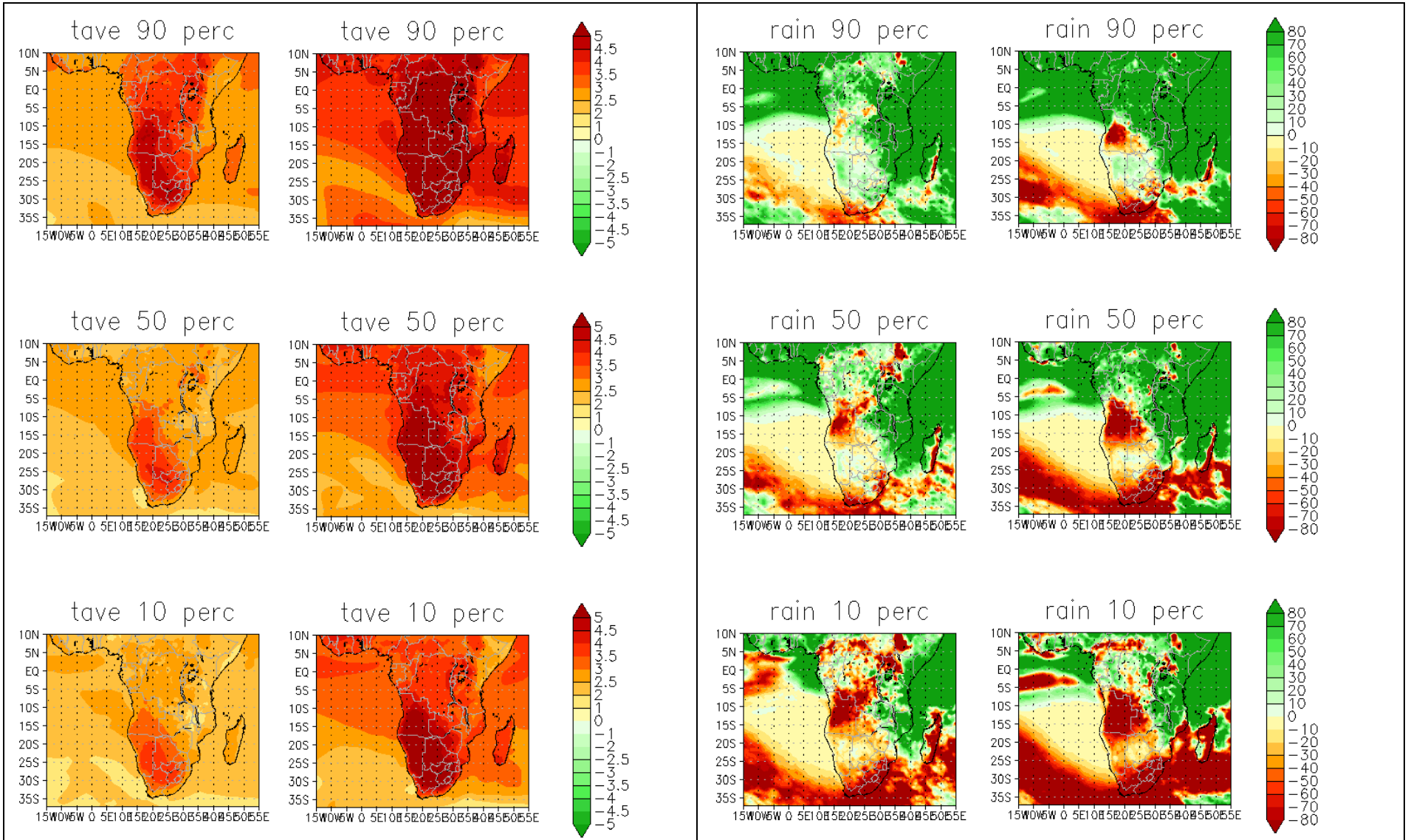
[1] IPCC. 2013. *Impacts, Vulnerability and Adaptation: Africa*. IPCC Fifth Assessment Report, draft for Final Government Review, Chapter 22.

[2] The projections of future climate change displayed in Figures 1 and 2 were provided by the Council for Scientific and Industrial Research (CSIR), and have been obtained through downscaling the output of a number of coupled global models (CGCMs) to high-resolution over Africa, using a regional climate model. All the CGCMs downscaled contributed to the Coupled Model Intercomparison Project Phase 5 (CMIP5) and Assessment Report 5 (AR5) of the Intergovernmental Panel on Climate Change (IPCC). Details on these simulations are provided in the LTAS Phase 1 Technical Report no. 1. The regional model used is the conformal-cubic atmospheric model (CCAM), developed by the CSIRO in Australia. For various applications of CCAM over southern Africa, see Engelbrecht, F.A., W.A. Landman, C.J. Engelbrecht, S. Landman, B. Roux, M.M. Bopape, J.L. McGregor and M. Thatcher. 2011. "Multi-scale climate modelling over southern Africa using a variable-resolution global model," *Water SA* 37: 647-658.



Note: The 90th percentile (upper panel), median (middle panel) and 10th percentile (lower panel) are shown for an ensemble of downscalings of three CGCM projections, for each of the time-slabs. The downscalings were performed using the regional model CCAM. All the CGCM projections are contributing to CMIP5 and AR5 of the IPCC, and are for RCP4.5.

Figure 1: Projected change in the annual average temperature (°C) and annual average rainfall (mm) over the SADC region, for the time-slab 2040–2060 and 2080–2099, relative to 1970–2005



Note: The 90th percentile (upper panel), median (middle panel) and 10th percentile (lower panel) are shown for an ensemble of downscalings of three CGCM projections, for each of the time-slabs. The downscalings were performed using the regional model CCAM. All the CGCM projections are contributing to CMIP5 and AR5 of the IPCC, and are for RCP8.5.

Figure 2: Projected change in the annual average temperature (°C) and annual average rainfall (mm) over the SADC region, for the time-slab 2040–2060 and 2080–2099, relative to 1970–2005

Figures 1 and 2[3] showed the projected change in the annual average temperature (°C) and annual average rainfall (mm) over the SADC region, for the time-slabs 2040–2060 and 2080–2099, relative to 1970–2005. The Figure 1 CGCM projections are for RCP4.5 and Figure 2 for RCP8.5.

Shifting perspective from 'development' to 'climate compatible development' requires significant scientific and social innovation. New forms of learning, leadership, planning, policy making and knowledge production are needed. New collaboration platforms will be needed within and between countries and their universities. Universities have a key role to play in supporting societal innovation and change for CCD. Not only do they develop the knowledge and competence of future leaders in government, business and civil society, but they also provide immediate societal responses given their pivotal role as centres of research, teaching, knowledge sharing and social empowerment. Given the risk multiplier effect of climate change, coupled with the multiple stressor context, it is clear that the impacts of climate change will be far-ranging, acting upon diverse sectors such as transportation, agriculture, health, industry and tourism. This necessitates a wide-ranging and cross-sector response, in which non-climate-related knowledge fields will be called upon. The Malawian government recognises this relationship between climate change and development, as cited in the Malawi Draft National Climate Change Policy (2013) being produced by the newly established Ministry of Environment and Climate Change Management:

> *"The National Policy on Climate Change will contribute to the attainment of sustainable development in line with Malawi's National goals, as outlined in Malawi's Growth and Development Strategy II and Vision 2020. It will achieve this through better adaptation to, and mitigation against, climate change, with a focus on resilience building, technology transfer and capacity building for Malawi's citizens. This Climate Change Policy is intended to guide actions that reduce people and ecosystem vulnerability through adaptation and mitigation, technology transfer and capacity building. The policy is also intended to guide financing of climate change initiatives and harmonised approaches by different sectors and institutions towards building peoples and ecosystem resilience to climate change." (Foreword)*

Universities need to develop a strong understanding of the knowledge, teaching, research and outreach implications of the external climate change development context in which they operate. This calls for:

- New scientific directions and practices;
- New teaching and learning content and approaches;
- Stronger forms of community outreach and policy outreach activities; and
- Enhanced collaboration between universities and other knowledge producers and users in society.

[3] Engelbrecht et al. 2014. "Multi-scale climate modelling". Climate trends and scenarios for South Africa. Long-term Adaptation Scenarios Flagship Research Programme (LTAS). Phase 1, Technical Report no. 1.

In recognition of the above issues and their longer-term implications for society and universities, the Southern African Regional Universities Association (SARUA) hosted a Leadership Dialogue in 2011, which resulted in a vision for a collaborative programme on climate change capacity development, with a defined set of outcomes. This programme is highly relevant for Malawi, given the country's vulnerability to the impacts of climate change (Box 1; as outlined in the Introduction to the draft National Climate Change Policy (NCCP) for Malawi, 2013).

1.2 The SARUA Climate Change initiative: History and objectives

Arising from the 2011 Leadership Dialogue, SARUA designed a five-year programme for Climate Change Capacity Development, to deliver on its mandate of promoting, strengthening and increasing higher education research and innovation, through expanded inter-institutional collaboration and capacity building initiatives throughout the region. The five-year programme is endorsed by a majority of Vice Chancellors within SARUA's 62 public university members (as at August 2013). The programme aims to build capacity for *climate compatible development* (CCD), which is emerging as a platform for significant collaboration across the academic sector. The objectives identified are as follows:

- **Collaborative network development** (establishment of six interesting collaborative networks);
- Policy and community outreach;
- **Research** (140 PhD students (average 10 per country) in two themed research programmes);
- **Teaching and learning** (integration of CCD into undergraduate and Masters degree programmes);
- **Knowledge management** (regional database and knowledge management systems); and
- **Institutional learning and support** (on-going reflexive development of programme).[4]

The programme started with an extensive **mapping study** of current climate-related priorities and university capabilities for CCD of countries in the region, supported by funding from the UK and Dutch-funded Climate and Development Knowledge Network (CDKN). The Higher Education Management Africa consortium (HEMA) is coordinating the study on behalf of SARUA. This Malawian Country Report forms part of the mapping study.

The SARUA climate change initiative is diagrammatically illustrated in Figure 3.

[4] Butler-Adam, J. 2012. *The Southern African Regional Universities Association (SARUA). Seven Years of Regional Higher Education Advancement. 2006-2012*. Johannesburg: SARUA.

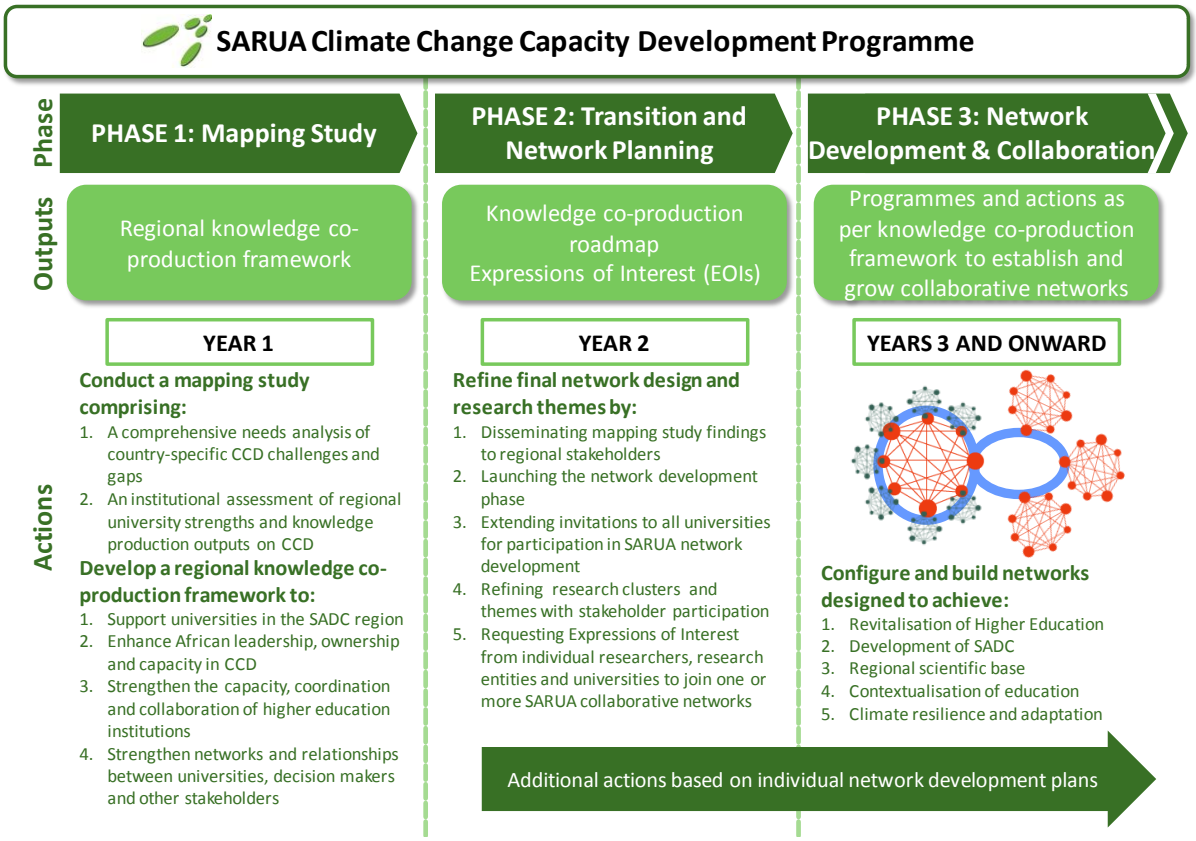


Figure 3: The SARUA Climate Change Initiative

The intended outcome of the SARUA **mapping study** will be a collaborative research framework to enhance co-production of knowledge on CCD. It will include strategies to strengthen networks for Climate Compatible Development research, teaching, community and policy outreach involving knowledge co-production processes between participating universities and policy and community stakeholders. This framework will form the basis for the realisation of the longer term objectives of the SARUA programme outlined above, as well as for a SADC-level research programme and various country-based partnership agreements. It will provide a 'knowledge platform' for regional and country-based fundraising for research and knowledge co-production. As such the framework seeks to benefit universities themselves, while also strengthening regional interaction and co-operation.

The Regional Knowledge co-production Framework for Climate Compatible Development can be obtained from the SARUA website www.sarua.org.

1.3 The SARUA CCD mapping study: Mapping existing capacity and future possible knowledge co-production possibilities

Climate compatible development (CCD) is low carbon, climate resilient development. While the concept clearly requires integration of development, adaptation and mitigation (see definitions below), specific framing of the concept of CCD may vary between countries, universities and disciplines, according to differing national, institutional and disciplinary goals, needs and values. The scope and strength of existing expertise, networks and capacity for climate compatible development research and knowledge production in SADC is largely unknown or unconsolidated. Despite the

emerging knowledge infrastructure for CCD in the region, opportunities for collaboration involving higher education institutions within and between countries are yet to be fully explored.

To address these factors, the mapping study aimed to:

- Explore diverse understandings of CCD on a country-by-country basis;
- Scope CCD knowledge and capacity needs on a country-by-country basis (a 'needs analysis'); and
- Identify and map research, teaching and outreach capabilities for CCD that exist in southern African countries (an 'institutional analysis' of SARUA member universities); and
- Produce an up-to-date picture of the extent of knowledge co-production and trans-disciplinary research practices across the SARUA network and identify opportunities for future collaboration.

The country-by-country mapping study reports are supplemented by a regional perspective generated through analysis across countries, to provide a platform for regional collaboration and knowledge co-production. This document contains the country analysis from Malawi.

The mapping process was designed to be scientifically informed, participatory and multidisciplinary. Through the workshop process new collaborative possibilities will emerge, and a stronger engagement and participation in the SARUA five-year programme on Capacity Development for Climate Change will be established.

1.4 Key concepts

Climate Compatible Development

Climate compatible development (CCD) is low carbon, climate resilient development. The concept has been developed in recognition of the urgent need for adaptation, given current climate variability and the severity of projected climate impacts that will affect the region; and the need to reduce emissions as rapidly as possible to avoid more catastrophic climate change in the future. Thus while CCD can be framed in different ways, given nationally and locally specific development trajectories, it does require that current and future climate risks are mainstreamed into development, and that both adaptation and mitigation are integral goals of development, as indicated by Figure 3. Thus CCD not only recognises the importance of both adaptation and mitigation in new development pathways, but, as further explained in Mitchell and Maxwell (2010), "Climate Compatible Development goes one step further by asking policy makers to consider 'triple win' strategies that result in low emissions, build resilience and promote development simultaneously". In the southern African context, poverty reduction, as an integral component and goal of regional and national development strategies would be a desired co-benefit. Uncertainties in major drivers of change, including climate, socio-economic and political risks, necessitate that CCD be viewed as an iterative process, in which vulnerability identification and risk reduction responses are revised on the basis of continuing learning. Climate Compatible Development emphasises

climate strategies that embrace development goals and development strategies that integrate the threats and opportunities of a changing climate.[5] Thus Climate Compatible Development opens up new opportunities for interdisciplinary and transdisciplinary research, teaching and engagement with communities, policy makers and practitioners.

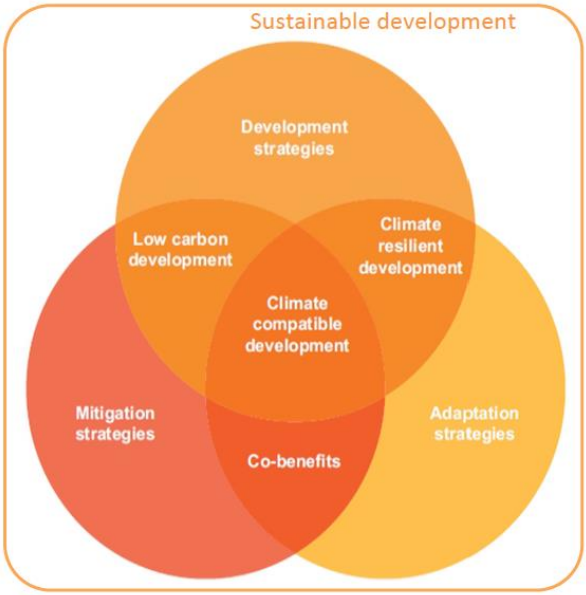


Figure 4: Conceptual framework for Climate Compatible Development (adapted from Mitchell and Maxwell, 2010)

While CCD is the central concept used in the work that is funded by CDKN, it is important that this is understood alongside the concept of climate-resilient development pathways as defined by the Intergovernmental Panel on Climate Change (IPCC) and the wider concept of sustainable development (see definitions below).

Climate-resilient pathways

The following definition of climate-resilient pathways is taken from the glossary of the Fifth Assessment Report prepared by the Intergovernmental Panel on Climate Change (IPCC)[6]: "Evolutionary processes for managing change within complex systems in order to reduce disruptions and enhance opportunities. They are rooted in iterative processes of identifying vulnerabilities to climate change impacts; taking appropriate steps to reduce vulnerabilities in the context of development needs and resources and to increase the options available for vulnerability reduction and coping with unexpected threats; monitoring emerging climate parameters and their implications, along with monitoring the effectiveness of vulnerability reduction efforts; and revising risk reduction responses on the basis of continuing learning. This process may involve a combination of incremental changes and, as necessary, significant transformations." The IPCC highlights the need for a focus on both adaptation and mitigation, as indicated by the following sentence: "Climate-

[5] Mitchell, T. and S. Maxwell. 2010. *Defining climate compatible development.* CDKN Policy Brief, November 2010.

[6] IPCC. 2013. *Fifth Assessment Report: Impacts, Vulnerability and Adaptation*. Currently in draft form.

resilient pathways are development trajectories that combine adaptation and mitigation to realise the goal of sustainable development. They can be seen as iterative, continually evolving processes for managing change within complex systems."[7]

Sustainable Development

The most widely accepted definition of sustainable development, as formulated in the Bruntland Commission's 'Our Common Future' report in 1987, is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This definition has been highly influential in shaping international environmental and development policy, since the Rio Earth Summit in 1992, where Agenda 21 was put forward as a global development plan for aligning goals of economic development with social and environmental sustainability. Early discussions on sustainable development tended to focus on the triple bottom line concepts of environment, economy and society separately. More recent discussions on sustainable development foreground the need for 'strong sustainability', in which society, economy and environment are seen as interacting in an inter-related, nested system. The concept of sustainable development as used widely today emphasises that everything in the world is connected through space, time and quality of life, and thus necessitates a systems approach to understanding and solving interlinked social, environmental and economic problems. In 2002 South Africa hosted the World Summit on Sustainable Development, and the Johannesburg Plan of Implementation re-affirmed commitment to Agenda 21, and the Millennium Development Goals. These are currently under review and will be expanded through Sustainable Development Goals. In 2012 the Rio+20 Conference was held in Rio de Janeiro, and the outcomes of this global summit on sustainable development are captured in a document entitled 'The Future We Want'. One major shift in discourse and objectives from the early 1992 Summit and the Rio+20 Summit is a stronger concern for climate change and climate compatible development, especially the emergence of a low carbon future, accompanied and partly implemented by Green Economies. These international commitments, together with ongoing assessment of national sustainable development concerns and goals, have driven the development of sustainable development policy and practice. The concept of CCD highlights the necessity of integrating current and future climate risks into development planning and practice, in the ongoing goal of achieving sustainable development.

[7] IPCC. 2013. *Fifth Assessment Report*.

2 METHODOLOGY, DATA SOURCES AND ANALYSIS LOGIC

2.1 Research design

This country-based study has been informed by an interactive and dialogical research design that included document analysis of key national and regional documents focusing on climate change in Malawi and in the SADC region. This produced an initial analysis which was used to plan for and engage university participants and national organisations involved in the climate change and development arenas in a consultation to discuss a) the validity of the analysis, and b) expanded views and perspectives on the analysis, and to generate further insight into knowledge co-production practice and possibilities for climate compatible development.

The following methods were used to compile the mapping study Country Report for Malawi, within an overall interpretive, participatory and consultative and social realist methodology[8]:

2.1.1 Document analysis

The country Background Information Document (BID) provides a summary of needs, priorities and capacity gaps already identified within key country documents (see below) for climate change, adaptation and mitigation, and in some cases, where this was available, Climate Compatible Development. This was used as a source of background information for the stakeholder and institutional consultations held in each country. While the scope of CCD is necessarily wide, the document analysis did not focus on sectoral policy and institutions, but concentrated on overarching policy dealing with mainstreaming climate change into planning and development. The initial document analysis was presented to stakeholders during the workshops, and was revised based on outcomes of the consultations held in the country. In addition to drawing on the BID, the following documents were analysed through rapid desk review, to develop the Malawi Country Report:

- Malawi Growth and Development Strategy (2006-2011), 2006;
- Malawi's National Adaptation Programme of Action (NAPA), 2006;
- Malawi National Capacity Self-Assessment for Global Environmental Management, September 2007; and
- Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), October 2011.
- The draft National Climate Change Policy for Malawi (GoM, 2013) which while in draft form was seen to be the most up-to-date information on Malawi's strategic climate change response policy initiative.

