climate change counts

STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA

Zambia Country Report

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southern african regional universities association

SARUA CLIMATE CHANGE COUNTS MAPPING STUDY

VOLUME 2 COUNTRY REPORT 11 2014

STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA

Zambia Country Report

Series Editor: Piyushi Kotecha

Authors: Penny Urquhart and Heila Lotz-Sisitka

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Note

This is the Zambia Country Report of the Southern African Regional Universities Association (SARUA) ***Climate Change Counts*** *mapping study. It brings together background documentation on climate change in Zambia, 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 Zambia.*

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

BID	Background Information Document
CCAM	Conformal-Cubic Atmospheric Model
CCD	Climate compatible development
CDC	Curriculum Development Centre
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CFFU	Climate Change Facilitation Unit
CGCMs	Coupled Global Climate Models
CSIR	Council for Scientific and Industrial Research
CSO	Civil Society Organisation
DRR	Disaster Risk Reduction
DSEE	Distance Sustainable Energy Engineering
EERG	Energy and Environment Research Group
ERB	Energy Regulation Board
ESCO	Energy Service Company
FFEWS	Famine and Flood Early Warning System
GHG	GreenHouse Gas
GIS	Geographical Information System
HEI	Higher Education Institution
HEMA	Higher Education Management Africa consortium
INC	Initial National Communication
IPCC	Intergovernmental Panel on Climate Change
IPPS	International Programme in Physical Sciences
KTH	Royal Institute of Technology (Sweden)
LRCE	Lusaka Regional Centre of Expertise
LSSE	Language and Social Sciences Education
MEAs	Multilateral Environmental Agreements
MRV	Monitoring, Reporting and Verification
MSc	Master of Science
MU	Mulungushi University
MUEESA	Mulungushi University Environmental Education Student Association
NAMA	Nationally Appropriate Mitigation Action
NAPA	National Adaptation Programme of Action
NCCDC	National Climate Change and Development Council
NCCRS	National Climate Change Response Strategy
NCSA	National Capacity Self-Assessment
NGO	Non-Governmental Organisation
PPCR	Pilot Programme on Climate Resilience

PRSAP	Poverty Reduction Strategy and Action Plan
R&D	Researh and Development
REDD	Reduced Emissions from Deforestation's and Forest Degradation
SADC	Southern African Development Community
SADC REEP	Southern African Development Community Regional Environmental Education Programme
SARUA	Southern African Regional Universities Association
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Use
SHS	Solar Home Systems
SNC	Second National Communication
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-REDD+	United Nations - Reduced Emissions from Deforestation's and Forest Degradation
UNZAEESA	University of Zambia Environmental Education Student Association
ZCCN	Zambia Climate Change Network
ZMD	Zambia Meteorological Department

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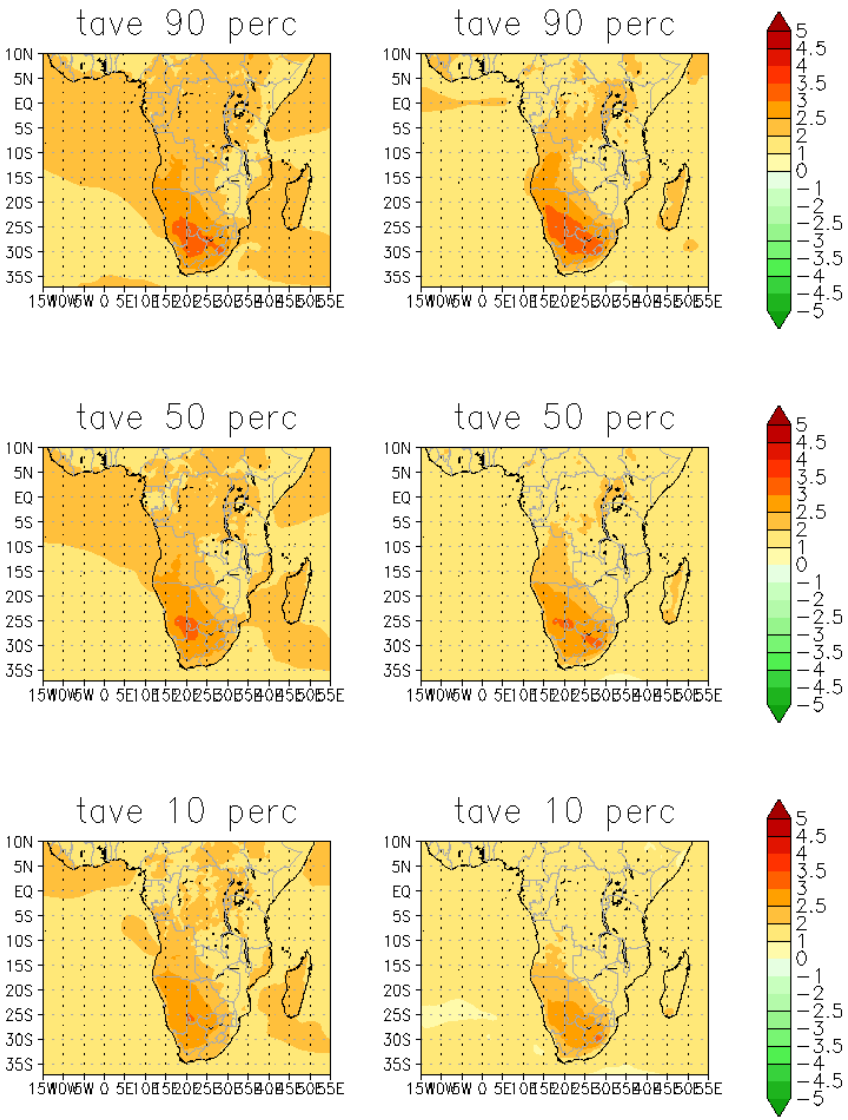