[8] A social realist methodology takes account of knowledge that has previously been established via scientific methods before engaging in consultative and participatory knowledge production processes.

2.1.2 Stakeholder and university staff consultations (national workshop)

As part of the SARUA mapping study Initiative *Climate Change Counts*, a country consultation workshop was held on the 17 September 2013 at Chancellor College in Zomba, a constituent college of the University of Malawi.[9] The consultations were structured as a one-day programme, with a combined group of participants that included university, government, private sector and NGO stakeholders. See Appendix A for the list of participants. A summary of the content of the different sessions is provided below in Table 1. From detailed workshop proceedings captured by a team of three rapporteurs a workshop report was produced, which was circulated to all who participated in the workshop for verification and accuracy. Data produced in the workshops was also verified and added to during plenary sessions. The workshop report forms a substantive basis of the data used for this Country Report, combined with document analysis and questionnaire data.

Table 1: Malawi workshop programme

Time	Activities
08h30 – 09h00	Registration
09h00 – 09h15	**WELCOME AND INTRODUCTORY REMARKS**
09h15 – 09h30	**SARUA INITIATIVE OVERVIEW**
09h30 – 10h15	**SESSION 1: FRAMING CLIMATE COMPATIBLE DEVELOPMENT (CCD) IN MALAWI** • Climate Change in Malawi • Climate Resilient Agricultural Development in Malawi • Climate Change and University research and policy contributions Short Plenary Discussion
10h15 – 10h30	Tea/coffee
10h30 – 12h15	**SESSION 2: MALAWI PRIORITIES, KNOWLEDGE AND CAPACITY GAPS FOR CLIMATE COMPATIBLE DEVELOPMENT** – Plenary and breakaway discussions
12h15 – 13h00	Lunch
13h00 – 14h00	**SESSION 3: FOCUSING ON BUILDING THE UNIVERSITY RESPONSE TO CLIMATE CHANGE – RESEARCH, TEACHING, POLICY AND COMMUNITY ENGAGEMENT**
14h00 – 15h00	**SESSION 4: STRENGTHENING THE ENABLING ENVIRONMENT FOR KNOWLEDGE CO-PRODUCTION, IMPLICATIONS FOR POLICY** – Plenary discussion
15h00 – 15h30	**WAY FORWARD AND CLOSURE**

2.1.3 Questionnaires

Two different questionnaires were prepared to obtain more in-depth data on climate change and CCD knowledge co-production practice and possibilities, and to enable people who were unable to attend the country workshops to participate in the mapping study (see Appendices C and D). One was designed for university professionals and the other for national and regional stakeholders who are involved in climate change and CCD. For Malawi, a total of 37 questionnaires were answered,

[9] The Malawi consultations were made possible through the kind contribution of the University of Malawi, supported by LEAD southern Africa.

which included 10 stakeholders and 27 university professionals. Questions covered the following areas:

2.1.3.1 University staff questionnaire

A. **General demographic and professional information** (name, gender, highest qualification, job title, years of experience, years of experience with CC, name of university, country, faculty, department, programme, contact details)
B. **Understandings of Climate Change and Climate Compatible Development** and views on critical CCD issues and responses from universities (staff and university leaders)
C. **Capacity, knowledge and research gaps** (levels of involvement in CC and CCD research – local, national and international; levels of single, inter- and transdisciplinary involvement in CCD research; stakeholder involvement; funding and fundraising for CCD research; policy contributions; major research programmes / projects; active researchers; research knowledge networks)
D. **Curriculum, teaching and learning** (specialist courses; integration of CCD issues into courses; cross faculty teaching; inter- or transdisciplinary teaching approaches; service learning approaches; critical thinking and problem solving approaches; social or technical innovation courses; assessment and examination of CCD issues; staff willingness and staff ability; actual courses and teaching methods)
E. **Policy, community engagement and student involvement**
F. **University collaboration** (inside the university; between universities in country; with partners; regional and international involvement)
G. **University policy and campus management**

2.1.3.2 Stakeholder questionnaire

The stakeholder questionnaire covered items A-C above, with an additional:

H. **Interests, policies, networks and Centres of Excellence or Expertise**

2.2 Limitations of the mapping study

This mapping study was constrained by a) a lack of baseline data on knowledge and research gaps for climate compatible development and university-based responses in Malawi, and b) by time and resource constraints that did not allow for **in-depth field visitation, individual interviewing or observation** before, during and after the consultation process. Moreover, the information generated at the country workshop relates to the number of participants, their expertise and the number of different sectors and institutions present. Further, while every effort was made to obtain questionnaire responses from as wide a range of stakeholders as possible, and follow-ups were made post-workshop to enhance this, the range of questionnaire responses obtained does provide certain limitations to the data set. However, the **best available information was carefully consolidated, reviewed and verified** in the construction of this Country Report.

While much information could be obtained on climate change- and CCD-related knowledge gaps, research needs and capacity gaps, there is obviously more to be learned about these. Similarly, as

much information as possible was obtained on 'who is doing what' and on existing research, knowledge co-construction practice and possibilities, but there is clearly also more to learn.

This Country Report therefore presents as a useful 'initial document' and it is hoped that Malawi, and in particular the University of Malawi (UNIMA) (Chancellor College, The Polytechnic, College of Medicine and Kamuzu College of Nursing), Lilongwe University of Agriculture and Natural Resources (LUANAR), Forestry Research Institute of Malawi, the Ministry of Environment and Climate Change Management, the Department of Climate and Meteorological Service, the Ministry of Education together with other national stakeholders can take this analysis forward in ongoing mapping and planning activities related to CCD research and knowledge co-production.

2.3 Expanding the mapping study

There are numerous ways to expand this study, most notably by administering the questionnaires (included in Appendices C and D) in a manner that would include every academic at universities in Malawi, and in a way that would allow for aggregate data within and across Faculties and Departments. The scope of such a detailed analysis lay beyond the capacity of the current mapping study. Data from questionnaires is therefore indicative rather than conclusive. Similarly, the questionnaire for stakeholders can be administered with additional national and local stakeholders (Appendix D) involved in environment and development initiatives in Malawi to understand the full scope of climate change and CCD responsiveness in Malawi, and to further develop the knowledge co-production capacity for CCD in Malawi. In many ways therefore the SARUA study, as reported in the Country Report, maps out the pathway forward for more detailed and ongoing reflexive analysis of CCD knowledge co-production capacity in Malawi, and through the questionnaires and analysis provided for in this document, begins to provide for ongoing monitoring and development capability for CCD knowledge co-production in Malawi. Ministries who could take this study forward could include the Ministry of Environment and Climate Change Management, Ministries of Agriculture and Food Security, Department of Climate and Meteorological Services, Ministry of Education together with other relevant partners and stakeholders.

2.4 Analysis logic

The analysis logic informing this Country Report is threefold. It firstly maps out a 'needs analysis' which identifies country based knowledge, research and capacity gaps for key CCD priorities as articulated in documents, workshop and questionnaire responses. Secondly, it provides an 'institutional analysis' providing insight into existing institutional capacity for CCD knowledge co-production. Thirdly, it provides a perspective not only on existing knowledge co-production practice for CCD in Malawi, but also on knowledge co-production possibilities, based on information gathered during the mapping study. It provides a knowledge base for producing knowledge co-production pathways in Malawi, which may also assist Malawi **to co-operate with other SADC countries in regional knowledge co-production processes.**

3 NEEDS ANALYSIS

3.1 Introducing the needs analysis

The needs analysis starts with a brief overview of Malawi's socio-economic context and a summary of the observed and projected climatic changes for the country (section 3.2) as these are key drivers for the 'need' for CCD identified by policy, in workshops and via the questionnaires (section 2.3). The needs analysis then describes **more detailed knowledge, research and capacity** needs (section 3.4) using the following differentiation of knowledge, research and capacity gaps:

- **Knowledge gaps** (e.g. insufficient knowledge of appropriate CCD technologies);
- **Research gaps** (e.g. no research on cultural uptake of CCD technologies);
- **Individual capacity gaps** (skills needed) (e.g. for technicians / systems thinking etc.); and
- **Institutional capacity gaps** (which have inferred knowledge and research gap implications) (e.g. resources to implement large scale technology change programmes).

It is possible that this analysis can be extended in future, and readers of the mapping study are advised to use the information provided here as best available information (produced within the constraints of the mapping study outlined above), rather than definitive.

3.2 Socio-economic context and projected climate change impacts and vulnerabilities: Drivers of CCD needs

3.2.1 Socio-economic context

Malawi is a landlocked country lying between 9° and 17° south of the equator, and 33° and 35° east of the Greenwich meridian. It has a total surface area of 118 000 km², 20 percent of which is covered by water. Its population was about 13 million in 2008, according to the official census. The climate is generally warm, with mean annual temperatures ranging from 25–26°C in the lowlands and 13–15°C on the high altitude plateaus. The average annual rainfall is relatively high, ranging from 725–2 500 mm per year. The land is divided into four agro-ecological zones: high altitude plateaus; medium altitude plateau; Lakeshore plain; and Shire Valley. One of the most densely populated countries in the world, Malawi's increasing population density – from 89 to 139 people per km² in the period 1987 to 2011 – is placing additional stress on the country's natural resources. According to the Second National Communication, agricultural expansion over the last four decades has significantly contributed to deforestation, soil erosion, and environmental degradation.

Climate sensitive rain-fed agriculture is the backbone of Malawi's economy, being a major contributor to the national gross domestic and foreign exchange earnings. It also supports the livelihoods of the over 80 percent of Malawians who are involved in primary and secondary agricultural activities. Primary economic sectors, in descending order of GDP contribution, are

agriculture (55 percent), services (26 percent), and industry and commerce (19 percent). The country's Gross National Income (GNI) per capita is US$170, with 52 percent living in poverty. HIV/AIDS continues to threaten human capacity in the country. The disease resulted in a drop in life expectancy to 46 years in 2000, with a subsequent rise to 54 years in 2011[10] due to treatment and awareness.

3.3 Observed and projected climatic changes, impacts and vulnerabilities

3.3.1 Observed climatic changes

Malawi has experienced an increase in average temperature over the last century. The UNDP Climate Change Country Profile notes that the mean annual temperature has increased by 0.9°C between 1960 and 2006. During the same period, the number of hot days and nights per year has increased by 30.5 and 41 days respectively. Higher temperatures coupled with low and erratic rainfall have been observed in the Shire Valley and the Malawi Lakeshore plain. Malawi has observed an increase in the incidence of extreme weather events, notably, droughts, floods, hailstorms and strong winds. Of the 254 natural disasters recorded since 1946, 186 of them (74 percent) were climate-related.

3.3.2 Projected climatic changes

In general, Malawi is expected to experience higher temperatures and lower rainfall in the future. The 2011 Second National Communication reports that mean annual temperature in Malawi is likely to increase by 1°C by 2020, 2°C by 2075, and 4°C by 2100. Temperature projections as reported in the UNDP Climate Change Country Profile are for an increase of between 1.1 and 3.0°C by the 2060s and between 1.5 and 5.0°C by the 2090s. The number of cold days and nights per year are projected to decrease. Mean monthly and annual rainfall is projected to decrease in the future, ranging from around -4.8 percent to -0.7 percent. The incidence of rainfall that occurs in heavy events will increase by 19 percent by 2090, under a scenario of high global greenhouse gas emissions.

3.3.3 Impacts and vulnerabilities

The projected temperature and rainfall changes are likely to result in the following climatic impacts: prolonged dry spells, droughts, floods, and increased evapotranspiration, all of which will compound existing stresses on the natural resource base, and lead to reduced performance in sectors such as water and irrigation, agriculture, natural resources and energy. Thus climate change will threaten the resource-based livelihoods of the majority of people who heavily depend on water, soils, fisheries, forests and woodland products. The SNC (2011) and NAPA (2006) summarise vulnerabilities and the need for adaptation responses in the following areas: agriculture, forestry and other land uses, energy, water resources, wildlife, fisheries, human health and gender.

[10] World Bank Data Profile on Malawi.

There are likely to be negative impacts on crop yields and livestock productivity as a result of increased temperatures and reduced rainfall. While a moderate increase in temperature tends to increase growth rate, temperatures above 35^{o}C would result in a reduction in biomass productivity and hence crop yields, particularly for maize. While all sectors and groups engaging in agriculture will be affected, this will be most severe for poor people living in marginalised areas, where the complex interaction of socio-economic stressors in subsistence farming households (poor health, inequitable access to land, gender inequality, population growth, and increasing competition for shared resources) will be exacerbated by climatic changes. These same issues are included in the draft National Climate Change Policy of 2013.

Climate change will have severe impacts on Malawi's important fisheries sector. For Lake Malawi, projected temperature profiles suggest serious implications for the survival of flora and fauna in the lake ecosystem, with potential negative impacts on the Chambo fish population which is a key fisheries resource.

Malawi's health indicators in terms of infant and maternal mortality, malaria, diarrhoeal diseases, HIV/AIDS and malnutrition are generally poor and are likely to worsen under climate change unless urgent and drastic measures are undertaken to reverse current trends. The country's infrastructure is threatened by climatic changes, as evidenced by damage to buildings, roads and hydro-power stations in recent years, resulting from climate-related events.

3.4 Identified needs: Short to medium term national priorities for CCD in Malawi

3.4.1 Identified adaptation and mitigation priorities articulated in policy and strategy

Malawi has identified key needs and priorities, related to the above mentioned observed and projected climate changes, impacts and vulnerabilities.

Specific **adaptation** priorities and associated needs that are highlighted in the Second National Communication (2011) and NAPA (2006), and in the draft National Climate Change Policy (GoM 2013) prioritise the need for adaptation responses in the following areas: agriculture, water resources, forestry, biodiversity, ecosystems and wildlife, fisheries, health, human settlements, and energy. Some specific adaptation priorities are:

- ***Agriculture:*** Promotion and support of efficient irrigation technologies, developing drought resistant and tolerant crops and fodder; improved livestock breeds, early warning systems and animal husbandry practices; expansion of cultivated land where temperature increases have increased agricultural potential; soil and water conservation; and pest and disease control.
- ***Forestry and other land uses****:* Development of seed banks for drought tolerant tree species, breeding and screening of drought tolerant tree species, co-management of forest resources, community based management of 'communal' forests, forest fire management, reforestation, and effective policing of protected areas. Promotion of REDD+, agro-forestry and use of alternative fuels are some of the initiatives suggested.
- ***Water resources:*** Investment in water infrastructure development and water conservation structures; watershed protection; arresting siltation; management of floods; construction of

small dams, implementation of water harvesting technologies and borehole drilling; and implementation of water conservation programmes.

- ***Biodiversity, ecosystems and wildlife:*** Adopting an ecosystems approach to conservation; improving habitat management through provision of water and prevention of fires; providing safe corridors for large mammals and translocating wildlife where necessary; community-based ranching and promoting sound management of ecosystems and biodiversity resources.
- ***Fisheries:*** Co-management of fisheries resources, aquaculture and cage aquaculture technologies; improving knowledge and understanding of temperature influences on fish breeding and survival; promoting and restocking vulnerable fish species; establishing climate monitoring systems on Lake Malawi; and mainstreaming climate change into fisheries strategies.
- ***Health:*** Malaria prevention and control; improved personal and household hygiene to control cholera and dysentery; and treatment of unsafe water, crop diversification and food supplements for the children under five.
- ***Human settlements:*** Improved zoning and planning to reduce vulnerability of people, development of human settlement policy to optimise land use and build resilience to climate related disasters and risks, improved land tenure systems, climate proofing and infrastructure.

In addition, the SNC prioritises five adaptation interventions, namely: (a) development of sustainable rural livelihoods, (b) restoring forests in the Shire Basin, (c) improving agricultural production under erratic rains and changing climatic conditions, (d) improving preparedness to cope with droughts and floods, and (e) improving climate monitoring to enhance early warning capacity, decision making and sustainable utilisation of Lake Malawi and lakeshore area resources.

3.4.2 Barriers to adaptation

The SNC identifies the following **barriers to adaptation** to climate change:

- ***Knowledge*****:** Limited human capacity in terms of numbers, skills range and depth; and limited systematic climate change data observation, collection and storage;
- ***Political and institutional*****:** Limited institutional capacity and unclear sectoral policies on climate change, limited coordination of climate change research and interventions, ageing telecommunication system, and the non-functioning of three of the four climate-related early warning systems[11];
- ***Socio-cultural barriers*****:** Relatively high levels of poverty and illiteracy, and resignation to the fate of climate change, and lack of appreciation of the importance of ICT by some senior civil servants;

[11] The systems that are not functioning are the seasonal forecasting with special focus on drought early warning; food early warning; and flood forecasting. The functional system is the tropical cyclone monitoring and early warning system.

- ***Financial barriers*:** Limited funding for long-term climate change research and programmes; and high initial investment required for technology transfer; lack of sustainability of donor-funded projects once donors pull out.

Key priorities for **mitigation** have also been identified. The Second National Communication (2011) identifies agriculture, forestry and other land uses (AFOLU) as the major sources of greenhouse gases in Malawi, accounting for 95 percent of the total emissions. The energy sector contributes 3.4 percent of emissions. Malawi is a net emitter of greenhouse gases. The main sources of emissions in AFOLU are livestock, chemical fertilisers, burning of agricultural residues, and use of biofuels. The following mitigation measures are identified:

- ***Agriculture*:** Manure management, efficient use of nitrogen-based chemical fertilisers, use of nitrogen fixing plants, tree crops to increase carbon sinks, and zero tillage agriculture;
- ***Forestry management and REDD+*:** Forest protection and reforestation, and use of renewable energy in place of fossil fuels, promotion of REDD+ as a strategy for mitigation;
- ***Clean Development Mechanism:*** Promotion of CDM as a smaller programme of activities, and upscaling of CDM projects and carbon financing mechanisms;
- ***Energy*:** Promotion of efficient cooking and lighting technologies, increase the ethanol-petrol ratio in fuel for motor vehicles, encourage use of solar powered lamps in place of paraffin lamps, establish micro-hydro power generation, promote biomass briquette production from waste materials, and reforestation;
- ***Waste management*:** Reduce waste generation, use landfills for methane generation, control incineration and encourage composting for organic manure, promotion of recycling, reuse and reduction of waste;
- ***Transport:*** Promote reduction of vehicular emissions, enforcing vehicle emissions standards, and promoting private sector roll out of government policy on higher ethanol-petrol blends;
- ***Industrial processes*:** Promote industries that use carbon dioxide as a raw material and introduce carbon capture and storage technologies;
- ***Housing and infrastructure development:*** Promotion of cleaner energy technologies in construction.

3.4.3 Barriers to mitigation

The SNC identifies several barriers to mitigation including: inadequate capital, lack of operational funds, non-availability of necessary information, and poor networking among stakeholders, which all result in poor diffusion of mitigation technologies. Further barriers include slow decision-making processes, the high costs of mitigation technology, lack of skills and difficulties of demonstrating energy efficiency of clean technologies.

The draft National Climate Change Policy (GoM 2013) additionally identifies the following as important areas that cross cutting and that are relevant to both mitigation and adaptation:

- ***Climate change capacity building, education, training and awareness:*** Promotion of awareness raising, development of user friendly toolkits and manuals, promoting training at all levels, involvement of media, curriculum development, capacity building for teachers, NGOs and civil society organisations, local government and policy makers;
- ***Research, technology development and transfer and systematic observation:*** Monitoring and observation, transfer of technologies into local productive practices, especially to

reduce dependence on wood and fossil fuels as energy source, enhancing weather station capacity, documentation of indigenous knowledge, promoting centres of excellence;

- ***Climate change financing:*** Increasing climate change budgetary allocations, providing incentives for CCD investment;
- ***Legislation:*** Promoting sector wide approaches and policy synergy across sector, policy revision to mainstream CCD;
- ***Population***: Integrate population into CCD management through integrated approach, enhance family planning, and address population density issues including rural-urban migration by providing rural growth centres and employment creation in rural areas;
- ***Gender and disadvantaged groups:*** Proactively include women, gender issues and disadvantaged groups needs and opportunities in CCD;
- ***Private sector and community participation***: Proactively encourage participation in Green Economy development, provide incentives, encourage public-private sector partnerships;
- ***Institutional strengthening and co-ordination:*** Strengthen institutional capacity development; improve knowledge exchange, data management and technology transfer, improve levels of education, training and awareness.

3.4.4 Identified needs associated with CCD articulated in workshop interactions

Participants provided a range of responses during the workshop session dedicated to identifying climate change- and CCD-related needs, which indicated a strong level of engagement with the issue, and also strong alignment with policy related needs. Participants highlighted the following prioritised needs for potential CCD:

Adaptation:

- Agricultural adaptation measures;
- Mainstreaming fisheries management in climate change;
- Forest management;
- Irrigation management as an adaptation tool for CCD; and
- Disease control and management.

Mitigation:

- Making and application of compost manure as mitigation measure;
- Waste management;
- Energy resources diversity;
- Energy resources management;
- Carbon trade;
- Clean energy programmes technologies; and
- Forestry management.

Cross-cutting:

- CC Education and knowledge management;
- Higher Education research and technology development;
- Mainstreaming climate change education at all levels;
- Measures to contribute to reduction of population growth;
- Human resource development in all sectors; and
- Gender mainstreaming in CCD.

3.4.5 Identified needs for CCD articulated in questionnaire data

Questionnaire data (captured in Table 2) showed that there is a relationship between institutional interest / mandate and/or disciplinary interest / mandate and the definition of priority needs for CCD. It also shows that there is wide-scale agreement and correlation with the nationally defined adaptation, mitigation and cross-cutting priorities identified in policy, although different people emphasised different aspects thereof.

Table 2: Needs identified by different stakeholders / disciplinary specialists (derived from questionnaire data)

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
Energy issues, especially sustainable energy issues Crop production and or crop productivity	Forestry Department
Adaptation technologies and methods	Natural Resources Management
Data base development Generation of practical innovations to address climate changes that can be shared with communities	Extension
Encourage knowledge sharing and dissemination of projects that significantly limit carbon emissions	Agriculture, Natural Resource Management
Mainstreaming climate change and how we can align the education curriculum and the issues of CCD Training/development of human resources in the CCD area	Maths and Statistics
The general management of natural resources – soil, land, forestry, water, air as these have a bearing when it comes to mitigation and adaptation	Forestry Department
Right type of curriculum to take care of climate change from primary school to university	Library
Improve research to develop innovative alternative ways to replace environmental degradation and risk activities	Medicine
Address environmental health issues	Obstetrics and Gynaecology
Economic empowerment Family planning to reduce population growth Improving literacy levels of public Awareness about causes and effects of climate change	Community and Mental Health
Energy resource management	Natural Resources and Environment Centre (NAREC)
Dealing with mindset of local communities where most of the development activities happen Making policy a national agenda and not a political party agenda so that there is continuity	World Vision, Assessment Design, Monitoring and Evaluation Coordinator
Provision of sustainable energy resources that help in preventing environment degradation Reduce current social activities that lead to environmental degradation through cutting down of trees, farming in marginal lands	Human Ecology

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
Avoid deforestation Control population Avoid degradation Proper refuse disposal	Maternal and Child Health
Participatory action research to identify and upscale site-specific resilient interventions	Geography and Earth Sciences
Address energy shortages Improve agriculture methods Sustain education in conservation methods plus replanting/ reforestation etc.	Practical Legal Studies
Address deforestation, over population, and poverty Improve pesticide management	Foundational Law
Economic empowerment/poverty reduction and capacity building	Biology
Networks of disseminating information on climate change should trickle down to primary school curriculum	History
Reduction of corruption as there are many short cuts in implementation of developmental initiatives whether by government or private sector through corrupt practices	Biology
Refuse disposal and management, natural resource management (including soil, water, forests, food); effects on health of these climate changes	Maternal and Child Health
Address high illiteracy and poverty levels, overuse of natural resources such as trees Provide education in its formal and informal sense to help deal with such issues	Social and Development
Co-ordination among stakeholders needs to be enhanced	National Agriculture Centre
Institute sound forest management practices such as forests for binding soil, water and reduction of surface runoffs	Forestry Department
Capacity development should facilitate to knowledge of local people. Policy changes that should enable enough to for resilience to CC	Chiradulu District Council, Planning and Development
Being an agricultural lead economy, develop technologies (i.e. for agriculture) which will address issues like shortage of rainfall and changes in temperature	Agricultural Research
Need for knowledge generation and dissemination of climate change issues Need for human resources capacity development for all sectors of society	Malawi Institution of Education
Malawi needs to deal with deforestation, soil depletion, population pressure, urbanisation, and industrial waste	World Vision International

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
Dissemination of knowledge Use of resources for intended purposes Political will More action than talking	Chancellor College
Conservation of natural resources, protecting the environment Putting to best use the environmental and natural resources that surrounds our community, encouragement of the sustainable use of the natural resources and non-polluting gases	Innovation for Poverty Action
Urban population growth Implement mitigation and adaption measures holistically Improve planning	Ministry of Economic Planning and Development

Table 2 above shows that stakeholders and university staff observe a wide range of priority needs that require attention for CCD in Malawi. The diversity of responses shows that while there are many common views of what needs to be done to address CC and ensure CCD, different institutions / disciplines and levels of interdisciplinary management often shape the perceptions of what the most important climate compatible development 'needs' are. It is important to identify and recognise these different perspectives in knowledge co-production processes and approaches, as personal experience and context can shed light on the specific priority areas that need to be addressed. The diversity of responses from such a varied range of experts in their field show the interdisciplinary and multi-sectoral nature of climate change. *How to harness such perspectives, and the associated expertise that informs such perspectives is the ultimate challenge of a knowledge co-production framework and process.*

3.5 Specific knowledge and capacity needs: CCD research, knowledge and individual and institutional capacity gaps (related to CCD priorities)

According to Malawi's draft National Climate Change Policy, a major priority that cuts across all areas/sectors is the need to strengthen education, communication and awareness and to generate information and knowledge. The draft National Climate Change Policy (2013, p. 39) states:

> *In Malawi it has been noted that there is need for more research in climate change issues and capacity needs assessments and training needs assessments have indicated that more work has to be done. In this regard training and research institutions have a pivotal role to play. Research which is local specific and which will provide solutions to problems faced in Malawi must be boosted. Training must continue for enhancing capacity of individuals and organisations to mainstream climate change issues into their activities and effectively adapt and mitigate to the impacts of climate change. Scientific knowledge from research must be used for decision making and practical solutions recommended that is user friendly and sensitive to local needs.*

3.5.1 Research needs and knowledge gaps

The Second National Communication (2011) states that as a nation dependent on agriculture, Malawi needs to urgently address the aforementioned problems, including: (i) enhancing **research capacity** in public and private sector organisations, especially Department of Meteorology, DARS and the Universities of Malawi, Lilongwe , Mzuzu and other private universities; (ii) **building capacity at both individual and institutional levels**; (iii) developing a comprehensive system of **data storage, management, quality control and accessibility**; (iv) establishing an elaborate **national and global network** of systematic observation stations for effective and efficient exchange of data and information at all levels; and (v) installing **automatic weather stations** in the country, including an upper air monitoring equipment.

The draft National Climate Change Policy (GoM 2013) includes **a specific objective on research, technology development and transfer, and systematic observation** which seeks to promote research and innovation for mitigation and adaptation, including technological innovation, using the following suggested **strategies:**

1. Implement the recommendations made by the capacity needs assessment reports and technology needs assessment reports;
2. Encourage and support research on climate change to help Malawi make informed and evidence based decisions to improve its adaptation and mitigation strategies:
   - Supporting technology transfer and innovation to enhance low carbon growth in both public and private sector;
   - Supporting the rehabilitation, maintenance and upgrade of existing weather and environmental monitoring stations and to introduce new stations to provide reliable data for better understanding of climate change and guide appropriate action against its impacts;
   - Supporting the documentation and validation of indigenous knowledge, through community engagement, so that it will be fully integrated within the overall knowledge base that informs policy and action;
   - Requiring the inclusion of monitoring and evaluation for all major climate change related programmes, to avoid unforeseen risks;
   - Enhancing collaborations between researchers, policy makers and media for effective advocacy and outreach make better use of research findings;
   - Promoting centres of excellence to undertake research in climate change science, adaptation and mitigation; and
   - Put in place financing and supporting mechanisms for the development of a national research agenda for climate change, through National institutions coordinating and conducting relevant Science and Technology research.

The draft NCCP also identifies a number of specific research and knowledge needs associated with the adaptation, mitigation and cross cutting priorities as follows:

- ***Agriculture:*** Vulnerability studies and assessments, development of short and long term adaptation scenarios to identify climate-resilient land uses and promote climate smart agriculture; explore new crops and livestock breeds that will easily adapt to climate change and promote practices that will reduce impacts of climate change on existing agricultural systems; research programmes on soil and water conservation, plant and animal breeding,

livestock feeds and feeding, and practices that lower emissions and those that will boost agricultural yields.

- ***Water resources**:* Conduct research into good catchment management and ecosystems approaches to managing water resources; irrigation via climate proofed infrastructure.
- ***Health:*** Promote research into eco-health issues and impacts of climate change on health; harmonise data collection; systems thinking and approaches; support research programmes that will strengthen information on links between disease occurrence and climate change.
- ***Energy:*** Promote innovation in the energy sector; research viable alternatives and uptake.
- ***Forestry:*** Promote research to preserve Malawi's indigenous, wild, endemic and/or economically important flowering plants for future use and biodiversity conservation; promoting ecosystems approaches through research; promote research into biomass for fuel that can address deforestation issues in a holistic manner.
- ***Biodiversity, wildlife and ecosystems:*** Promote research in biodiversity and its changes as a result of climate change; research to demonstrate the cost-benefit advantages of protecting ecosystems and biodiversity.
- ***Fisheries:*** Promote research on fish species and aquaculture technologies; promote a harmonised approach and ecosystems approach in water resources management, value chain improvements; and enhance data collection and dissemination for effective climate change adaptation in the fisheries sector.
- ***Mitigation:*** Clean energy technology research; evaluation of emissions through improved collection of emissions data; research carbon storage and other approaches to mitigation in agriculture; and research into low carbon alternatives in the industry sector.

Relevant higher education and parastatal organisations that would need to consider specific research and knowledge gaps presented above and also in Table 3 below include: (i) the University of Malawi (Chancellor College, the Polytechnic, College of Medicine and Kamuzu College of Nursing)[(a) Lilongwe University of Agriculture and Natural Resources: Centre for Agricultural Research and Development (CARD); (b) Centre for Social Research (CSR), Centre for Educational Research and Training (CERT), Natural Resources and Environment Centre (NAREC), Molecular Biology and Ecology Research Unit (MBERU), Consultancy and Industrial Research Unit, (c), and (d]; (ii) University of Mzuzu; and (iii) Malawi Industrial Research and Technology Research Centre (MIRTDC).

Related to the above, and to this mapping study overall, is the emphasis placed in the Malawi draft National Climate Change Policy on the need for knowledge generation and research, and for research across different sectors and priorities as outlined above. The same document suggests that there is a need to improve data production, data sharing, data use and that there is a need to strengthen research capacity for observation, monitoring, evaluation and innovation. It also recognises the need for research capacity building.

Workshop and questionnaire data also identified knowledge and research needs related to some of the key adaptation and mitigation priorities outlined in policy including energy resources management; fisheries management; forest management; irrigation technologies; waste management; carbon trade; clean energy production; and health (Table 3 below). Additionally, there was a **strong focus** in the workshop on **climate change education and training**, human resource development and social change, with the latter being related to reduction of population growth, and gender mainstreaming and equity (Table 4 below).

Table 3: Knowledge, research, individual and institutional capacity gaps related to identified adaptation and mitigation priorities in Malawi identified by workshop participants

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Energy resources management	▪ Lack of alternative energy sources ▪ Energy use efficiency ▪ Institutional arrangements for multiple clean energy alternatives ▪ Clean energy sources for conservation and emissions reduction	▪ Lack of extensive research on alternative energy sources ▪ No research on the policy, institutional and legal framework to promote and incentivise multiple clean energy alternatives ▪ Little research into the development of energy efficient technologies	▪ Energy researchers ▪ Energy engineers ▪ Energy economists ▪ Energy policy experts ▪ Social skills ▪ Experts in specialised clean energy resources and alternatives	▪ Institutional arrangement for management of multiple clean energy technologies and alternatives ▪ Capacity for development and popularisation of energy efficient technologies ▪ Lack of political will ▪
Mainstreaming fisheries management in climate change	▪ Limited knowledge of fish hot spots for breeding hinders targeted conservation measures ▪ Limited knowledge of potential sites for fish farming ▪ Limited incorporation of indigenous knowledge in planning and mitigating climate change issues	▪ Lack of research on genetics and biodiversity ▪ Limited surveys of potential sites for promoting sustainable fish farming ▪ Limited research on indigenous adaptive practices	▪ GIS experts in fisheries modelling ▪ Limited numbers of highly skilled extension officers	▪ Limited institutional capacity in fishing community groups ▪ Inadequate funding ▪ Inadequate research facilities

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Forest Management	▪ Inadequate knowledge of alternative land use options ▪ Limited knowledge of carbon assessment and carbon beneficiation (e.g. payment for Ecosystem Services, benefits of REDD+ etc). ▪ Limited knowledge on gender issues ▪ Limited knowledge on co-management and its co-benefits among local communities ▪ Limited knowledge of alternatives to deforestation and ecosystem based approaches to forestry management ▪ Lack of knowledge on how forestry species will react to CC ▪ Which species is highly adaptable to CC or affects afforestation activities ▪ Species site matching	▪ Research into land use planning options and approaches, including alternatives ▪ Carbon assessment methodologies and carbon beneficiation practices and approaches ▪ Need research into processes of collaborative forestry management (co-management approaches and how they work) ▪ Ecological understanding of non-timber forestry products utilisation in the face of climate change (as adaptation measure) ▪ Test/investigation on productive tree species adapt/resilient to CC ▪ Research on plant-based IK and how to use indigenous knowledge	▪ Inadequate extension staff ▪ Inadequate skills and knowledge ▪ Little available expertise in carbon assessment ▪ Little available expertise in natural resources assessment for co-management approaches and ecosystems approaches to management ▪ Inadequate staff for natural resources management ▪ Knowledge management and dissemination capacity is weak ▪ Need for more biologists – young and energetic ▪ Postgraduate forest biologists and botanists ▪ Experts in monitoring and evaluation ▪ Lack of capacity for data collection and analysis (high quality)	▪ Failure to replicate research findings ▪ Lack of sense of ownership ▪ Lack of clear sharing of benefits ▪ Lack of community based management ▪ Limited extension advisory services with knowledge of CCD and current issues ▪ Inadequate institutional capacity to manage and monitor progress ▪ Inadequate training institutions ▪ Conflicting policies ▪ Limited funding for forest management activities ▪ Limited implementation and enforcement of policy and legal instruments ▪ Forest sector inability to manage and disseminate information ▪ Funding for data collection ▪ Linkages and coordination for proposals/research ▪ Funding for research in the gaps given

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Irrigation management as an adaptation tool for CCD	▪ Need for knowledge of effects of irrigation on soils (salination and underground water levels) ▪ Surface water for irrigation	▪ Need research into nutrient content of underground water (status of water for irrigation). Is all water (surface and underground) suitable for irrigation? ▪ Research impact of irrigation on aquatic life and ecosystems and sustainability of ecosystem services	▪ Lack of trained personnel in associated research gaps mentioned ▪ Hydrologists ▪ Water system experts ▪ Ecological scientists	▪ Not enough funding to train personnel ▪ Rigidity and resistance to change ▪ Institutional mismatches ▪ Tensions between central water labs and Ministry of Agriculture's decentralised needs ▪ Fragmentation and lack of coordination and integration amongst those working on water
Waste management	▪ Limited knowledge about waste management and how to mitigate CC with improved waste management approaches	▪ Research into waste management and mitigation strategies	▪ Experts in waste management	▪ Limited waste management facilities e.g. recycling; biogas production etc.
Carbon trade	▪ Limited knowledge on operation of carbon trade arrangements	▪ Need research into the carbon trade opportunities available for Malawi, and how they can be accessed and used	▪ Carbon trade economists ▪ Carbon trade popularisation	▪ Policy institutional and legal framework for carbon trade
Clean energy programmes and technologies	▪ Limited information on clean energy technologies ▪ Little knowledge of the impacts of alternative energy sources (negative sources) to adopt best option ▪ Economic implications clean energy programmes and technologies: cost benefit analysis ▪ Socio-cultural implications of changes to new energy technologies	▪ Baseline analysis of energy efficient technologies ▪ Implications/link of the alternative energy sources and its contribution to sustainable economic growth ▪ Relationship between energy, poverty and environment ▪ Balance between clean energy and food security i.e. biofuels vs. biogas ▪ Cultural change research	▪ Engineers with clean energy technology capability ▪ Capacity of policy makers (technical capacity) ▪ Social scientists with an interest in new technology development and adoption.	▪ Weak curricula on energy related programmes at early stages e.g. primary, and in TVET and higher education streams. ▪ No clear strategies to adopt policies that promote innovation ▪ Challenges in upscaling working projects ▪ Failure to recognise indigenous knowledge technologies ▪ Inadequate financial support and incentives for institutions that work on or promote clean energy technologies

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Disease control and management	▪ Lack of understanding of predisposing factors to diseases related to CC ▪ Lack of knowledge of the dynamics of diseases in the context of climate change	▪ Vector mitigating measures ▪ Assessing indigenous knowledge systems that work in disease control and management ▪ Disease modelling (transmission procedures)	▪ Epidemiology ▪ Mathematical modelling skills	▪ Inadequate training of community health specialists ▪ Lack of training programmes in mathematical modelling

As mentioned above there was also a strong set of knowledge and research needs identified that relate to social change processes including education and training, human resource management, population and gender mainstreaming.

Table 4: Knowledge, research, individual and institutional capacity gaps related to education, training and social change, as identified by workshop participants

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Mainstreaming of CCD Education into all levels of curricula and teaching programmes, and knowledge management	▪ Inadequate knowledge ▪ Lack of sharing ▪ How to integrate CC science, impact analysis and vulnerability into education and training programmes ▪ How to integrate mitigation and adaptation strategies into education and training ▪ How to deal with risk and emerging issues in education and training programmes	▪ Capacity needs assessment for educators to establish their capacity to deal with CC related knowledge and approaches (e.g. action learning) ▪ Status of CC education in Malawi (detailed study needed) ▪ Very little educational research to improve the situation	▪ Educational experts with CCD knowledge and experience ▪ Lack of sharing ▪ Knowledge gaps of educators and lack of experience with new pedagogical approaches and methods ▪ Lack of knowledge of transformative learning approaches	▪ Curriculum reviews lag behind the rate of change (e.g. emerging issues) ▪ Policy gaps NESP, MDGs ▪ Optional/core subjects in secondary schools may be needed for environmental sciences / climate change adaptation ▪ Lack of coordination ▪ Lack of sharing ▪ Absence of central database ▪ Inadequate knowledge resources and capacity to integrate CCD issues into curricula and teaching programmes

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Higher Education	▪ Stagnant curriculum that result in recycling old knowledge	▪ Assessment of the impact of higher education curriculum and its relevance to contemporary issues	▪ Limited staff capacity in climate change science	▪ Limited funding for research ▪ Knowledge management and dissemination through publications on research generated at all levels (BSc, MSC, PhD) is weak ▪ Limited documentation and feedback between research and teaching programmes
Gender	▪ Need for different groups of women ▪ Where to access finances ▪ How to use the finances ▪ Awareness of alternative livelihoods ▪ Fast and less laborious ways of water purification/ water recycling and water harvesting ▪ Appropriate technology for increased access to water and taps or windmills ▪ Energy sources: marketing and distribution of wood saving stoves ▪ Replication of skills in production of energy saving technologies	▪ Categorisation of women into various categories because women are not homogenous (socially, economically, age, education, marital status, occupation) ▪ Women awareness on the availability of financial institutions and alternative technologies ▪ Socio-cultural research to establish uptake of new technologies and approaches amongst women groups	▪ Illiteracy education and training ▪ Trained extension workers with capacity to reach women and support changes in practice	▪ Ministry of gender must put more efforts into CCD related training and capacity building ▪ Capacity (personal, finance) is inadequate for reaching all women ▪ Coordination between government and NGOs ▪ Need for multi-sectoral co-operation to reach all women groups
Population growth	▪ Need to explore indigenous practices on family population growth management practices which are effective ▪ Acceptability of contraceptives among youth and society ▪ Ideal family size	▪ Research is needed to establish policy, institutional and legal frameworks on ideal family size	▪ Training of experts in statistics, demography, social scientists	▪ Lack of adequate policy frameworks and implementation of policy direction on population issues

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
Human resource development	▪ Lack of statistics of the country's need of human resources ▪ Lack of clear technical understanding of CCD and its implication for planning of HRD needs	▪ Human resource capacity survey ▪ Uptake of information on climate by both local people and institutions	▪ Environmental scientists ▪ Economists ▪ EIA scientists ▪ (experts) ▪ Educators (trainers) ▪ HRD specialists with CCD knowledge	▪ Lack of relevant institutional structures ▪ Lack of training and equipment for proper statistical research ▪ Lack of environmental management systems

As can be seen from Tables 3 and 4 above, the workshop participants provided extensive detail of the specific knowledge and capacity gaps for CCD in Malawi, within clearly defined priorities within thematic contexts. Overall workshop participants highlighted a general lack of climate change knowledge in various sectors, with particular concern show for the effect of climate change on **forestry, energy and fisheries resource management**. Issues of limited data and knowledge in all the different priority areas were raised. An interesting cross-cutting issue was that of population growth and climate change, and the knowledge gap associated with indigenous forms of family planning, and exploring the acceptability of contraceptives among youth and society. The question of what the ideal family size might be, considering the constraints placed on Malawian society by climate change was an interesting and controversial knowledge and research question raised in the workshop.

Specific **knowledge gaps** emerging from policy point to the need for comprehensive climate change information to adequately support decision making. Knowledge on how mitigation can be improved through carbon trading in Malawi and specific sustainable energy technologies could be applied was a specifically highlighted knowledge gap in the workshop (see below). The policy documents assessed revealed specific knowledge gaps, which consisted of:

- Key vulnerabilities caused by climate change;
- How temperature changes affect the breeding and survival of fish species;
- Up-to-date information on environment and climate change;
- Effects of climate change on vulnerable communities and fragile agro-ecosystems;
- Accurate data on GHG emissions;
- Trends of disease outbreaks due to climate change; and
- Indigenous knowledge and practices in relation to climate change.

Congruent with the workshop participants, the policy documents also considered fisheries, agriculture, mitigation, health and indigenous knowledge in their assessment of key knowledge gaps in Malawi.

As also indicated above**, research priorities** highlighted in the policy and also in workshop data focussed on the following:

- Cataloguing of environmental and climate change data;
- Research and systematic observation activities in meteorological, atmospheric and oceanographic research;
- Analysis of meteorological data;
- Policy, institutional and legal frameworks for mainstreaming climate change into sectoral and national policies and programmes;
- Determination of minimum data sets, parameters and variables required for climate change detection, mitigation and adaptation;
- Skills and know-how for developing appropriate and relevant measures for adaptation and mitigations of climate change, especially floods and droughts; and
- Research into sustainable agricultural practices.

The policy assessment of research gaps take a more general evaluation of research, highlighted the need for policy and legal framework development, establishing baseline data sets and more detailed meteorological research for monitoring and modelling. Agriculture is

specifically highlighted as a major area for specific research by the policy documentation. Workshop participants pointed out a need for **education and training research.** In policy education and training was only identified as a priority, and not *a knowledge / research* priority. Workshop data also pointed to a need for social and socio-cultural research, particularly as this relates to population growth, adoption of new technologies, social innovation and education, training and communication.

Questionnaire data revealed the following research gaps and knowledge needs:

Malaria research, especially focusing on **infectious parasitic diseases and medical entomology/ public health**; addressing the following knowledge gaps:

- Lack of understanding of predisposing factors;
- Lack of dynamics of diseases in the context of climate change;
- Vector mitigating measures;
- Assessing indigenous knowledge systems that work in disease control and management; and
- Disease modelling (transmission procedures).

Fisheries research, especially focusing on **fish stock assessment and environmental monitoring, and CC influence on fisheries and fisheries adaptation practices**, addressing the following knowledge gaps:

- Limited knowledge on genetics and biodiversity and relationship to CC;
- Poor identification of potential sites for promoting sustainable fish farming;
- Limited knowledge on indigenous adaptive practices;
- Limited knowledge of fish farming best practices (Fisheries Scientists); and
- Limited knowledge of CC impacts on Malawian fisheries (especially the Lake).

Social-ecological systems and ecosystem services research, focusing on multi and transdisciplinary research in critical social-ecological systems being affected by CC, such as the Lake Chilwa basin addressing the following knowledge gaps:

- Observation and monitoring of ecosystem changes;
- Integrated social-ecological systems interactions and impacts of CCD;
- Value-creation and new technology development;
- Societal change and economic support structures (e.g. mobile banking, micro credit etc.); and
- Social learning and community education and knowledge sharing.

Agricultural sciences research, especially focusing on drought resistant crop varieties, climate variability and production systems, and irrigation system technologies, responding to the following knowledge gaps:

- Lack of knowledge of crop varieties that can cope with climate change;
- Early maturing maize varieties; and
- Irrigation systems and options (linked to hydrological research).

Forestry sciences research focusing on climate change impacts and implications for forestry, responding to the following knowledge needs:

- Lack of knowledge on how forestry species will react to CC;
- Which species is highly adaptable to CC or affects afforestation activities; and
- Species site matching.

All of the above research and knowledge needs are relevant to the implementation of the new Draft National Climate Change Policy (2013). It is also interesting to note that there is a strong congruence between workshop, questionnaire and policy articulations of research and knowledge needs, although there are nuanced differences between these expressed knowledge needs. The section above also provides useful insight into how the CCD priorities are linked to knowledge gaps, research needs and individual and institutional capacity concerns. This analysis is taken further in sections 3.4.2 and 3.4.3 below, which reflect in more detail on individual and institutional capacity gaps

3.5.2 Needs analysis: Individual capacity gaps

A National Capacity Self-Assessment (NCSA) was carried out in 2007 to identify capacity needs, constraints and priorities for the implementation of the Climate Change, Desertification and Biodiversity Conventions. Also the recent Draft National Climate Change Policy (2013) for Malawi calls for specific capacity gaps to be addressed, which primarily calls for a focus on the capacity building for academia and scientists, calling for inclusion of climate change into the curriculum of tertiary education across disciplines.

Overall policy calls for improved higher degree training in climate change and its relevance to the fields of Agriculture, Engineering, Environment, Wildlife, Meteorology, Climatology, Modelling, Statistics, Mathematical Sciences, Physics, Chemistry, Biology, Geography, Earth Sciences, Sociology, Environmental Education and Psychology. In addition to this the policy recommends that specific capacity gaps lie in computer simulation and climate change modelling.

The policy also suggests that incentives need to be provided to reduce 'brain drain' in the country. Individual capacity building for teachers was also highlighted. Ensuring the inclusion of climate change in primary and secondary school curricula and to provide teachers with the skills, tools and resources to educate the children and youth about climate change is emphasised, as is skills development for the media (journalists).

Within the workshop discussions individual capacities were identified per thematic area, as seen in Tables 3 and 4 above. Participants called for improved capacities of researchers in the renewable energy sector, particularly engineers, economists and policy experts. Expertise in GIS, carbon assessment (carbon trade economists), natural resources assessment, waste management and mathematical modelling was called for. Workshop participants also called for more Epidemiologists, Environmental scientists, EIA scientists and social scientists. Finally workshop participants felt that the climate capacity of extension officers needed to be improved, and there was a need to respond to the current limited availability of extension officers active in rural areas. Again teacher's capacity to teach climate change at all levels of the education and training system was mentioned as an area that requires attention. Workshop participants also questioned how youth were to be trained to become more involved in CCD. The workshop also gave rise to a discussion on the need for critical

engagement with climate change related issues at a national-global level, as reflected in this discussion extract:

> *"There is need for training of young people in universities to engage in the economic debates surrounding climate change, and to continue to advocate for mitigation where emissions are being produced, and not just accept adaptation as the only response… the greatest concern is that developed countries are allowed to pollute but asked to fund a project in a developing country to provide for the catastrophic effects of the cause … expertise is required to calculate the effects versus the funding that is to be given and a baseline on this is required."*

Congruent with the workshop data, questionnaire data called for improved capacities in GIS based modelling, forest management, computer simulation of modelling, carbon trading, water management, development planning, eco-tourism, extension training, and sustainable engineering.

3.5.3 Needs Analysis: Institutional Capacity Gaps

The SNC notes that climate change research and systematic observation have been constrained by many factors, which include: (i) **weak institutional capacity** in most sectors; (ii) **limited financial resources**; (iii) inadequate professional staff; (iv) lack of central co-ordination, so that each sector is carrying out its own research and systematic observation studies independently; (v) lack of mechanisms for sharing information among sectors, either horizontally or vertically; and (vi) current structures for coordinating climate change initiatives are not functional for various reasons, but perhaps most importantly inadequate financial resources.

The draft National Climate Change Policy (GoM 2013) states clearly that:

> *"There is need for strengthening of institutions and enhance coordination in order to have effective climate change management. Furthermore, other players such as private sector also must be adequately coordinated for effective climate change management. Finally, communities and district decentralised structures must be strengthened and well-coordinated for adequate participation at all levels."*

Workshop participants raised a number of specific institutional capacity gaps per thematic area captured in Tables 3 and 4 above; however a variety of general overarching institutional capacity gaps were also highlighted. These included a lack of political will and a rigidity to change. Poor coordination, management and monitoring of progress were other issues cited. Information access through institutions was poor, due to a lack of sharing and the absence of a central database. Policies contain limited innovation and there is a noticeable lack of favourable policies that promote innovation. Of those policies that do exist, workshop participants felt that they were limited in their implementation and enforcement as there were no robust policy and legal instruments available. Funding and allocation of climate change budgets was another key intuitional capacity gap highlighted. In addition to this coordination between government, NGOs and the private sector was poor. Finally a commonly cited institutional capacity gap was the current weak climate change and CCD related curricula

and efforts to enable the development of new curricula across disciplines in tertiary, middle and primary education. Also lack of adequate human resource development planning was cited as an institutional capacity gap, which was related to inadequate data.

The workshop also raised a vibrant discussion on institutional capacity to work with indigenous knowledge and how indigenous knowledge was / was not being included in decision making on climate change. The debate focussed on what needed to be done to relate indigenous knowledge to modern science, and how modern science could make use of indigenous knowledge. Workshop participants felt strongly that indigenous knowledge plays a very important role in the adaptation of climate change and it was noted that there have been failures in capturing the usefulness of indigenous knowledge because most of the time modern science overtakes it. However it was stressed that there is need to weigh the relevance of both modern science and indigenous knowledge and to find ways of incorporating what is relevant. Participants agreed that there is need for scrutiny on some of the indigenous knowledge because things have changed and they may not still hold the same meanings; indigenous knowledge is not static but is evolving over time.

There was also comment on the legal systems and how they work in Malawi, and it was noted that customary legal systems appear to work better in protecting the environment. One example was that the most conserved environments in Malawi are graveyards because no one would attempt to cut down trees in the areas due to traditional laws and customs. It was therefore seen important to consider customary laws in climate change discussions.

The workshop also raised the problem of a lack of adequate research planning at national level, and the lack of a national strategy for research.

Questionnaire data echoed the workshop discussions with regard to infrastructure and financing capacity gaps, and also called for improved information sharing and knowledge that is accessible to all communities, from un-educated to educated citizens. Another key institutional capacity gap raised by a questionnaire respondent was the limited funding and resourcing of climate change research in Malawi. Inadequate facilities for monitoring were also identified a number of times.

4 INSTITUTIONAL ANALYSIS

4.1 Introducing the institutional analysis

This section describes the current responses of different institutions (higher education, government, NGO/CBO, private sector) to addressing climate change and promoting CCD, within the broad context of the above-mentioned research, knowledge and capacity gaps. Core emphasis is placed on higher education institutions, as it is widely recognised that they have an important role to play in research, education and training, and in providing policy and strategy support and leadership for development.

The institutional review begins by mentioning wider institutional arrangements for addressing climate change and moving towards CCD, and any relevant research and development frameworks. It then goes on to discuss some of the current climate change and CCD initiatives and programmes that are taking place in Malawi, and identifies some of key stakeholders that could form part of a Malawi's CCD knowledge co-production framework.

Following this, it examines understandings of CCD amongst stakeholders and university staff, and then begins to probe research practice and capacity, as well as curriculum, teaching and learning programmes and capacity in the higher education sector. From there, it also considers other aspects of higher education interaction with climate change and CCD, namely community engagement, student involvement, policy engagement and campus sustainability initiatives.

4.2 Policy and institutional arrangements

4.2.1 Policy and institutional arrangements governing Higher Education in Malawi[12]

The government's National Educational Sector Plan 2009–2012 sets out three priority areas for higher education improvement (Ministry of Education, Science and Technology 2009):

- *Priority 1: Governance and management.* This focuses on national education sector plans to improve the quality and relevance of higher education, to create legal provision and change in managerial approaches.
- *Priority 2: Access and equality.* Here the aim is to increase the number of higher education institutions in Malawi. There is insufficient space for all eligible students to be accommodated within the two public universities and thus students do not have a fair chance of accessing higher education in Malawi. This supports World Bank findings (World Bank 2008), which indicate that access to higher education in Malawi remains one of the lowest in sub-Saharan Africa. Another report by the United Nations, based

[12] This short summary is derived from a SARUA Country Profile compiled by Israel Mawoyo. 2011. "Chapter 16: Malawi." in *A profile of Higher Education in Southern Africa. Volume 2*. (www.sarua.org)

on research from selected African countries, reveals that less than one per cent of Malawi's qualified cohort is actually enrolled in some form of tertiary education (UN 2010).

- *Priority 3: Quality and relevance*. The Malawi Growth and Development Strategy seek to transform the nation from poverty to prosperity. This requires a sound human capital resource base with skills that are technologically up-to-date and adequate knowledge in scientific research. The quality of higher education will need to meet the human resource requirements and development needs of the country.

These priorities resonate closely with the main objectives stated in the 2012 Output Budget issued by the Ministry of Education, Science and Technology, namely to:

- Mainstream gender issues in higher education activities;
- Fight HIV/AIDS and minimise its impact in schooling and society;
- Strengthen educational management and governance at all levels;
- Improve quality and relevance of education at all levels; and
- Widen equitable access at all levels to all Malawians.

There is evidence of an effort to link higher education to national development needs. This is observed in the 2001 Policy and Investment Framework of the Ministry of Education, Sports and Culture: '*the Government acknowledges the significance of a solid higher education system in enhancing the development of Malawi*' (Minister of Education, Sports and Culture 2000:32). The overall regulation of higher education is done through an accreditation committee whose membership comprises the Ministry of Education (Education Methods and Advisory), the Office of the President and Cabinet (Department of Human Resources Development and Training) and the University of Malawi. For public universities, governance issues are regulated by Acts of Parliament (Chevwara 2009).

According to the Ministry of Education, the Ministry does not monitor governance and management of higher education at the institutional level: institutions are independent. With the exception of funding, which comes from the Ministry of Finance as well as irregular interventions from the Ministry of Education, all internal institutional planning and processes are conceived and implemented at institutional level. Interventions are based on institutional needs, and institutions have responsibility for both governance and management. The University of Malawi and Mzuzu University are each governed by a council, consisting mainly of members appointed by the government, and supported mostly by government grants and miscellaneous income sources. Recently the Bunda Agricultural College had been restructured into a national university named the Lilongwe University of Agriculture and Natural Resources. Private higher education institutions usually have independent councils and senates which are appointed by their proprietors, mostly religious bodies. Examples of these universities that also participated in the mapping study are the Catholic University of Malawi and the Adventist University of Malawi. The Ministry of Education also indicated that parliament had approved the establishment of the National Council for Higher Education, and council members have been appointed.

4.2.2 Policy context for climate change

Overarching policies of relevance for addressing climate change in Malawi include Vision 2020, launched in 2000; the Malawi Poverty Reduction Strategy (2002), and the Malawi Economic Growth Strategy (2004; 2006). The most relevant sectoral policies include the Food and Nutrition Security Policy (2005), HIV and AIDS in the Agriculture Sector Policy and Strategy (2003); National Land use Planning and Management Policy (2005), Malawi Irrigation Policy and Development Strategy (2000), Malawi National Water Policy (2004), National Forestry Policy (1996) and Energy Policy. In addition, there are several environmental policies that address climate change. Examples are: the National Environmental Management Policy of 1996, revised in 2004; and the National Strategy for Sustainable Development (2004). The National Environmental Management Act is the main legal instrument for enforcing the implementation of the above policies and strategies and the NASC report (2007) notes that it does not explicitly provide for climate change. There is nonetheless a key policy focus for Malawi on low carbon development and towards long-term sustainable development and adaptation to the effects of climate change, as set out in the SNC. The Government of Malawi has been active in providing social support to the most vulnerable and in disaster risk management, and has recently developed a National Climate Change Programme.

A draft National Climate Change Policy was produced in 2013, and is still under revision. This draft policy states that Malawi has several legal and policy frameworks that are directly or indirectly dealing with climate change, economic development environment and natural resources. These include:

- The Constitution;
- National Environmental Policy (2004);
- National Forestry Policy (1996);
- Wildlife Policy (2000);
- National Energy Policy (2003);
- National Water Policy (2005);
- National Land Policy (2002;)
- National Land Resource Management Policy and Strategies (2000);
- Mines and Minerals Policy (2007);
- National Fisheries and Aquaculture Policy (2001);
- Food Security Policy (2006);
- Draft National Agricultural Policy;
- Environmental Management Act (2006);
- Disaster Preparedness and Relief Act (1991) (being revised 2013);
- National Parks and Wildlife Act (2004);
- Road Traffic Act (1997);
- Water Resources Act (1969);
- Mines and Minerals Act (1981);
- Energy Regulation Act (2004);
- Local Government Act (1998);
- Forestry Act (1997) and Forestry Policy (being revised 2013); and
- Fisheries Conservation and Management Act (1997).

It further states that:

> *"As climate change will affect almost all sectors, the sectoral acts and policies need to consider climate change. The Climate Change Policy will serve as an overarching reference document for policy makers in Government, the private sector, civil society, and donors concerning climate change as a priority development issue. It will feed into the Sector Wide Approaches (SWAps) to inform strategic government programming, including in relation to the MDGs. It will also support broader guiding legislation, policies and strategies, such as the constitution of the Government of Malawi, Vision 2020, the Malawi Growth Development Strategy and United Nations Development framework for Malawi (UNDAF). In particular, the policy will build on the National Environmental Policy (NEP) that deals with issues of air quality, reduction of greenhouse gas emissions and supplement several guiding principles in the policy. It will complement other policies such as those of energy, water, agriculture and forestry that are relevant in climate change issues."*

4.2.3 Institutional arrangements for Climate Change

Environmental matters, of which climate change is one, are the responsibility of the Environmental Affairs Department (EAD), the National Council on the Environment (NCE), and the Technical Committee for the Environment (TCE). Significant is the fact that the Environmental Affairs Department has recently changed to a Department of Environmental Affairs *and Climate Change Management* (EA&CCMD). The National Climate Change Committee (NCCC), which has its secretariat in the EA&CCMD, and is chaired by the Department of Meteorological Services, in responsible for reviewing policies and programmes on climate change. Members of the NCCC come from the government sector, universities, private sector, municipalities and NGOs. The EA&CCMD is the Designated National Authority. The Department of Physical Planning and Land and Valuation is responsible for planning, administering and managing land and other natural resources. The Department of Planning and Development works with a range of stakeholders, including NGOs, to monitor and report on environment and development activities. The Parliament's Committee on Agriculture and Natural Resources Management deals with environment and natural resources issues, including climate change.

With regard to stakeholder engagement, the Second National Communication (SNC) of Malawi was prepared through a broad consultative and participatory process involving scientists from different public and private sector organisations, including NGOs. National experts were drawn from government departments and ministries, parastatal organisations, universities of Malawi and Mzuzu, NGOs, and the private sector (individual consultants). It is not clear whether consultation workshops were held with the broader public.

The draft National Climate Change Policy (GoM 2013) recognises that climate change governance involves many stakeholders operating across many sectors and that leadership must be provided at government level. The draft policy suggests that "The prime goal of this leadership is to convene, facilitate and guide rather than to command and direct so that an

integrated approach towards the common goals and objectives of this policy can be achieved. This leadership role must also embrace district and local levels of government as well as the national level, and also seek community based engagement and action." Key stakeholders include: government, non-governmental organisations and civil society, the private sector, academia, development partners, local communities, the church and identified disadvantaged groups. It is also proposed that at government level the current cabinet committee on Natural Resources and Environment should expand its mandate more explicitly to include Climate Change issues. Similarly the Parliamentary Committee on the Environment should be expanding its mandate to incorporate climate change. The Cabinet Committee will enable all arms of government to coordinate their actions. The Parliamentary Committee will serve to provide good governance oversight of climate change issues. Additionally, it is envisaged that the existing Technical Committee on Climate Change may be strengthened, with additional stakeholders including private sector as green economy measures form an integral part of climate change management (GoM 2013).

4.3 Research and development frameworks

The National Research Council of Malawi (NRCM) is one of the Government's central agency institutions operating within the purview of the Office of the President and Cabinet (OPC). As a professional arm of the OPC on matters relating to research, science and technology, the NRCM plays a crucial role in the promotion and coordination of research, science and technology in the nation. Malawi has no specific institution assigned to conduct climate change research. However, the National Commission of Science and Technology is a government structure that coordinates research and innovation. Three departments that conduct research in fields related to climate change are the Department of Agricultural Research Services, the Department of Meteorological Services, the Department of Fisheries, and the Department of Water Resources. The Universities of Malawi and Mzuzu, the Lilongwe University of Agriculture and Natural Resources, parastatals, private universities, the private sector and some NGOs also conduct climate change-related research.

4.4 Some current CCD initiatives and programmes

There are a number of CCD initiatives and programmes active in Malawi. This institutional analysis was only able to identify *some* of these (see Table 5). More comprehensive national analysis would be able to expand the insights into existing active programmes.

Table 5: Some CCD initiatives and programmes in Malawi

Programme / initiative	Driving agency / department	Focus and time frame	Status / additional comments
National Climate Change Programme	Government of Malawi UNDP Norway, DfID, Japan	2010 – ongoing : Mainstream climate change considerations into national development Develop a National Climate Change Response Framework and Strategy	Build the capacity of national and local government institutions and key civic-society stakeholders towards climate change, piloted in the 7 NAPA districts
Climate proofing local development gains in rural and urban areas of Machinga and Mangochi Districts – Malawi	UNDP Ministries of Local Government; Agriculture, Irrigation and Water Development; Natural Resources, Energy and Environment, Finance and Development Planning, Public Works, Gender and Communities GEF-LDCF	2013–2018: Integrated package of ecological, physical and policy measures to reduce climate change related risks	Includes water and flood management, and post-harvest management
National Renewable Sustainable Energy Programme	Department of Energy, supported by GEF and Danish International Development Agency (DANIDA)	Time frame unknown: Promotes use and development of renewable energy technologies (RETs)	
SADC Regional Programme on Biomass Energy Conservation	Supported by GTZ and EU	Time frame unknown: Promotes efficient use of biomass and alternatives to fuel wood and charcoal	SADC Regional Programme on Biomass Energy Conservation
Solar and thermal photovoltaic projects in government clinics and community day secondary schools	Supported by UNICEF, Japanese International Cooperation Agency (JICA), and GEF among others	Time frame unknown: Promotion of renewable energy technologies in health and education sectors	Solar and thermal photovoltaic projects in government clinics and community day secondary schools
Integrating climate change adaptation and mitigation in the Agriculture and Natural Resource curriculum in Malawi	Bunda College of Agriculture (now Lilongwe University of Agricultural and Natural Resources) UNDP UNEP CC-DARE	Time frame unknown: Mainstreaming climate change adaptation in curriculum for tertiary education and modules for the stakeholders	Integrating climate change adaptation and mitigation in the Agriculture and Natural Resource curriculum in Malawi

Programme / initiative	Driving agency / department	Focus and time frame	Status / additional comments
The Lake Chilwa Basin Climate Change Adaptation Programme (LCBCCAP)	University of Malawi (Chancellor College) and LEAD Southern and Eastern Africa Agricultural University of Norway (NORAGRIC) University of Agder World Fish Center	2014– 2018; secure the livelihoods of 1.5 million people in the Lake Chilwa Basin and enhance resilience of the natural resource base	The programme aims to achieve this goal through the development and implementation of basin-wide climate change adaptations in support of the Malawi National Adaptation Programmes of Action (NAPA) that will enhance the capacity of communities to adopt sustainable livelihood and natural resource management practices
Capacity Building for Managing Climate Change in Malawi (CABMACC)	Lilongwe University of Agriculture and Natural Resources (LUANAR) Funded by the Royal Kingdom of Norway and implemented through LUANAR in collaboration with the University of Life Sciences (Norway)	2013–2018 (five-year programme) Capacity Building for Managing Climate Change in Malawi: to strengthen the training, research and outreach in climate change adaptation and mitigation by the LUANAR with a view to improving food security. Programme has a strong capacity building element and will support curriculum innovation and staff capacity building at LUANAR	Programme just starting up, but builds on lessons learned in earlier programmes at LUANAR and in other Norwegian funded programmes. Will be implemented in 10 EPAs of the six climate hot spots in Malawi: Rumphi, Mzimba, Nkhotakota, Dedza, Balaka and Phalombe

Note: the list in Table 5 is not comprehensive but is more illustrative of how some of the issues identified above are already being addressed

4.5 Existing status of CCD research, education, outreach and networking in Malawi

4.5.1 Understandings of CCD: National policy, stakeholders and university staff

At present Malawi has no specific institution assigned to conduct climate change research. As mentioned earlier the National Commission of Science and Technology coordinates research and innovation, and therefore should be responsible for coordinating climate change and CCD research. Even with the current Draft National Climate Change policy (2013), there is a need to

develop a common understanding of the core issues of Climate Compatible Development (CCD) necessary for knowledge co-production in Malawi. Discussion on the meaning of CCD in the workshops in Malawi centred around the core definition provided by the facilitators:

- Climate Compatible Development (CCD) is low carbon, climate resilient development – in other words, development that integrates current and future climate risks, adaptation to climate change, and mitigation (or reduction) of greenhouse gas emissions.
- Given uncertainties in climate projections, and the complex manner in which climate change and other drivers such as environmental degradation, globalisation and economic development processes interact, CCD necessitates an iterative, learning-by-doing approach that involves ongoing adaptation.

Workshop presentations demonstrated a strong understanding of Climate Compatible Development in the Malawi climate change community. For example, Mr Nkhokwe, Director of Climate Change and Meteorological Services in Malawi emphasised the relationship between poverty, economic development and climate change when he said that:

> *"The survival and livelihoods of the Malawian population is dependent on rain fed agriculture and because of that climate change affects the economy at large … one of the government priorities in safeguarding the economic and development gains is the elevation of climate change management to a high priority status in the Malawi Growth and Development Strategy."*

Professor Chiotha from LEAD Southern and Eastern Africa indicated in his presentation that climate compatible development discussions in Malawi reflect a focus on issues of concern, on poverty alleviation, and on holistic responses that are action centred and that are seeking to provide solutions that are practical and that can be upscaled. The Ministry of Agriculture presentation confirmed that the way that Malawi was thinking about Climate Compatible Development was closely linked to its national policies on development, human well-being, and addressing key issues of poverty response.

Amongst the stakeholders involved in CCD related policy and knowledge mediation activities, different understandings of CCD exist, as shown by these extracts from the questionnaire data:

- "Development efforts that embrace or incorporate climate change issues"
- "Instituted measures to maintain weather patterns"
- "Development activities that will support communities to adapt and be resilient to changes in the climate change"
- "Development initiated to mitigate the effects of climate change"
- "Development that takes into consideration issues of climate changes and ensures that there is low greenhouse gas and carbon emissions as development activities are being undertaken"
- "Development that preserves or maintains climate patterns within their acceptable limits for human survival. It is development that preserves environmental interactions"
- "Development that will mitigate negative effects of CC"
- "This is the development of finding lasting solution that will enable the situation to be overcome and those that can make things not be very disastrous to the community

and user friendly. The problems that may come in with the change of the climate, weather and environmental"

- "Any development that takes into consideration means and ways of minimising pollution and planning ahead for the impacts of climate change and changes in the population dynamics"

Within the universities across Malawi, there were also diverse understandings of CCD, as shown by these extracts from the questionnaire data obtained from nine university respondents:

- "Development that is not destructive in the face of climate change, or a form of development that will not compound or increase the effects of climate change"
- "It's a kind of development which uses methods/technologies that will enable people to cope with current changes in climate in all sectors like forestry, agriculture and fisheries"
- "Developments that limit carbon emissions on those that [illegible] significant amount of carbon"
- "Development that takes into account the issues of climate changes in the nation/region"
- "Climate friendly development: development that withstands the 'new environment'"
- "Development or innovation which reduces changes in weather patterns"
- "Development that takes into account sustainable development (infrastructure development)"
- "It's the type of development that takes into account climate change issues and deliberate effort made to mitigate, prevent environment degradation and climate change"
- "Type of development that is resilient and low carbon e.g. agriculture development that can withstand inter annual rainfall variability and at the same time that does not contribute to emissions of GHGs"
- "Development that does not compromise or unduly endanger the environment"
- "Development initiatives that take into account the impact the development activity will have on climate change – considers positive impacts"
- "CCD is development that is implemented taking care of the destructive impacts of such development activities through efficient EIAs and through provision of legal frameworks that support SD"
- "Development that does not interrupt nature's stability. In cases where it is unavoidable to interfere with nature's stability, the development of planning should also find ways of replenishing it"
- "As an educator, it implies making relevant inroads in the formal and formal educational curriculum, alerting all stakeholders of education, that climate change is real, and that all sectors of our economy including education, should bring forth their individual and collective efforts to be involved in addressing these issues"

From this it is possible to see that although understandings of CCD differ amongst and between stakeholders and university staff involved in CCD related work, there is generally a close conceptual association between climate compatible development and **adaptation and mitigation**, and climate compatible development and **sustainable development**. **Context** also has an influence on how CCD is understood, and influences meaning making and

understanding of the concept. This has important implications for knowledge co-production processes, and will require careful engagement in development of mutual understanding in such processes.

4.5.2 Current research related to Climate Compatible Development

4.5.2.1 General view

An assessment of what research is needed for CCD in Malawi and a detailed database search of all research published on climate change / sustainable development research in Malawi would provide substantive detail on what research is already being conducted in Malawi. As this fell outside of the scope of this study, it is only possible to show ***some*** of the research that is currently being undertaken on climate change in Malawi.

A rapid review of published research available on Google Scholar (first ten articles listed with 'climate change Malawi' in the search) shows the following research conducted on climate change in Malawi.

Table 6: First ten articles listed with 'Climate Change' and 'Malawi' in the search and the national location of the first author

Article	Origin of first author
Wellard, K., D.Kambewa, S. Snapp, A. P.Castro, D. Taylor and D.W. Brokensha. 2012. Farmers on the frontline: adaptation and change in Malawi. Climate change and threatened communities: vulnerability, capacity and action, 41-56.	Malawi
Nordhagen, S. and U. Pascual. 2012. The Impact of Climate Shocks on Seed Purchase Decisions in Malawi: Implications for Climate Change Adaptation. World Development.	UK
Njoloma, H. M., I. Kita, Y. Kitamura and S. Aoyagi. 2011. "Effect of Climate Change on Rainfed Maize Production: Assessment of Maize Production vs. a Changing Rainfall Pattern in Malawi," 雨水資源化システム学会誌 16(2), 25-37.	Japan
Brown, D. 2011. "Making the linkages between climate change adaptation and spatial planning in Malawi," *Environmental Science & Policy* 14(8): 940-949.	Canada
Cook, A. M., J. E. Ricker-Gilbert and J. P. Sesmero. 2013. "How do African households adapt to climate change? Evidence from Malawi." In 2013 Annual Meeting, 4–6 August, 2013, Washington, DC (No. 150507). Agricultural and Applied Economics Association.	USA
Kasulo, V., S. Chikagwa-Malunga, M. Chagunda and D. Roberts. 2012. "The perceived impact of climate change and variability on smallholder dairy production in northern Malawi," *African Journal of Agricultural Research* 7(34): 4830-4837.	Malawi
Saka, J. D., P. Siable and S. Hachigonta. 2013. "Southern African Agriculture and Climate Change: A Comprehensive Analysis – Malawi." University of Malawi, The World Bank; Food Agriculture and Natural Resources Policy Analysis Network and International Food Policy Research Institute (IFPRI). http://dspace.cigilibrary.org/jspui/bitstream/123456789/33595/1/aacccs_malawi_note.pdf?1	Malawi

Article	Origin of first author
Ziervogel, G. and A. Taylor. 2011. "Integrating Climate Change Information within Development and Disaster Management Planning: Lessons from Malawi, Mozambique and Zambia." In *Climate Change Adaptation and International Development,* 129-151. London: Earthscan.	South Africa
Hochrainer, S., R. Mechler and G. Pflug. 2009. "Climate change and financial adaptation in Africa. Investigating the impact of climate change on the robustness of index-based microinsurance in Malawi," *Mitigation and Adaptation Strategies for Global Change* 14(3): 231-250.	Austria
Stringer, L. C., D. D. Mkwambisi, A. J. Dougill and J. C. Dyer. 2010. "Adaptation to climate change and desertification: Perspectives from national policy and autonomous practice in Malawi," *Climate and Development* 2(2): 145-160.	UK

It is encouraging to see that there are a variety of different research publications available regarding Climate Change in Malawi. Even more encouraging is to see eight out of the first ten publications with the title including "climate change" and "Malawi" were published within the last two years. Furthermore, the climate change research and publication coming from Malawi is in the international arena, although only three out of ten were authored by Malawian researchers. The majority of the articles/chapters focus on agricultural and financial adaptation, spatial planning and disaster management, which support the research and knowledge gaps reported on above in section 3.

While the above 'rapid review' provides insight into the internationally published literature, an 'Annotated Bibliography' produced by Mwale, Chiotha and Phalira (2013) on '*Rural Livelihoods, Environmental Sustainability and Climate Change in Malawi*' (www.lakechilwaproject.mw) reveals a list of some 390 published works on this topic, almost all of which have been produced in Malawi and by Malawian authors. The annotated bibliography includes media reports; workshop reports; project reports; and research reports (mostly postgraduate studies), as well as formally published journal articles which are mostly published in national and Africa-based journals, with some in international journals such as those listed above. A review of the topics also shows that most of these published works focus on issues of local concern and significance, and smaller scale case study work. Examples include:

- A study by J. De Gabriel on improving community-based management of boreholes focusing on how hand-pump sustainability may be improved;
- An MSc study by P. Mwale (2002) on indigenous knowledge and natural resources management focusing on indigenous fishing practices in Chembe Village along the shores of Lake Malawi;
- An MA study by M. Kwaitaine (2002) on the influence of micro-credit on rural household food security in Zomba;
- An MSc study by E. Gondwe (2006) on institutional arrangements for local level management of natural resources, a case study of Chamaliro Forest Reserve in Kasungu, Malawi;
- An MSc study by G.A. Chiunda (2002) on competences of standard seven pupils towards environmental management in Malawi;

- A PhD study by J. Manginson (1999) on land degradation, profitability and diffusion of erosion control technologies in Malawi;
- An MA (Development Studies) study by J.W. Jere (2011) focusing on living with floods: adaptation strategies and challenges of population of Chikhwawa District; and
- An MA (Economics) study by D. Luhanga (2012) on the performance of fish smoking kilns and associated impact on forest resources.

There are more such studies listed in the annotated bibliography. These are selected here to demonstrate the *type of knowledge* that is being produced, and also to show that issues relevant to CCD are being picked up in postgraduate programmes *across a range of disciplines.* The Annotated Bibliography is a very useful tool for making knowledge that is being produced more visible and accessible. Without such knowledge management strategies, much of the knowledge that is being produced remains fragmented and difficult to locate as 'grey' and 'postgraduate' literature. However, as shown by the Lake Chilwa Project (which compiled this annotated bibliography), valuable contextual knowledge *is* being produced by Malawian researchers that has validity for CCD. The Annotated Bibliography reveals that there is a need to differentiate between research-based literature and more popular forms of literature. However, a resource such as the Annotated Bibliography provides a very useful baseline tool for knowledge co-production on CCD.

4.5.2.2 University-based research

The Malawi questionnaire and workshop data shows a diversity of university faculty and department involvement in climate change related research, amongst others:

Table 7: Diversity of university faculty and department involvement in CC research

FACULTY / SCHOOL / CENTRE	DEPARTMENT	PROGRAMMES / INSTITUTES
Malawi College of Fisheries	Fisheries Department	Environmental Management (Environmental Education), Fish stock assessment and environmental monitoring (Fisheries Scientists)
University of Malawi	Environmental Science	Natural Resources and Environment
University of Malawi	Chancellor College Faculty of Science	Climate Change Adaptation Research (with LEAD SEA) Social-ecological systems research Human Ecology research Vulnerability mapping research Value addition research
University of Malawi	College of Medicine	Welcome trust – Malaria research
University of Malawi	Natural Resources & Environment Centre (NAREC)	Soil carbon mapping in Malawi. Climate change adaptation in Malawi/Tanzania. Agro-ecosystem services (Malawi – USA Universities). Water resources project (SADC – NEPAD).

FACULTY / SCHOOL / CENTRE	DEPARTMENT	PROGRAMMES / INSTITUTES
University of Malawi	Law	Environmental Law (climate change policy development research)
Lilongwe University of Agriculture and Natural Resources	Department of Agriculture Research Department of Environmental Sciences	Climate smart agricultural research Crop diversification research Extension services and CC research A new CCD project has been established: includes capacity building and research, curriculum development and new programmes, as well as practice-based engagement with CCD issues
Mzuzu University	Forestry Science	Forestry and Climate Change research
Catholic University of Malawi	Department of Social Work	Social work and climate change adaptation research
Catholic University of Malawi	Department of Education	Educational research on CCD

Note: Table may not be complete, and is therefore indicative rather than definitive.

Table 7 above shows both faculty-based diversity and departmental level diversity of participation in climate change related research. The table also shows that between the universities most of these have some form of climate change related research programme in operation. Workshop and questionnaire data further showed specific research projects and programmes linked to individuals, captured in Appendix C (expertise database). However, it was also clear from the workshop and questionnaire data that there is further need to expand the expertise database in Malawi, given the limitations of the mapping study.

Gender and PhD profile: Of those lecturers responding to the questionnaire five were female, and 21 were male, showing that while there is some participation of women scientists in climate related questions in Malawi, the research environment seems to be somewhat male dominated. Those responding to the questionnaire as climate change or CCD related researchers indicated having between four and 28 years climate change experience in their disciplines. However, of the respondents involved in climate change only four had PhDs, indicating that there may be a need to improve institutional and academic support for developing more PhD scholars in Malawi in the area of climate change. It was also noticeable that those that did have PhDs were playing strong roles in co-ordination of climate change and CCD related research, and were also raising substantive funding for CCD related research and implementation programmes.

4.5.2.3 Centres of Excellence, Centres of Expertise and Research Networks

TERMINOLOGY USED IN THIS SECTION:

Nodes of expertise as used in this document refers to 'clusters of expertise' related to a specific CCD related research area, involving at least one high performing academic with postgraduate scholars.

Centres of Expertise refers to already established research centres or institutes most often operating at university level, or between a number of universities with networked partnership links (these may be national or international).

A **Centre of Excellence** as used in this study refers to a multi-institutional partnership framework that addresses a key CCD research area involving multiple universities, and formalised national and international partnerships.

A **Research Network** refers to interest-based research groupings that convene regularly to discuss or debate research or concerns that are relevant to CCD.

Centres of Excellence:

The University of Malawi also hosts the **Leadership for Environment and Development (LEAD) Southern and East African Programme**. This is a regional Centre of Excellence for southern and eastern Africa. It is linked more widely to LEAD Africa, and LEAD international. LEAD SEA is a Centre for research and development at Chancellor College, and an affiliate programme of LEAD International, a non-profit organisation based in the UK. It was established in 1994 under the Scientific and Industrial Development Centre in Harare, and later relocated to Chancellor College in 2004. LEAD's mission is to create, strengthen and support networks of leaders and institutions promoting change towards sustainable development through capacity development and strategic, outcome-oriented activities consisting of policy, research, communications and training. The core activities of LEAD in Malawi are training and capacity building in leadership and sustainable development and project implementation on environment and natural resources management including climate change. The LEAD CoE is a key implementing partner of the Lake Chilwa Basin Climate Change Adaptation Programme (LCBCCAP; see detail below in Box 2). Apart from the LCBCCAP LEAD is implementing two other climate change projects: a three-year project aimed at building capacity of rural communities in understanding and managing climate change in Nsanje and Machinga funded by DFID; and another three-year project aimed at understanding the impact of climate change on the livelihoods of people dwelling in the forest and water interface in Machinga and Mangochi. The Zomba Regional Centre of Expertise in Education for Sustainable Development is located with LEAD SEA. The Director of LEAD SEA is Professor Sosten Chiotha (schiota@cc.ac.mw).

Mzuzu University hosts a **Centre of Excellence in Water and Sanitation** which was established in 2009 within the Faculty of Environmental Sciences. The Centre's main objectives are to improve the effectiveness of sanitation, water supply interventions, water quality and practical application of research findings though training and outreach. The Centre draws on expertise from a range of departments including the Faculty of Education, Health Sciences, Mathematics

Department, Communication and Information Science, and Environmental Sciences. The Centre's collaborative structure allows key WASH issues to be addressed from a multidisciplinary perspective by bridging practitioners and academics into a single unit. This approach is relatively new in the health and sanitation sector in Malawi. The Centre receives funding from a range of donors and private sector organisations, and offers short courses, training, applied research and programme planning and coordination. The Centre has laboratory established procedures for water quality analysis and has high quality Hach Company instrumentation and trained, experienced technicians and students in the laboratory. While its main focus is not CCD, it has expertise that is required in CCD adaptation practices, particularly related to human health and water resources management and community based adaptation. An example of current research involves the study of water quality in 339 elephant pumps around the country, with data collected on water quality, community utilisation of water pumps, performance of the pumps, and functionality of Water Use Committees. The Centre has an extension arm, named the SMART centre, which offers demonstrations of innovative and affordable water and sanitation technologies, and trains the local private sector in manual well drilling, production of rope pumps, groundwater recharge, water storage tanks, irrigation, water filters and other technologies, and also offers courses for NGOs and government officials on sustainable water supply and sanitation. The Centre is Directed by Dr Golden Msilimba (msilimba@yahoo.co.uk) and managed by Dr Rochelle Holm (rochelledh@hotmail.com).

Centres of Expertise

The University of Malawi is one of eight institutions from five countries in the SADC region that is linked into the **NEPAD Networks of Water Centres of Excellence**. However, it was not clear to which institutions in the University of Malawi the NEPAD CoE is linked.

However, NAREC's work on water resources research, and also the work of WASHTED (the Centre for Water, Sanitation, Health and Appropriate Technology Development (www.washted.mw), based at the University of Malawi Polytechnic, stands out for its expertise and hence can be viewed as a Centre of Expertise. It is a semi-autonomous unit within the Faculties of Engineering and Applied Sciences. WASHTED was established by the University of Malawi in 2003. The Centre is headed by a Director who reports to a Steering Committee. Its vision is to be a resource centre for capacity building in water and sanitation and environmentally sound and sustainable development and management of water resources in Malawi. WASHTED involves a group of researchers that are actively involved in climate change research including: undertaking climate change studies for Malawi: inventory of GHGs, and vulnerability and adaptation strategies; development of remote sensing tools for monitoring the trophic state of Lake Malawi and monitoring the surface temperature of Lake Malawi; assessing the impact of land use and land use cover (LULC) on water levels of Lake Malawi, using AFHRR and MODIS satellite imagery; developing water purification methods; assessing the hydrochemistry of groundwater resources in Malawi; development of a transport model framework; identifying appropriate sources of renewable energy that can be harnessed for use in pumping water for domestic water supply; development of a Solar Still with separate condenser for water purification, and investigating co-morbidity due to infectious diseases. WASHTED have also developed an innovative menu approach (M4M) for the provision of clean

water practices and technologies, and provides training and capacity building through hands-on workshops on M4M approaches. WASHTED is also co-operating with the East African Great Lakes Observatory (EAGLOnet) partners in studying environmental change on the dynamics of the African Great Lakes. Current projects of WASHTED are: development of the Malawi Renewable Energy Acceleration Programme (MREAP); Malawi Renewable Energy Research Programme (MRERP). The director of WASHTED is Dr Salule Masangwi (smasangwi@gmail.com).

The University of Malawi hosts the **Natural Resources and Environment Centre** (NAREC). This Centre was mentioned during the workshops as being actively engaged with climate change related research. The objective of the NAREC is to provide an institutional infrastructure and capacity for research, training and consultancy in natural resources and the environment for poverty reduction at household and national levels. The Centre encourages multidisciplinary approaches and all members of the Faculty of Science's six departments, including Geography and Earth Sciences provide the required expertise for NARECs thematic groups in areas of environmental management, indigenous knowledge systems, biotechnology, ecology, food science / technology, renewable energy, climate change, traditional / plant medicine and geosciences. Some projects that NAREC has been involved in include: Water and climate change in the Shire River Basin (funded by GEF), the National Capacity Self-Assessment for Global Environmental Management, Strengthening capacity of village level NRM committees and CBOs for national resources management, and Maintenance and restoration of ecological integrity for sustainable livelihoods. It is currently also involved in soil carbon studies, CCA studies, and water resources management linked to the NEPAD CoE network. Professor John Saka is the co-ordinator / team leader in the Faculty of Science's NAREC.

Malawi LUNAR hosts the **Centre for Agricultural Research and Development** (CARD) which is a research arm of the Bunda College of Agriculture, the main campus of LUANAR. It is an umbrella research centre composed of four units: Agricultural Policy Research Unit (APRU); training and consultancy unit (TCU), programmes co-ordination unit (PCU) and Agricultural Policy Analysis and Training Unit (APATU). The centre is mandated to carry out research in the fields of agriculture, rural development, environment and social sciences. Its vision is to become a centre of excellence in agricultural, environmental and development policy research and training for sustainable and equitable development of national and international communities. It conducts research on improving rain use efficiency and yield sustainability under rain fed agriculture, forest co-management, multi-sector policy analysis, household surveys and baseline studies, agricultural processing and production systems, and also links with the Faculty of Development Studies, who have a Department of Extension and Rural Sociology, and a Department of Agriculture Education and Development Communication. The Department of Extension and Rural Sociology offer MSc and PhD programmes in extension and rural sociology. The Department of Natural Resources Management in the Faculty of Natural Resources Management, offers an MSc Degree in Environment and Climate Change Science. The CARD is also associated with a new five-year programme named Capacity Building for Managing Climate Change in Malawi (CABMACC) which runs from 2013–2018, and has the objective of building university based capacity for teaching, research, outreach and community based adaptation facilitation with a focus on food security and enhanced livelihoods. The CABMACC programme is implemented via the University and has a nationally instituted

Programme Advisory Committee which governs its activities. The programme proposes to undertake research in areas such as development of appropriate climate change mitigation and adaptation technologies / strategies in agriculture, including Climate Smart Agriculture; assessment of land use impacts on climate change including GHG fluxes, carbon measurement and monitoring in forest or agriculture; climate change impacts modelling and vulnerability assessments of ecosystem services and livelihoods; climate change and livestock including dairy goat production; policy and legal framework analysis of CCD aspects; CC and fisheries / aquaculture production; CC impacts on energy / waste and CC impacts on disaster risk management. Dr Alexander A. Kalimbira is Acting Director at the Centre for Agricultural Research and Development and a Senior Lecturer in Human Nutrition (akalimbira@bunda.luanar.mw).

Malawi LUANAR hosts the **NEPAD Regional Fish Node (RFN)** at Bunda College in the Aquaculture and Fisheries Science Department. The NEPAD Regional Fish Node (RFN) was established in 2006 at Bunda College through an application to the Steering Committee of the inter government network of the South African Network Biosciences Initiatives for Bioscience (SANBio) which falls under the NEPAD Science and Technology. The application was made through the Malawi Government National Commission of Science and Technology (NSCT) which is part of the SANBio Steering Committee. The vision of the RFN is to "use science, technology and innovative systems to build and strengthen a network of researchers, policy makers, and the private sector in enhancing fisheries, aquaculture production and conservation of fish biodiversity". Its mission is to be a Centre of Excellence for the coordinating and facilitating of the state of art of research and dissemination on fisheries and aquaculture in Africa. While their research may not all be directly focussed on CC, their research focuses on critical issues that are relevant to CCD adaptation in the fisheries sector. Current projects include: BioFISA Fish Biodiversity project which is mapping information on fish biodiversity in five countries within the southern African NEPAD region; hosting an Aquaculture Working Group Partnership for African Fisheries, the African Fisheries Expert Network, and a Community Action Research Programme that is dealing with aquaculture innovations in the fisheries value chain (CARP), focusing on enhancing fish production and marketing for food security and income in Malawi. They also facilitate policy dialogue and enhancement of the quality of education and research in fisheries and aquaculture. Professor Emmanuel Kaunda heads up the programme, and co-ordinates and initiates nodal activities.

Research Networks

Malawi Research and Knowledge Networks cited in the workshop include:

- Civil Society on Agriculture Network (CISANET);
- Civil Society Network on Climate Change (CISONECC);
- National Technical Committee on Climate change;
- LEAD Southern and Eastern Africa;
- WATERNET – especially the gender component;
- Centre for Environment for Environmental Endowment and Advocacy (CEPA); and
- Malawi Environment Endowment Trust (MEET).

Regional Environmental Research Centres and knowledge networks include:

- SARUA (Southern African Universities Association);
- SADC Vulnerability Assessment Committee;
- SADC Early Warning Unit;
- SARCOF (Southern African Regional Climate Forecasting);
- SADC REEP (Regional Environmental Education Programme);
- EEASA (Environmental Education Association of Southern Africa); and
- FEWSNET (Famine Early Warning Systems).

4.5.3 Curriculum innovations and teaching for CCD

Participants who responded to the questionnaires indicated that there is some existing work taking place with regard to CCD curriculum innovation in their departments (see Table 8 below). Questionnaire responses indicate that all the participants from the various universities showed a willingness to get involved in new issues such as climate change and/or climate compatible development with regard to their curriculum innovation and teaching, and the questionnaire data showed that staff ability to get involved was good. Lilongwe University of Agriculture and Natural Resources (LUANAR), University of Malawi and the Forestry Research Institute confidently claimed that CCD issues and opportunities were incorporated into their current curriculum; the other universities felt they did not feel confident that they were teaching CCD specially yet. University of Malawi, the Forestry Research Institute and the Natural Resource College respondents claimed they had experience with regard to inter- and/or transdisciplinary teaching approaches to CCD.

The following specific courses were identified as being on offer (cited in the workshop discussions and questionnaire data). As climate change is often infused into existing courses, it is not easy to 'detect' climate change content in existing course descriptions, unless the courses are specifically 'named' as climate change courses. Thus it is not simply a matter of reviewing all the courses in an institution. Identification of climate change content in courses thus requires engaging with those that teach the courses. Data presented is therefore limited by this factor.

Table 8: Courses that are oriented towards climate compatible development – questionnaire and workshop data

Course/s being developed and run	Who is involved	Type and level of course
Population and environment – environmental science and offered in third year Environmental policy and law – environment science offered in third year Environmental impact assessment – natural resources management offered in fourth year	Mtsiunge Clara Kaiudzu Lilongwe University of Agriculture and Natural Resources (LUANAR) mtisunge.kaiudzu@yahoo.com	Undergraduate
Environmental management CBNRM Agroforestry	Angstone Mlangeni Natural Resources College Lecturer MSc Agriculture anjtmlangeni@yahoo.com	Undergraduate

Course/s being developed and run	Who is involved	Type and level of course
Bachelors degree in Environmental and Science Technology years 1 to 4 Masters in Water and Supply Management Masters in Environmental Protection and Management Masters in Sustainable Engineering Masters in Infrastructure Development	Nancy Chitera UNIMA – the Polytechnic Applied Sciences Maths and Statistics nchitera@poly.ac.mw	Undergraduate and postgraduate
Undergraduate years 1 & 2 – community nursing and environmental health	Melanie Yandakale Harai University of Malawi Nursing Maternal and Child Health hamim4@kcn.unima.mw	Undergraduate
Climate change is integrated in most of our courses at graduate level. Courses include environmental studies and natural resources management, rural development, agricultural geography, climatology etc. However, curriculum currently under review and climate change is one of the suggested courses to be introduced at second and fourth year.	Miriam Dalitso Joshua University of Malawi Environmental Science, Geography and Earth Sciences mjoshua@cc.ac.mw madahitojoshua@yahoo.com	Undergraduate
Environmental law – third year. Environmental law – part of MSc in Environmental Science	Sundvzwayo Madise University of Malawi Lecturer and Dean of Students Practical Legal Studies sunduzwayo@yahoo.co.uk smadise@gg.ac.mw	Undergraduate and postgraduate
Environmental law – LLB (Hons) Environmental law, policy and ethics Master of Science – environmental science	Chikosa Banda University of Malawi – Chancellor College Deputy Dean, Law Lecturer LLM Law Foundational Law ulendo@yahoo.com chanda@cc.ac.mw	Undergraduate and postgraduate
African Environmental History – 4th year undergraduate programme African Environmental Agricultural History (MA, African Social) MSc (water management and development)	Grist Kausira University of Malawi – Chancellor College Lecturer MA (African Social History) Social Science gkayira@cc.ac.mw	Undergraduate and postgraduate
MSc in Environmental Management	Clifford Mkanthama University of Malawi (Chancellor College) Programme Officer MSc in Carbon Management Science Biology cliffordmkanthama@gmail.com	Postgraduate (MSc)

Course/s being developed and run	Who is involved	Type and level of course
Year 1 undergraduate – unit within community nursing module: "Environmental and Environmental Management" Degree of Philosophy in Nursing Research and Theory Development. Nursing Maternal and Child Health	Ursula K Kafulafula Deputy Dean of Faculty, University of Malawi, Kamuzu College of Nursing, Senior Lecturer. ursulakafulafula@kcn.unima.mw	Undergraduate
People and their environment, Ecological systems, Climate change and environment Bio-geographical sciences	Misheck Munthali University of Malawi-College of Education, Social Development myagontha@yahoo.co.uk	Undergraduate
MSc Degree in Environment and Climate Change Science	Department of Natural Resources Management in the Faculty of Natural Resources Management	Postgraduate

Note: This list is not exhaustive, it can be updated and extended as part of a next phase.

There appears to be a link between those lecturers involved in climate change related research and curriculum innovations in this area. This shows that the relationship between CCD research and curriculum innovation should be more clearly understood, which implies that there is a need to examine *how research drives curriculum innovation* in new knowledge areas such as CCD in universities. Additionally, Malawi has also had CC-DARE, an international development programme, focusing specifically on CCD related curriculum development, which may explain why there is a strong existing integration of CCD in courses, especially in LUANAR, where the project was located.

As can be seen from Table 8 several institutions have dedicated CC / CCD courses at undergraduate and postgraduate level. For many of the universities the dominant pattern of practice appears to be to 'integrate' aspects of CCD into existing courses. It is difficult to examine the scope and focus of such integration without a detailed curriculum analysis. The table above also shows that it may be productive to examine CCD integration within *all faculties and all departments* within the university. The university-based questionnaire (esp. Section C) in Appendix C can be used for this purpose. The questionnaire will, however, have to be introduced to all staff in the university, preferably at Departmental level to obtain a clearer view of how CCD is / is not being integrated into teaching, and where the 'gaps' are for new development of CCD content into either a) existing programmes or b) design of new programmes. Such a process would need to be led by the Academic Registrar of the university to ensure consistent and comprehensive data.

Teaching Methods that were identified in the questionnaire as being potentially effective for CCD in courses beyond traditional processes included:

- Group discussions;
- Special projects;
- Outreach for students (attachments);

- Farm practicals;
- Self-discovery approaches, outside the classroom;
- Inquiry based learning;
- Case studies and use of films/videos;
- Learning visits to areas where climate change effects are seen;
- Presentations of research papers on climate change/CCD;
- Role play;
- Lecture participatory experiment field visits to communities of practice case studies and engaging the local communities to provide relevant examples, case studies and Indigenous Knowledge;
- Role modelling and theatre for development;
- Seminar/tutorial method;
- Group discussion, expert panel discussions; and
- Individual or group research programmes.

Inter- and transdisciplinary approaches to curriculum innovation are discussed in the next section (section 5).

4.5.4 Community and policy outreach

Limited data was provided on community and policy outreach. However, research records show that those Malawian researchers that are involved in CCD research have been undertaking research specifically to inform the first and second national communications, and climate change policy development. A number of academics are also involved in major CCD related development projects and programmes in Malawi, and these influence community well-being, as well as policy (e.g. the LCBCCAP). Through these mechanisms academics contribute to both policy and community outreach, and especially through donor funded projects to which they provide consultancy support services and research support. The establishment of research centres / centres of expertise (see above), particularly appears to facilitate this kind of policy and practice engagement, which is important for knowledge co-production approaches, and all of the Centres reported on above, are actively informing policy and practice for CCD.

Additional to this, questionnaire data indicated further that the Deputy Dean and environmental law lecturer Chikosa Banda at Chancellor College, University of Malawi has been involved in policy development and other environmental legislative action in Malawi, and that Dr. J. Namangale at the Natural Resources and Environment Centre (NAREC) at the University of Malawi has been involved with the Malawian parliamentary committee on natural resources and environment. Professor Chiotha from LEAD has made numerous policy contributions over the years to environment and NRM policy, and more recently to CCD policy. The University of Malawi is actively involved in WATERMET with a view of promoting wise and sustainable utilisation of water resources in Malawi, the responsible person is Professor W.O. Mulumfu and WASHTED play a key role here too. The University of Malawi is also working with schools (primary and secondary) in implementing school and community based climate and environment issues. This has been under the coordination of Misheck Munthali, within a Civic Education Programme called Project Citizen.

The LEAD programme has, under the LCBAAP been able to establish a community radio station that broadcasts mainly environment and climate change related news to local communities in the Lake Chilwa basin. This is an interesting community development innovation, focussed on community awareness knowledge of climate change adaptation practices and alternatives.

4.5.5 Student involvement

Respondents from the University Malawi highlighted the Green Campus Initiative, LEAD SA initiative with the Wildlife and Environmental Society of Malawi which are both involved in students participating in tree planting, forest management planning with communities. They also promote renewable energy – solar, biogas, and sustainable cooking stoves. The Department of Education at the University of Malawi also houses the Project Citizen Malawi (PCM) from which students participate in civic programmes at select schools in Malawi.

4.5.6 University collaboration and networking

The institutional analysis shows that the Centres (mentioned above), development projects, and contributions to national reporting and policy processes appear to be the key strategies that facilitate the formation of partnerships for CCD research and knowledge co-production in Malawi. Malawi has a number of development partners such as Norwegian aid, Irish aid, UNDP, UN CC-DARE, DfID that facilitate the formation of partnerships around key issues that have policy and practice relevance. University academics often play leading roles in these partnership formations, especially if they are operating from Centres or Units within faculties that are set up for this purpose. These structures therefore seem to be an important mechanism for partnership formation, intra- and inter-university collaboration and for collaboration between universities, development partners and government organisations.

The institutional analysis shows that there is already a high level of knowledge co-production on CCD occurring in Malawi, and that these approaches are shaping research as well as curriculum development (as show in the CC-DARE) programme. Further potential for knowledge co-production partnerships (Table 9) exist via the range of knowledge partners identified for CCD knowledge co-production in Malawi. Table 9 shows these ‘mapped’ out, with ascribed roles (as per workshop discussions). This list is, however incomplete and can be further developed for internal monitoring purposes.

Table 9: CCD Knowledge co-production partners

Research organisations	Civil society organisations	Private sector	Government	Regional organisations	International organisations
▪ University of Malawi ▪ Lilongwe University of Agriculture and Natural Resources ▪ Mzuzu University ▪ Catholic University of Malawi ▪ Adventist University of Malawi	▪ World Vision ▪ Concern Universal ▪ Rain Harvest Association of Malawi ▪ Total Land Care ▪ Clinton Hunter Association of Malawi ▪ Malawi Environment Endowment Trust	▪ PANNAR Seed ▪ Seed Co-Malawi (private seed company)	▪ Ministry of Environment and Climate Change Management ▪ Department of Climate and Meteorological Service ▪ Department of Fisheries ▪ Department of Forestry ▪ Mulanje Mountain Conservation Trust	▪ SARUA ▪ SADC Vulnerability Assessment Committee ▪ SADC Early Warning Unit ▪ SARCOF (Southern African Regional Climate Forecasting) ▪ SADC REEP(Regional Environmental Education for Sustainable Development) ▪ FEWSNET (Famine Early Warning Systems)	▪ UNDP ▪ DFID ▪ UNFCC ▪ UNEP ▪ CC- DARE

Note: The list is incomplete, and can be added to and used for monitoring purposes.

4.5.7 University policy and campus management

The University of Malawi participates in tree planting, and also has a sustainable waste management strategy. However, no specific university polices were mentioned at the University of Malawi, or any of the other universities.

4.6 What existing practices can be strengthened and what can be done differently?

4.6.1 Allocation of resources for CCD and CCD policy implementation

Malawi's stakeholders, researchers and lecturers have a very clear understanding of what needs to be strengthened and what could be done differently when it comes to CCD in research, teaching, outreach and networking in their contexts. What can be seen from the outcomes of the workshop and questionnaires is that several different key areas require attention. A key issue raised repeatedly was the need for more adequate resource allocation for CCD and CCD policy implementation. Although Malawi was recipient to a number of externally funded programmes and projects on CCD it was noted that while these are important for facilitating innovation and for generating knowledge and new practice

demonstrations, in the longer term these innovations need to be taken up by government. This would require giving attention to CCD financing, which is an item included in the draft National Climate Change Policy, in which a goal is framed that states that:

> *"Malawi will prioritise enhanced financing of climate change management activities through increased national budgetary allocation, improved capacity to access to international climate financing (both multilateral and bilateral) and involvement of the private sector. Assess and address barriers that limit access and efficient absorption of international climate financing".*

4.6.2 Co-ordination, collaboration and improved partnership building

There is generally a need to improve internal co-operation, collaboration and improved partnership building in Malawi, especially multi-sectoral co-operation as also identified in the draft National Climate Change Policy (GoM 2013). Overall improvements are needed in communication, knowledge transfer and coordination of a sound integrated climate change and CCD related research framework. Improved motivation and interest from government departments, and their willingness to collaborate with research institutions is also needed, however recent activity in the development of Malawi's Draft National Climate Change Policy (2013) has made many researchers confident and inspired regarding future climate change and CCD related research going into the future. The data shows that universities in Malawi are already providing climate change and CCD related curricula, or are in the process of establishing these, what is needed is for the private sector and government to participate in this growing research community, to further prepare their own systems and strategies to accommodate a growing individual capacity for climate change and CCD in Malawi.

4.6.3 Strengthen and expand understandings of CCD

As shown in section 4.2 above, CCD is a relatively new concept to some stakeholders and university researchers, yet it is being integrated into their research and teaching already. From the workshop and questionnaire data it can be seen that the concept of CCD also has different meanings, and lends itself to a diversity of contextual interpretations. It is also multidisciplinary, and multi-faceted and has diverse research and capacity building implications. This was further explored in the workshop which brought in regional perspectives, stressing that there is need for alternative development options that are continually responsive to changing climate change and emerging global and regional development paradigms related to climate which take into account what is happening in the region in and around Malawi. Further discussion revealed the need to see CCD as not a static concept, but rather as an emergent and evolving research area that needs to include indigenous forms of mitigation and adaptation.

Linked to this is the need to continue to strengthen and expand understandings of CCD. Workshop participants stressed the importance of integrating this into a Malawi's education system, including public education and grass roots community programmes. Incorporating indigenous knowledge into research, education and curriculum building was a commonly emergent theme. Curriculum development and community awareness and training were

continuously cited in the workshop and questionnaires, and this is a key area of concern for further educational development into the future.

4.6.4 Capacity building for CCD and staffing

There was a also a strong call for capacity building, particularly for undertaking research but as mentioned above, also for integrating CCD into curriculum and teaching as well as in specific disciplines and technical positions, and into the extension services. As this is a multidisciplinary issue, such capacity building should take both a specialist (to develop specialist research capacity) and a multidisciplinary approach that allows for knowledge exchange and the development of collaboration. The CC-DARE project that focussed on integrating CCA into the Agriculture and Natural Resource Curriculum in Malawi's shows a good example of how this can be done, as do the LEAD training programmes on CCD for policy makers and other CCD leaders.

4.6.5 Curriculum development and curriculum innovation

As shown in the institutional analysis above, CCD is currently mainly being 'integrated' into existing courses. There seems to be a strong expertise in CCD adaptation research and subsequent curriculum development in a variety of areas. As Malawi's most prolific research outputs related to CCD appear to be in the NRM, water and agricultural sectors at present, efforts should be made to expand these curriculum innovations into other disciplinary areas such as education and health where such processes appear to only be beginning. The CC-DARE project at the LUANAR provides a good example of how knowledge co-production processes can feed into the design of new curricula, and the MSc in Environment and Climate Change is instructive in this regard, as it drew on field-based pilot research, stakeholder inputs, community engagement activities and policy in its construction (see Box 3 below).

4.6.6 Research and research capacity building

Many recommendations were made on how research for CCD could be improved in Malawi's university and between other stakeholders. Key amongst these was to improve the CCD research culture in the universities, and research partners, especially local and national government who are responsible for creating an overarching CCD research strategy and action plan. This would require integrated coordination and collaboration of universities with government, and other partners. The dissemination of knowledge for all spheres of the society (government, communities, academia and civil society organisations) was highlighted, and climate change research was seen to not simply include geographical and environmental sciences but a range of different disciplines.

Improved identification of training needs, more community driven research, the introduction of CCD across faculties, developing multidisciplinary teams to collaborate with government departments were some of the innovative suggestions offered. A call for NGOs and the private sector with different skills and expertise to participate in such research networks was also suggested. A positive outcome of the SARUA workshop in Malawi was the identification of a small group who undertook to work within the framework of the new CCD programme at

LUANAR to develop a national research strategy and action plan for CCD. This is being led by Professor David Nkwambisi.

Research priorities also included the development of methods for information dissemination, that improve not only how knowledge is generated (for example forms of participatory research) but also how knowledge is expanded and shared so that knowledge production is used inherently to support communities affected by climate change. This shows a strong commitment to knowledge co-production approaches to research (see below) and there are already some examples of this approach that can be expanded and scaled up in Malawi.

4.6.7 The role of university leaders

The role that university leaders play in supporting CCD research and development mostly focussed on their responsibility to incorporate climate change in their institutional research and outreach agendas. Fundraising and the allocation of funds for research and outreach to climate change issues was another consistently suggested role of university managers in the questionnaire data. Other participants felt that university leaders should enable the sharing of knowledge on climate change and participate in think tanks and policy forums on climate change. The incorporation of CCD across the university curriculum was a key priority raised in the workshops and the questionnaire data, and this was also seen to require university leaders' support. It is encouraging therefore that the Pro-Vice Chancellor of the University of Malawi, Professor Mtenje made a clear statement of university management support for CCD research and curriculum innovation in his opening remarks at the SARUA workshop when he stressed the need to revise formal curricula to mainstream climate change at various levels of education. He told the workshop that the University of Malawi is already engaged in a number of research programmes related to climate compatible development and that such practices should expand.

Other suggestions included: encouraging publication of relevant climate change research results; training and supervising of students undertaking research on climate change and offering exchange programme to expose those universities that have no components of CCD to those that have. University leaders were also seen to be responsible for developing dedicated institutions/units that participate in research specialisation on climate change and adaptation for Malawi and surrounding regions. Leadership should also encourage research into key policy issues as well as encourage policy briefs and knowledge transfer between researchers and policy makers, through conferences, workshops and other platforms. Staff development through the creation and support of various training programmes in climate change and CCD was also suggested.

5 KNOWLEDGE CO-PRODUCTION POSSIBILITIES

5.1 Clarifying the meanings of multi-, inter- and transdisciplinary approaches to research

The scope and scale of problems and challenges associated with climate change, and climate compatible development – as shown in the needs analysis of this mapping study Country Report – require new forms of knowledge production. Multi-, inter- and transdisciplinary approaches to research are emerging in this context, from an understanding that research modelled on a 'business as usual' approach will not drive ingenuity in resolving complex social-ecological challenges like climate change.

Historically, the dominant approach to research is based on research in the single discipline. While single discipline research remains extremely important for development of in-depth and high quality knowledge, there is also a need to expand these approaches over time towards new, institutionally more complex forms of knowledge production.[13] Figure 5 below, shows that over time, research can build towards and include a wider range of research approaches that include multi-, inter- and transdisciplinary research approaches.

Note: Diagram showing research approaches and how they can emerge over time, in relation to outcomes that meet societal needs in the context of complex problems that need to be resolved such as climate resilient development.[14]

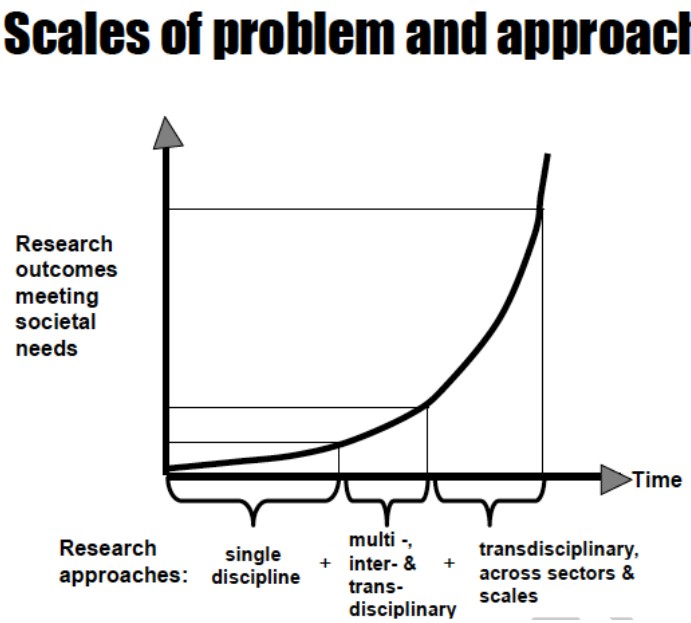


Figure 5: Research approaches

[13] This is because universities are organised and established around a disciplinary knowledge production structure.

[14] Source: Palmer, Lotz-Sisitka, Fabricius, le Roux & Mbingi, in press.

There is global evidence that more researchers are beginning to expand the single discipline approach to research, to include multi-, inter- and transdisciplinary approaches, and through this, their research is engaging across sectors and scales, and with changing social-ecological systems, complexity and integration.

Researchers working with these approaches argue that research outcomes that are generated in this manner have a greater chance of meeting societal needs.[15]

These emerging approaches to research are clarified below.

Multidisciplinarity

This involves using different disciplinary studies to address a common empirical focus or problem. Existing disciplinary methods and structures are not changed in multidisciplinary research. Multidisciplinary research helps to develop different 'angles' or different understandings of a problem, from the vantage point of different disciplines.

Interdisciplinarity

This marks a position between multi- and transdisciplinarity. It involves multidisciplinary studies, but takes these further by synthesis work that takes place *across* the different disciplines. It involves the development of a common framework and perhaps the use of discipline-transcending terminology and methodologies while maintaining certain critical disciplinary distinctions. Important in interdisciplinary research are processes of synthesis and a 'blending' or relating of knowledge from different disciplines.

Transdisciplinarity

This entails using strategies from interdisciplinary research, but it also involves taking this further into development of new theoretical understanding and new forms of praxis that are needed across sectors and at different scales. These are based on an interpenetration of disciplinary perspectives or understandings, and a 'creative re-deployment' of these in contexts of practice[16]; often contexts that are complex.

It is possible to differentiate between 'weak transdisciplinarity', which only relates existing knowledge to practice and 'strong transdisciplinarity', which goes much deeper into developing new and more complex ways of understanding and engagement in contexts where new forms of theory and practice come together[17] across sectors and at different scales.

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[15] There is a growing body of scientific work that reflects this perspective. See for example: Hirsch Hadorn, G., H. Hoffmann-Riem, S. Biber-Klemm, W. Grossenbacher-Mansuy, D. Joye, C. Phol, U. Wiesmann and E. Zemp (eds). 2008. *Handbook of Transdisciplinary Research*. Springer.

[16] Bhaskar, R. 2010. "Contexts of interdisciplinarity: interdisciplinarity and climate change." In *Interdisciplinarity and Climate Change. Transforming knowledge and practice for our global future,* edited by R. Bhaskar, F. Frank, K. Hoyer, P. Naess and J. Parker. London: Routledge.

[17] Max Neef, M. A. 2005. "Commentary: Foundations of Transdisciplinarity," *Ecological Economics* 53: 5-16.

Transdisciplinarity involves different modes of reasoning: the rational, the relational and the practical. Transdisciplinarity research presents an 'unfinished scientific programme' that offers fascinating possibilities for advanced reflection and research.[18] This is increasingly being seen as a real opportunity for innovation. Transdisciplinary research, oriented towards knowledge production for societal change, can be seen as a process that can develop over time.

Knowledge co-production

Traditionally (and currently) most research partnerships and funding arrangements still focus on the single discipline. However, international research platforms are changing towards inter- and transdisciplinary knowledge production, especially in the social-ecological sciences. Engaging in inter- and transdisciplinary knowledge production (because of its interest in new synthesis and creative deployment of knowledge in contexts of practice across scales and sectors) requires new ways of relating, thinking and doing.

As a result, new partnerships are needed between researchers and a wider range of societal actors. Movement in this direction depends on: 1) society becoming widely involved in the research domain (this includes researchers, managers, practitioners and civil society); 2) time investments to develop the trust between and competence of research partners and participants; and 3) a willingness to recognise that there are different forms of knowledge that need to interact for societal change to occur; and 4) learning by doing, or social learning.[19] Knowledge co-production is also referred to as knowledge co-creation. This requires working to bring together different contributions in the knowledge production process.

5.2 The current 'status' of multi-, inter- and transdisciplinary approaches to research and knowledge co-production

In the workshop discussions there was not enough time for in-depth discussions on examples of transdisciplinary research in Malawi but examples were identified and are reported in Boxes 1 to 3 below. In the questionnaire data, Miriam Dalitso Joshua indicated that there was multidisciplinary research in their department regarding natural resource management. Brief mention of plans for a new CCD programme at the Lilongwe University of Agriculture and Natural Resources was also made, but full details were not available at the time of writing. Three examples of multi- and transdisciplinary research are provided, all of which have strong community engaged dimensions.

[18] Max-Neef. 2005. "Commentary: Foundations of Transdisciplinarity".

[19] Adapted from the Akili Complexity Forum draft proposal, NRF South Africa (March 2010).

Box 1: Mzuzu University Choma-Chgwere Biogas Project

The project is being implemented by the Department of Energy Studies at Mzuzu University with support from the David Livingstone Fund, through the Malawi High Commission. Its purpose is to contribute to the reduction of carbon dioxide and methane emissions into the atmosphere through the promotion of biogas for cooking instead of charcoal and firewood, and is a mitigation focussed project.

A number of biogas plants have been constructed and are operational and emissions reduction is being calculated and monitored. This research project has led to a number of on-the-ground practice outcomes, as well as to engagement with multiple stakeholders, while also producing new knoweledge of biogas technologies and their mitigation potential.

Project co-ordinator: Mr Collen Zalengera (czalengera@mzuni.ac.mw)

Box 2: CC-DARE Research and Curriculum Development Project, LUANAR Faculty of Natural Resources

The CC-DARE research and curriculum development project was implemented by the LUANAR Faculty of Natural Resources, then the Department of Forestry and Horticulture in the Bunda College of Agriculture of the University of Malawi. The purpose was to use a research-led approach to integrate climate change adaptation into the Agriculture and Natural Resource Curriculum in Malawi. The project involved a range of stakeholders including the Environmental Affairs Department, district assemblies in the two districts of Chikhwawa and Nsanje, district agricultural officers, district irrigation officers, and district Forestry officers. Additionally, NGOs including Action Aid Malawi, the Catholic Development Commission of Malawi and the Evangelical Lutheran Development organisations were involved in the project, showing a multi-stakeholder approach. Community organisations and chiefs, and local media were also involved. A baseline study was undertaken to establish best practices in adapting to climate change, and from this knowledge, curriculum modules were developed for building capacity of institutions and communities in adapting to climate change. The study was located in two NAPA priority areas (Chikhwawa and Nsanje), and involved three research scientists from the Bunda College of Agriculture who worked with students, colleagues and the multi-stakeholder set-up to undertake the research, and to translate it into curriculum. Key practices that were identified were rainwater harvesting, irrigation agriculture, winter cropping, crop diversification, and growing of drought tolerant crops, as well as improved tillage practices. The research based information was used to inform a curriculum stakeholder workshop, where additional inputs were offered from multidisciplinary perspectives. Besides the university based curriculum modules for the MSc programme, additional modules for training of teachers and community members were developed and teachers in six villages in two districts were trained. This approach to research and curriculum development resulted in a number of multi-disciplinary stakeholder partnerships: climate change and agriculture, climate change and health, climate change and forestry, and climate change and policy development amongst others. Community education was also part of the programme, and through local community radio, knowledge that had been developed was shared more widely at community level, and was also shared with extension officers working at district level.

Interestingly, this integrated, transdisciplinary research and practice project contributed direction to curriculum innovation, and five modules were developed for the new MSc in Environment and Climate Change. It has also provided an opening for further research for scholars who undertake the degree, and at the time that the project was completed, there were plans to expand the approach to other NAPA districts.

This project has given rise to a further expanded project at LUANAR which continues to strengthen curriculum development and research for CCD in Malawi.

Source: www.ccdare.org: Malawi Bunda CCDARE Project Final Report, August 2010

Box 3: Lake Chilwa Basin Climate Change Adaptation Programme (implemented by LEAD SEA, Chancellor College Malawi, together with the World Fish Centre, and the Ministry of Environment and Climate Change Management with support of the Norweigan government) (2010-2014)

This transdisciplinary research and development project is a five-year programme with the overall goal to secure the livelihoods of 1.5 million people in the Lake Chilwa Basin and enhance resilience of the natural resource base. The programme aims to achieve this goal through a social-ecological systems approach to the development and implementation of basin-wide climate change adaptations in support of the Malawi National Adaptation Programmes of Action (NAPA), and to enhance the capacity of communities to adopt sustainable livelihood and natural resources management practices. The project is being implemented in ten selected Hot Spots in the Lake Chilwa Basin comprising villages from the three districts of Machinga, Phalombe and Zomba. A number of research activities support this larger programme, which include: ongoing monitoring and observation of climate patterns and trends; stakeholder analysis; data collection on fisheries and aquaculture; a fisheries frame survey; livelihoods analysis; income generating activities analyses; value creation and value chain research; practical action research to try out and demonstrate alternatives; technical ecological and ecosystem service assessments; and participatory monitoring. From this it is possible to see that CCD projects tend to be 'research rich' and that the research questions are situated in real issues, and data generated has potential for immediate application. The research also 'builds' over time from technical baseline type assessments to analysis of options and monitoring of new practices and benefits (although not necessarily in a linear manner). In the LCBCCAP, research results are drawn on to inform ongoing project activities and implementation plans, making knowledge useful in contexts of implementation. This forms part of a reflexive programme implementation process with annual reports that show the relationship between knowledge production and application, demonstrating also the knowledge co-production process that takes place between multiple stakeholders and multiple disciplinary researchers. The situated context of the research provides the platform for co-operative knowledge co-production and use. The LCBCCAP research products are also well documented and available on the website, showing the blend of methodology development, actual studies, and how studies 'come together' in practical project activities, which are reported on regularly. Examples such as this can provide valuable case examples of transdisciplinary knowledge co-production processes that draw on multiple disciplines and multiple stakeholders.

Source: www.lakechilwaproject.mw. The project is being directed by Professor Sosten Chiotha from LEAD / University of Malawi.

Reflections on the role of universities in CCD knowledge co-production processes in the workshop showed that university participants and stakeholders agreed that universities had an important role to play in relation to their three core functions, and that these could be 'aligned' around common objectives for CCD:

With regard to **teaching**, it was said that universities should review and develop curricula that mainstreamed CCD, and that universities should provide knowledge, expertise and experiences to students and other stakeholders on issues of policy advocacy and implementation, and help to facilitate information dissemination. It was said that they had a unique role to play as they were 'set up' for teaching tailor-made courses on CCD and climate change and that they could play an important role in training human resources on CCD. It was said that more university lecturers should be supported through capacity building to fulfil this role.

With regard to **research,** it was said that universities should get involved in multidisciplinary research teams and conduct ongoing research programmes on CCD, and that they should share research outputs in accessible ways. Involving students in new forms of knowledge production was also said to be important, as was using the research findings to inform government policy and implementation practice. There was a strong feeling that the kind of research that was needed was research that could counteract the effects of climate change and support communities with adapting to, and coping with the impacts of climate change. This linked strongly to the third main role of universities which is **community engagement,** and it was said that research and teaching should 'link up' via community engagement activities. Here exchange programmes and involvement of students in action projects were seen to be important.

Thus while there are a few examples of innovative approaches to research that seem to support inter- and transdisciplinary forms of knowledge co-production in Malawi, there was an understanding that this was 'not the norm' and that more needed to be done to create enabling environments for academics to play such roles in and for CCD. Several constraints that needed to be overcome for such approaches (inter- and transdisciplinary) to become the 'norm' in Malawian universities included:

- More skilled and trained researchers at higher education level;
- More and stronger research links and communications within and across institutions;
- Improved sectoral co-ordination and partnerships between universities, government and development partners;
- Improving publications outputs and knowledge sharing approaches; and
- More student scholarships that allowed for field-based internship activities during their study.

6 SUMMARY AND CONCLUSION

6.1 Synthesis perspective on the knowledge, research, individual and institutional capacity needs analysis

6.1.1 Context that frames needs

Malawi has an already established warming trend. The UNDP Climate Change Country Profile notes that the mean annual temperature has increased by 0.9°C between 1960 and 2006. During the same period, the number of hot days and nights per year has increased by 30.5 and 41 days respectively, and Malawi has experienced observed an increase in the incidence of extreme weather events, notably, droughts, floods, hailstorms and strong winds. In general, Malawi is expected to experience higher temperatures and lower rainfall in the future. The 2011 Second National Communication reports that mean annual temperature in Malawi is likely to increase by 1°C by 2020, 2°C by 2075, and 4°C by 2100. Mean monthly and annual rainfall is projected to decrease in the future, ranging from -4.8 percent to -0.7 percent. The incidence of rainfall that occurs in heavy events will increase by 19 percent by 2090, under a scenario of high global greenhouse gas emissions.

Within this context, the mapping study needs analysis for Malawi revealed that while progress has been made in identifying research and capacity needs in broad terms, the status of CCD knowledge and research remains inadequate for the responses that are required. According to the draft National Climate Change Policy (GoM 2013) a priority that cuts across all sectors is the need to undertake research, engage in technology innovation and share knowledge through education and communication approaches. In this regard, the findings of the needs analysis could be helpful in the implementation of the draft National Climate Change Policy, as the needs analysis provides a refined view of the status quo of knowledge production and knowledge co-production in Malawi.

Consistent with the socio-economic context of Malawi, in which approximately 80 percent of Malawians depend on renewable natural resources for livelihoods, the Malawian government has identified a number of adaptation, mitigation and cross-cutting priorities at policy level, and it has also established a new Ministry of Environmental Affairs and Climate Change Management. Overarching barriers to adaptation and mitigation have also been recognised. These relate to poor quality information and knowledge which in turn is related to limited human capacity in terms of numbers, skills range and depth; and limited systematic climate change data observation, collection and storage, and limited institutional capacity which includes limited coordination of climate change research and interventions, ageing telecommunication system, and the non-functioning of three of the four climate-related early warning systems. Socio-cultural barriers such as poverty and illiteracy, slow diffusion and adoption of technological innovation, and limited funding for longer-term climate change research and programmes creates further barriers to CCD in Malawi.

6.1.2 Broad adaptation and mitigation needs

There is broad agreement amongst the data sources used to compile this mapping study report (mainly documents and workshop data as questionnaire responses were limited) on the *broad priority focus areas for adaptation* – namely, water resources management; agriculture; forestry and other land uses; biodiversity, wildlife and ecosystems; fisheries; health; and human settlements. These reflect the climate vulnerabilities of Malawi, especially for its majority rural populations. The data sources also agree on *broad mitigation priorities and needs,* which encompass measures related to agriculture; forestry management and REDD+; energy; waste management; transport; industrial processes (clean technology); making better use of the Clean Development Mechanism; and climate proofing housing and infrastructure developments. Workshop and questionnaire data further emphasised these priorities, but also gave attention to the importance of CCD education, training and capacity building, gender mainstreaming of CCD issues, population growth and human resource development. These are also outlined as cross-cutting issues in the draft National Climate Change Policy.

6.1.3 Specific knowledge and research gaps

The Malawi draft National Climate Change Policy states that "*there is need for more research in climate change issues and capacity needs assessments and training needs assessments have indicated that more work has to be done".* Policy outlines a number of specific research and capacity gaps, which include improving data production, management and storage, observation systems, and research capacity. The draft National Climate Change Policy includes a specific objective on research, technology development and transfer, and systematic observation which involves rehabilitating and upgrading, and expanding weather monitoring stations around the country. It also includes supporting the documentation of indigenous knowledge for CCD. Specific research priorities are identified for adaptation priorities, which includes vulnerability and risk assessments, ecosystem service assessments, biodiversity change monitoring and assessment, and research for new technology and practices (e.g. aquaculture; renewable energy; clean technology, and eco-health approaches). Workshop participants tended to agree with these research needs, but also indicated that there was a need for environmental education and training research to improve education and training approaches and programmes; and human resource planning research, as well as socio-cultural change research. Issues of limited data, research capacity and knowledge in relation to all the different priority areas were identified. Questionnaires raised a few additional research priorities, related to the need for malaria research, and social-ecological systems research linked to ecosystem service approaches to research. It was said that these more integrative approaches were not widely practised as researchers tended to work in disciplinary silos and adoption of system-based approaches was not widespread.

6.1.4 Interesting cross-cutting issue

An interesting cross-cutting issue was that of population growth and climate change, and the knowledge gap associated with indigenous forms of family planning, and exploring the acceptability of contraceptives among youth and society. The question of what the ideal family size might be, considering the constraints placed on Malawian society by climate change was

an interesting and controversial knowledge and research question raised in the workshop. Capacity to document and evaluate the relevance of indigenous knowledge in relation to western scientific knowledge and to work with both knowledge systems was also noted as a key research gap, as was policy and institution development research.

6.1.5 Individual capacity needs

Individual capacity needs were identified in policy documents and in workshop discussions as a lack of specific skills related to higher degree training in climate change and its relevance to the fields of Agriculture, Engineering, Environment, Wildlife, Meteorology, Climatology, Modelling, Statistics, Mathematical Sciences, Physics, Chemistry, Biology, Geography, Earth Sciences, Sociology, Environmental Education and Psychology. In addition to this the policy recommends that specific capacity gaps lie in computer simulation and climate change modelling. Ensuring the inclusion of climate change in primary and secondary school curricula and to provide teachers with the skills, tools and resources to educate the children and youth about climate change was emphasised in the workshop, as was skills development for the media (journalists). Workshop participants also called for improved capacities of researchers in the renewable energy sector, particularly engineers, economists and policy experts. Expertise in GIS, carbon assessment (carbon trade economists), natural resources assessment, waste management and mathematical modelling was called for. Workshop participants also called for more Epidemiologists, Environmental scientists, EIA scientists and social scientists. The workshop further gave rise to a discussion on the need for the skills (political, negotiation, critical thinking) for critical engagement with climate change related issues at a national-global level.

6.1.6 Institutional capacity gaps

Specific institutional capacity gaps emerging from documentation and the workshops show an overall lack of institutional capacity on climate change issues. There is, however, a strong awareness of this in policy, and in workshop and questionnaire data. There is consensus across the data that there is a need to substantively strengthen capacity for information and research development for CCD, and to develop appropriate stronger multi-sector knowledge sharing platforms between universities and other research-based stakeholders. The lack of an adequate national research infrastructure, and research funding was another issue that emerged often, especially also the lack of a national research strategy for CCD. Lack of political will and a rigidity and resistance to change were also cited as institutional gaps. Poor coordination, management and monitoring of progress were other issues cited. Information access through institutions was poor, due to a lack of sharing and the absence of a central database. Policies contain limited innovation and there is a noticeable lack of favourable policies that promote innovation. Of those policies that do exist, workshop participants felt that they were limited in their implementation and enforcement as there were no robust policy and legal instruments available. In addition to this coordination between government, NGOs and the private sector was poor. Finally a commonly cited institutional capacity gap was the current weak climate change and CCD related curricula and efforts to enable the development of new curricula across disciplines in tertiary, middle and primary education.

Co-production of knowledge and its reliance on improved cross-sectoral institutional capacities can be seen as a significant area of concern for Malawi. The knowledge, research, individual and institutional capacity gaps pose particular relevance for the implementation of the future National Climate Change Policy, which relies on research and knowledge (co) production processes. This section of the country mapping study for Malawi has shown that there is need for careful planning and resource allocation to address these knowledge and institutional gaps, which should be taken forward into the strategy and action planning that will accompany the release of the National Climate Change Policy.

6.2 Synthesis perspective on the institutional analysis

As noted above, there are numerous, complex knowledge, research, individual and institutional capacity needs expressed by stakeholders and university staff themselves. Of significance is the obvious lack of strongly established institutional capacity for CCD in the country which, as mentioned above can be explained by the fact that CCD research is a new area of research and there is still relatively little engagement with CCD, although a few nodes and centres of expertise in this area could be identified.

The institutional assessment has shown Malawi has made progress with initial analysis of CCD related priorities and policy development but that there is a need for more university professionals to get involved in CCD related research. It was also noticeable that more established forms of CCD research were found in the natural resource management, agriculture, water, forestry and energy areas, with other areas still weakly developed (e.g. rural sociology, environmental education, law and policy studies, CC and health, CC gender mainstreaming etc.). Government, supported through international development partners, is playing an important role in initiating and also conducting CCD related knowledge. It was also noticeable that those academics with strong track records in this area of research, and with PhDs or professorships were able to initiate and drive implementation of major CCD related research and development initiatives in partnership with government and other stakeholders. However, there were only a few such individuals identified, and there is need for a much stronger 'critical mass' and thus for capacity development to strengthen high level research capacity amongst a broader group of research. It was encouraging that some women were engaged in CCD research, although it was clear that this was a male dominated research area. It was noticeable that few of the academics involved in CCD research had obtained PhDs. In general it was felt that scientific capacity for CCD was still weak, and in its infancy in Malawi, although there were some good examples of CCD relevant research. This also showed up in publications where much of the very useful local research is not being published except in 'grey literature' form, making it difficult to track and use such knowledge in knowledge co-production processes.

The institutional assessment revealed that there were still few courses focusing on CCD in teaching programmes, and where this was happening CCD integration was following the model of integration into existing disciplines, mainly at the undergraduate level, although there was some integration of CCD into other mainstream postgraduate degrees. One interesting exception was the CC-DARE project that developed an MSc in Environment and Climate Change through a multi-stakeholder and multidisciplinary approach to research and curriculum

development. This has also heightened awareness of the need for CCD curriculum innovation, and there is more discussion on this issue now, especially in the Lilongwe University of Agriculture and Natural Resources, where the CC-DARE curriculum innovation project was located. It was further noted that specifically dedicated knowledge networks for CCD are still in development in Malawi, and where these existed, they tended to be linked to major development projects, in which universities were involved. The sustainability of these projects, however, remained a problem for the longer term as most CCD implementation and research work in Malawi is quite dependent on donor funding. Organisations such as LEAD SEA at Chancellor College in Malawi were, however, playing a strong role in building national understanding of CCD and also in training for leadership of CCD.

The Malawian institutional assessment also revealed that there are a number of Centres at universities which play an important role in bridging multidisciplinary research, and in research programme development and research partnership building. It seems that having such semi-autonomous centres is a core part of the functioning of Malawian universities, although these are few, and only a few are focussed on CCD as their 'core business'. It is encouraging therefore that the draft National Climate Change Policy of Malawi suggests strengthening Centres of Excellence for CCD research and practice in Malawi. From the evidence in this mapping study, these are a key institutional structure that is *enabling* of the kind of research and knowledge production necessary for CCD. However, these Centres also appear to be vulnerable to changes in donor funding patterns, and are also heavily reliant on donor funding for their research and development activities. While it was difficult to obtain evidence to this effect, it seems that CCD initiatives that start, often end when donor funding ends, creating an unstable environment for knowledge co-production in the longer term.

Identified sources of expertise in Malawi can be found in a table form in Appendix E.

The University of Malawi has a Green Campus Initiative that involves students in CCD related activities such as tree planting, waste management, community based forest management, and engagement with renewable energy technology promotion and use – solar, biogas etc. The College of Education at the University of Malawi also houses the Project Citizen Malawi (PCM) from which students participate in civic programmes focusing on some CCD related activities in Malawi schools.

Stakeholders and university professionals in Malawi showed a clear understanding that CCD was closely related to both adaptation and mitigation and sustainable development. The institutional analysis also showed that amongst the university community there were some examples of transdisciplinary research, but that these were always linked to donor funded projects such as the Lake Chilwa Basin Climate Change Adaptation Programme which is being directed from LEAD SEA. The CC-DARE programme was interesting as it involved a transdisciplinary, multi-stakeholder research programme that informed curriculum development of a new MSc programme, as well as community education and outreach activities, showing how this kind of research can seed curriculum innovation. The project context, however, creates a 'real life' context for CCD research and appears to enable a strong relationship between knowledge co-production and use to develop and flourish, the LCBCCAP being a good example of this process in action. However, as mentioned above, these programmes are vulnerable to donor funding pattern changes, and knowledge co-production

on key programmes can cease to exist if funding dries up. A more sustainable national source of research funding would help to address this problem.

The institutional assessment has shown that there is an urgent need to expand capacity building in CCD related matters amongst the Malawian research community to strengthen critical mass and ensure sustainability of the research trajectories that already exist, and to expand these to other disciplines and to greater effect. While there are some good examples of CCD related curriculum development and research, there is still a need for basic disciplinary capacity development for CCD research, as well as for expanding more innovative and expansive forms of transdisciplinary research and teaching as these tend to be located within the ambit of a few that have developed expertise in this area over the past ten or more years.

Given the severity of the projected impacts of climate change on the natural resource productivity base of Malawi, and the associated risks of droughts and floods, and the levels of vulnerability that exist to these, the institutional assessment highlights that it is extremely important for universities in Malawi to become more strongly engaged with issues of CCD knowledge co-production concerns *across faculties and in inter-disciplinary formations within and between universities*, so that they are able to better support and inform policy and CCD practice. Key areas identified for Malawi include curriculum development and innovation, research institution capacity development, individual professional development and research competence development, knowledge sharing and research publishing, and community and policy outreach and stronger approaches to student involvement.

6.3 A broad map of Malawi's CCD knowledge co-production pathways

Considering the workshops and questionnaires, as well as other data sets *in relation to each other*, one can begin to map out a CCD capacity development pathway/s for Malawi. One example is offered here (Table 10). Further examples associated with CCD priorities can be further developed based on the identified CCD needs in this mapping study and in national policy.

Additional knowledge, research and capacity development pathways can be developed as also shown in the Lake Chilwa Basin Climate Change Adaptation Programme (Box 3), and the CC-DARE programme (Box 2) where a situational focus is taken as starting point, and from where knowledge and research gaps, individual capacity gaps and institutional capacity gaps are used to develop integrated frameworks for knowledge co-production and use. The CC-DARE programme shows how research-based knowledge can inform curriculum innovation.

Table 10: CCD Knowledge, Research, Capacity Building and Institutional Capacity Gap Analysis for one of the Malawi Adaptation Priorities: Disease control and management

CCD Priority	Knowledge and Research Gaps (Research Agenda)	Individual Capacity Gaps (Education and Training Agenda)	Institutional Capacity Gaps (Institutional Development Agenda)
ADAPTATION: Disease control and management	▪ Lack of understanding of predisposing factors ▪ Lack of dynamics of diseases in the context of climate change ▪ Vector mitigating measures ▪ Assessing indigenous knowledge systems that work in disease control and management ▪ Disease modelling (transmission procedures)	▪ Epidemiology ▪ Mathematical modelling skills ▪ Environmental health extension workers and community health educators with CCD knowledge and expertise	▪ Inadequate training of community health specialists ▪ Lack of training programmes in mathematical modelling

The analysis such as the one modelled above, can be developed for all major CCD priorities, and should ideally form part of national climate change policy development. Such an analysis provides a starting point for knowledge co-production at a national level. Attention should be given not only to those areas where some strength already exists, but also to areas such as the one above, that still require expanding, given the severity of the issues that they are seeking to address.

Malawi researchers are beginning to engage with CCD and some good examples of CCD related innovations in Higher Education are visible in the Malawi university context. Encouraging to note is that this is occurring across the Malawi universities and Centres of expertise are being developed or exist already that can be expanded. Further possibilities also exist in regional partnerships for CCD research with southern African institutions such as SASSCAL. The strongest influence in CCD research in Malawi at present appears to be donor funded projects, into which university academics contribute. In some cases, university academics are playing strong leadership roles in these projects (e.g. in LUANAR and LEAD SEA cases). A key finding of this mapping study is that the existing expertise base can be significantly expanded and supported in more strategic ways that allow for rapid expansion of existing capacity and nodes and centres of expertise.

Various recommendations were made for strengthening capacity for research and knowledge co-production in this mapping study that can be useful for charting a way forward, including aspects such as improving access to information, including sharing and better management of data, improving communication and co-operation, obtaining adequate funds for research including scholarships for students, and other aspects related to knowledge sharing and transfer.

Critical issues to be addressed if Malawi is to expand its CCD knowledge co-production capacity are:

- Further consolidate the national knowledge co-production analyses based on the needs and institutional analyses in this country mapping study, and as modelled in the example above (Table 10), to guide further action at country level.
- Support and expand the capacity of the NEPAD Water Centre of Excellence at the University of Malawi, and the LEAD SEA Centre of Excellence and other Centres of Expertise as these are currently providing important 'hubs' for expanding knowledge of CCD and CCD related research expertise. Also encourage the development of new Centres of Expertise and Centres of Excellence in critical areas where strong need for knowledge and capacity development have been expressed. Develop a 'capacity pathway' for strengthening individual research competence, so that individual interest and research capacity can grow into a 'node of expertise' and then into a 'centre of expertise', and potentially in future a Centre of Excellence. Strategic policy support from the climate compatible development policy community, and the Higher Education community will be needed to facilitate such capacity building pathways in Malawi, especially to build and extend research capacity, and curriculum innovation capacity, and to link up various CCD research initiatives that are occurring under the auspices of government and development programmes with university research and research capacity building.
- Improve co-operation, communication and shared access to data at all levels and maximise potential knowledge exchange and co-operative research opportunities with national and regional research organisations that are focusing on CCD.
- Develop motivation and incentives for researchers, especially for engaging in multi-, inter- and transdisciplinary research approaches. Support capacity development of researchers in these areas and create mechanisms that allow existing researchers to learn from new approaches to inter- and transdisciplinary research as modelled in national development case studies (e.g. the LCBCCAP).
- Strengthen research partnerships and research infrastructure, including research funding and incentives for students.
- Support curriculum development capacity, and curriculum innovation to mainstream CCD into existing courses and programmes.
- Strengthen existing policy and community outreach activities within a knowledge co-production framework and develop monitoring tools to make the impact of such work visible within the university system, and seek ways of incentivising engagement with policy systems and communities.
- Develop campus management policies and practices that engage students in CCD issues and that also model solutions and provide demonstrations of CCD learning pathways.

The large scale research and development programmes being undertaken with support from international donor organisations, UNDP, DfID and other major donors in partnership with various universities, ministries and development organisations potentially provide a significant platform for enhancing knowledge of CCD related issues, and knowledge co-production processes, as the research being undertaken within these large scale projects is interdisciplinary, and is also tied to application and implementation programmes and

processes. However, platforms will need to be explicitly created for such knowledge sharing to take place and for the wider university community to learn *how* to approach such research programmes.

Co-production of knowledge and its reliance on **improved cross-sectoral institutional capacities** were a significant area of concern for Malawi. These specific knowledge and research gaps pose particular relevance for the implementation of the draft National Climate Change Policy and its strategy and action plan, which rely on research and knowledge (co-) production processes. It would be important that the diversity of these knowledge needs and associated institutional capacity issues should be well articulated in such policy at a suitable level of detail.

6.4 Possibilities for linking into a networked system of knowledge co-production in the SADC region

Climate Change and CCD research and teaching in Malawi seems to be dominated by adaptation expertise, but there is also encouraging signs that research on renewable energy is gaining ground nationally. The emphasis on adaptation research may also be due to the strong drought disaster relief incentive placed by the government since 1996, which focussed heavily on drought relief that involved a variety of adaptive and some mitigation forms of research. There are also some interesting mitigation and cross-cutting climate change related knowledge production niches in Malawi. Particular areas of strength identified in Malawi include:

- **Climate change adaptation research**: Conservation Agriculture and Climate Smart Agriculture, Climate change and freshwater fisheries, Climate Change and Health, Agro-ecosystem services, Water resources research, capacity building of extension services and research on CC adaptation, Ecosystems management; and Social-ecological systems research.
- **Climate change mitigation research**: Renewable Energy research; Soil carbon mapping, Carbon Management, Waste management.
- **Cross-cutting issues research**: Sustainable Rural Livelihoods, Health and Climate Change.
- **Systems of social change research**: Environmental Law and climate policy development.
- **Teaching and curriculum innovation:** Natural Resources Management and Climate Change (MSc in Environment and Climate Change); Environmental Law (Environmental policy and law), Community Based Natural Resource Management (CBNRM) and Agroforestry, Sustainable Engineering (Masters programme), African Environmental Agricultural History, water management and development.

APPENDIX A: WORKSHOP ATTENDANCE LIST

List of participants at the Malawi workshop, 11 September 2013

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	Name	Department /Faculty / Organisation	Designation	Contact number/s	Email
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APPENDIX B: ACTIVE RESEARCHERS IDENTIFIED WHO ARE CONTRIBUTING TO CC /CCD RELATED RESEARCH ACTIVITIES

Table 11: Active researchers contributing to CC/CCD related research activities in Malawi

Institution, Faculty, Department	Research project / discipline	Researcher/s Years experience : Years experience in Climate Change research	Type of research project
Lilongwe University of Agriculture and Natural Resources (LUANAR)	Programme Manager / Agricultural Sciences	David Nkwambisi (PhD) ddmkwambisi@gmail.com	Urban agriculture and poverty reduction Climate smart agriculture A new CCD project has been established: includes capacity building and research, curriculum development and new programmes, as well as practice-based engagement with CCD issues
LUANAR	Environmental Science and Management	Boyson Moyo (PhD) bmoyo@brenda.lunar.mw 28 years: 28 years	Climate Smart Agriculture with FAO/EU. CABMACC with Royal Norwegian Government
LUANAR	Agricultural extension	Rodgers Akungwa (MSc) makungwarp@yahoo.com 9 years: 6 years	The impact of conservation agriculture on climate change effects
LUANAR	Biological Sciences	Elizabeth Bandason (MSc) elizabandason@gmail.com	Best approaches to minimise post-harvest losses using hermitic storage Conservation agriculture and livelihood diversification Pest control and vector control using bio-pesticides
LUANAR	Aquaculture and Fisheries Science Department, Bunda College	Prof Emmanuel Kaunda fishnode@yahoo.com	Fish biodiversity Aquaculture – community based adaptation strategy
University of Malawi Faculty of Science	Natural Resources and Environment Centre (NAREC)	Jimmy Namangale (PhD) jnamangale@cc.ac.mw jjnamangale@yahoo.com narec@cc.ac.mw 27 years: 4years	Soil carbon mapping in Malawi. Climate change adaptation in Malawi/Tanzania. Agro-ecosystem services, Water resources research project (SADC - NEPAD).
University of Malawi Faculty of Science	Human Ecology	Martin Charles Likongwe (BSc) martinlikongwe@yahoo.com 8 years: 7 years	Lake Chilwa Climate Change adaptation programme
University of Malawi Faculty of Science	Geography and Earth Sciences Natural Resources and Environment Centre, Environmental Science	Miriam Dalitso Joshua (MSc) mjoshua@cc.ac.mw madahitojoshua@yahoo.com 9 years: 7 years	Capacity building of extension services and research on CC adaptation. Assessing rural-urban linkages and the impact of climate change. Multidisciplinary researcher

Institution, Faculty, Department	Research project / discipline	Researcher/s Years experience : Years experience in Climate Change research	Type of research project
University of Malawi – Chancellor College Faculty of Law	Law	Cikosa Banda (LLM) Deputy Dean, Law Lecturer ulendo@yahoo.com chanda@cc.ac.mw 16 years: 14 years	Environmental law and climate change policy development
University of Malawi (Chancellor College)	Department of Biology	Professor Sosten Chioto (PhD) LEAD Director schiotha@yahoo.com Clifford Mkanthama (MSc) cliffordmkanthama@gmail.com experience unspecified	Social-ecological systems research / climate change adaptation research Carbon management research
University of Malawi College of Education	Education	Misheck Munthali (M. Ed) 17 years: 17 years myagontha@yahoo.co.uk	Waste and Ecosystems management research
Malawi Polytechnic	Engineering	Kenneth Joseph Gondwe (MEng). gondwekj@gmail.com Professor Victor Chipofya (Civil Engineering Department) Dr Geoffrey Chavula (WASHTED, Civil Engineering) Kelvin Tembo (WASHTED)	Research and technological development Initial studies and sector reports for Malawi Climate Change policy. Development of algorithms for estimating chlorophyll-a concentrations in Lake Malawi using MODIS satellite imagery and SEADAS software. Research contributes to monitoring of eutrophication and surface temperatures of the lake. Renewable Energy
Mzuzu University		Titus Bwalo Maxon Chitawo	Malawi Renewable Energy Acceleration Programme
Mzuzu University	Mzuzu University, Forestry Environmental Sciences		
Mzuzu University	WASH Centre of Excellence	Dr Golden Msilimba msilimba@yahoo.co.uk Dr Rochelle Holm rochelledh@hotmail.com	Water supply and management at community level Water quality research
UNFCCC	UNFCCC National Focal Point for Malawi	M. Makonombera, makonombera@yahoo.com	
Bunda College of Agriculture	CC-DARE project at Bunda College of Agriculture	Mr. Mwase, wmwase@bunda.unima.mw	

Note: Table may not be complete, and is therefore indicative rather than definitive.

APPENDIX C: UNIVERSITY QUESTIONNAIRE

QUESTIONNAIRE FOR UNIVERSITY MANAGERS, TEACHING AND RESEARCH STAFF: Status of Climate Compatible Development Research, Teaching and Policy / Community Engagement

A: GENERAL INFORMATION	
A1: NAME	
A2: GENDER	
A3: HIGHEST QUALIFICATION	
A4: JOB TITLE	
A5: YEARS OF EXPERIENCE	
A6: YEARS OF EXPERIENCE WITH CLIMATE CHANGE / COMPATIBLE DEVELOPMENT RELATED ISSUES	
A7: NAME OF UNIVERSITY	
A8: COUNTRY	
A9: NAME OF FACULTY	
A10: NAME OF DEPARTMENT	
A 11: NAME OF PROGRAMME/ CENTRE / UNIT / INSTITUTE	
A12: E-MAIL CONTACT	
A13: WEBSITE ADDRESS:	

B: GENERAL VIEWS

B1: Give a short description of **how you understand** 'climate change'

B2: Give a short description of **how you understand** 'climate compatible development' in your context

B3: What, in your view, are the most **critical aspects** to deal with in your country if 'climate compatible development' is to be achieved?

B4: In your view, what is **the role of universities** in contributing to the achievement of climate compatible development?

B5: In your view, what is the **role of university managers** in contributing to achievement of climate compatible development?

C: CAPACITY, KNOWLEDGE AND RESEARCH GAPS

Please indicate if you are answering these questions on behalf of a:

University	
Faculty	
Department	
Programme / Centre / Institute	

	Rate the contributions of your university / faculty / department / programme using 1-5 with 1 being non-existent, and 5 being very active or well developed	1	2	3	4	5
C1	Involvement in research in the area of climate change and/or climate compatible development					
C2	Involvement in **local** climate change and/or climate compatible development research					
C3	Involvement in **national** climate change and/or climate compatible development research					
C4	Involvement in **international** climate change and/or climate compatible development research					
C5	Involvement in single discipline approaches to climate change and/or climate compatible development research					
C6	Involvement in **interdisciplinary** approaches to climate change and/or climate compatible development research					
C7	Involvement in **transdisciplinary** approaches to climate change and/or climate compatible development research					
C8	Involvement of multiple stakeholders in climate change and/or climate compatible development research					
C9	Record of raising funding for climate change and/or climate compatible development research					
C10	Contributions of the research to local climate compatible development pathways					
C11	Contributions of the research to national climate compatible development pathways					

C12: Would you describe your university / faculty / department / programme's research primarily as being focussed on:

Climate Change	
Climate Compatible Development	
Other (please specify)	

C13: List major research projects / programmes focusing on climate compatible development in your university / faculty / department / programme:

C 14: List the most active researchers involved in climate change and/or climate compatible development research in your university / faculty / department / programme, and their 'specialist' areas of research and if possible give an email contact address

C 15: List any major practices and research initiatives you or others regard as innovative in your university / faculty / department / programme, and their 'specialist' areas of research, and if possible provide a contact name and email of a person responsible

C16: List any major research or knowledge production networks that you may be involved in that focus on or support knowledge production and / or use that is relevant to climate compatible development in your context? If possible, provide a contact name and email address for the person responsible for the network:

D: CURRICULUM, TEACHING AND LEARNING

Rate the contributions of your university / faculty / department / programme using 1-5 with 1 being non-existent, and 5 being very active or well developed		***1***	***2***	***3***	***4***	***5***
D1	**Specialist courses** offered on climate change / climate compatible development					
D2	Climate change / climate compatible development issues and opportunities **integrated into existing courses**					
D3	**Cross faculty teaching** on climate change / climate compatible development					
D4	**Inter- and/or transdisciplinary teaching approaches** used for climate change / climate compatible development courses					
D5	**Service learning** (accreditation of community engagement as part of formal curriculum) focusing on climate change / climate compatible development concerns					
D6	Courses develop **critical thinking** and **integrated problem solving** skills					
D7	Courses clearly focus on development of **social and/or technical innovation** and **ethical actions**					
D8	Climate change / climate compatible development aspects are included in **assessment and examinations**					
D9	**Staff willingness** to get involved in new issues such as climate change and/or climate compatible development					
D10	**Staff ability** to get involved in new issues such as climate change and/or climate compatible development					

D11: List any main courses in climate change / climate compatible development in your university / faculty / department / programme and indicate if they are undergraduate (1st, 2nd, 3rd year etc.) or postgraduate (Hons, Masters, PhD)

D 12: Give an example of one or two teaching methods that you would use for teaching climate change / climate compatible development in your courses

E: POLICY / COMMUNITY ENGAGEMENT AND STUDENT INVOLVEMENT

Rate the contributions of your university / faculty / department / programme using 1-5 with 1 being non-existent, and 5 being very active or well developed		**1**	**2**	**3**	**4**	**5**
E1	Involvement in climate change / climate compatible development policy outreach / engagement activities					
E2	Involvement in climate change / climate compatible development community outreach / engagement activities					
E3	Student involvement (e.g. through societies, clubs etc.) in climate change / climate compatible development activities on campus and in the surrounding areas					

E4: List any major climate change / climate compatible development **policy** outreach / engagement activities and if possible, the person responsible for the programme:

E5: List any major climate change / climate compatible development **community** outreach / engagement activities and if possible, the person responsible for the programme:

E6: List any major student organisations / activities that are engaged with climate change / climate compatible development activities

F: UNIVERSITY COLLABORATION

What opportunities exist for collaboration towards climate compatible development knowledge co-production?

F1: Inside the university

F2: Between universities in country

F3: With partners

F4: Regionally

F5: Internationally

G: UNIVERSITY POLICY AND CAMPUS MANAGEMENT

G1: Does the university have any policies that are aligned with climate compatible development objectives? If yes, then please list them.

G2: Does the university engage in any campus management activities that are aligned with climate compatible development objectives? If yes, then please list them.

G3: Are there major networks / research groups or programmes that the university is affiliated to that focus on climate compatible development? If yes, please list them.

APPENDIX D: STAKEHOLDER QUESTIONNAIRE

SHORT QUESTIONNAIRE FOR STAKEHOLDERS on CLIMATE COMPATIBLE DEVELOPMENT KNOWLEDGE, RESEARCH AND CAPACITY NEEDS

A: GENERAL INFORMATION

A1: NAME	
A2: GENDER	
A3: HIGHEST QUALIFICATION	
A4: NAME OF ORGANISATION	
A5: NAME OF SECTION / DEPARTMENT IN ORGANISATION	
A6: JOB TITLE	
A7: YEARS OF EXPERIENCE	
A8: YEARS OF EXPERIENCE WITH CLIMATE CHANGE / COMPATIBLE DEVELOPMENT RELATED ISSUES	
A9: COUNTRY	
A10: EMAIL CONTACT DETAILS	
A11: WEBSITE ADDRESS	

B: GENERAL VIEWS

B1: Give a short description of **how you understand** 'climate change'

B2: Give a short description of **how you understand** 'climate compatible development' in your context

B3: What, in your view, are the most **critical aspects** to deal with in your country if 'climate compatible development' is to be achieved?

C: CAPACITY, KNOWLEDGE AND RESEARCH GAPS

C1: What, in your view, are the most critical **knowledge gaps** that need to be addressed for achievement of climate compatible development in your context?

C2: What are your most critical **specific research needs** for achieving climate compatible development in your context?

C3: What, in your view, are the most critical **capacity gaps** (individual skills and institutional capacity) that need to be addressed for achievement of climate compatible development in your context?

C 4: In your view, what is **the role of universities** in contributing to the achievement of climate compatible development?

C5: In your view, how could / should **your organisation** be collaborating with universities to strengthen climate compatible development in your country?

D: INTERESTS, POLICIES, NETWORKS AND CENTRES OF EXCELLENCE OR CENTRES OF EXPERTISE

D1: Briefly describe your organisation's main interest in climate change / climate compatible development

D2: List any major policies and plans that have relevance to climate change / climate compatible development in your country and/or organisational context

D3: Briefly describe any collaboration that you have had with universities and/or research, learning and innovation centres, etc. on mobilising knowledge and capacity for climate change / climate compatible development. List the specific initiative / collaboration, and if possible give details of a person responsible for this.

D4: Are there any national centres of excellence in climate change / climate compatible development research and innovation practices in your country? If yes, please list them and indicate their specialist competence areas.

D5: Is there any specialist expertise in your country / context for climate change / climate compatible development research and learning that you know of? If yes, please list who they are, and indicate their specialist competence areas.

D6: Are there any networks that are engaging with climate change / climate compatible development research and innovation practices in your country? If yes, please list them, and indicate what they focus on. If possible, list a responsible person (with contact details if possible).

APPENDIX E: IDENTIFIED SOURCES OF EXPERTISE FOR CCD IN MALAWI

Table 12: Identified sources of expertise for CCD in Malawi

University	Nodes of expertise	Centres of expertise	Centres of excellence	Active Research Networks that could develop CCD expertise links
University of Malawi, including: ▪ Chancellor College ▪ Polytechnic ▪ College of Medicine ▪ Kamuzu College of Nursing	▪ Faculty of Science (individual researchers contributing to NAREC) ▪ Faculty of Law: policy and institutional development research ▪ College of Medicine: Welcome Trust Malaria Research	▪ Natural Resources and Environment Centre (NAREC) in the Faculty of Science, Chancellor College Malawi. Involved in CC adaptation research in Shire River basin, Soil carbon mapping; Agro-ecosytem services research and Water resources research linked to NEPAD Centres of Excellence Network ▪ Centre for Water, Sanitation, Health and Appropriate Technology (WASHTED) at University of Malawi Polytechnic; Involved in a range of CCD research including vulnerability studies, technology development, monitoring and renewable energy	NEPAD Water CoE at University of Malawi LEAD Southern and Eastern Africa (Chancellor College): ▪ Centre for research and development; focus on leadership training and development for environment and SD, includes three large CCD research and development programmes. ▪ Linked to LEAD Africa and LEAD international; UNEP MESA Programme, and UNU Centres of Expertise in ESD. ▪ Local community radio station	Malawi Research and Knowledge Networks cited in the workshop include: ▪ Civil Society on Agriculture Network (CISANET) ▪ Civil Society Network on Climate Change (CISONECC) ▪ National Technical Committee on Climate change ▪ LEAD Southern and Eastern Africa ▪ WATERNET – especially the gender component ▪ Centre for Environment for Environmental Endowment and Advocacy (CEPA) ▪ Malawi Environment Endowment Trust (MEET) Regional Environmental Research Centres and knowledge networks include: ▪ SARUA (Southern African Universities Association) ▪ SADC Vulnerability Assessment Committee ▪ SADC Early Warning Unit ▪ SARCOF (Southern African Regional Climate Forecasting)
Lilongwe University of Agriculture and Natural Resources (LUANAR)	Agricultural scientists engaged in CCD research Natural Resource Management Scientists engaged in CCD research Rural sociology and Extension researchers	Centre for Agricultural Research and Development (CARD), which undertakes agriculture and agricultural policy research, with some links to CCD research, and the Faculties of Natural Resources, Rural Sociology and Extension. Linked to the new CABMACC research programme. NEPAD Regional Fish Node (RFN), focusing on biodiversity research,		

University	Nodes of expertise	Centres of expertise	Centres of excellence	Active Research Networks that could develop CCD expertise links
	engaged in CCD research	monitoring, aquaculture practices and fisheries policy and extension. Aims to become a Centre of Excellence. Has regional network. Not very clear about CCD specific related research although basic research is relevant to CCD		▪ SADC REEP (Regional Environmental Education Programme) ▪ EEASA (Environmental Education Association of Southern Africa) ▪ FEWSNET (Famine Early Warning Systems)
Mzuzu University	Forestry Sciences		Centre of Excellence in Water and Sanitation which was established in 2009 within the Faculty of Environmental Sciences. Focus is on effectiveness of sanitation, water supply interventions, water quality and practical application of research findings though training and outreach. Not all research is CCD related, but the basic research has CCD adaption relevance	
Private universities, including Catholic University of Malawi Adventist University of Malawi	Social Sciences and CC research: Department of Social Work and Department of Education			
Other tertiary institutions such as the Malawi College of Fisheries	Fisheries monitoring research			

Note: This analysis is based on best available evidence. With further information and evidence, it can be expanded, and also used for monitoring and updating of CCD expertise in Malawi.

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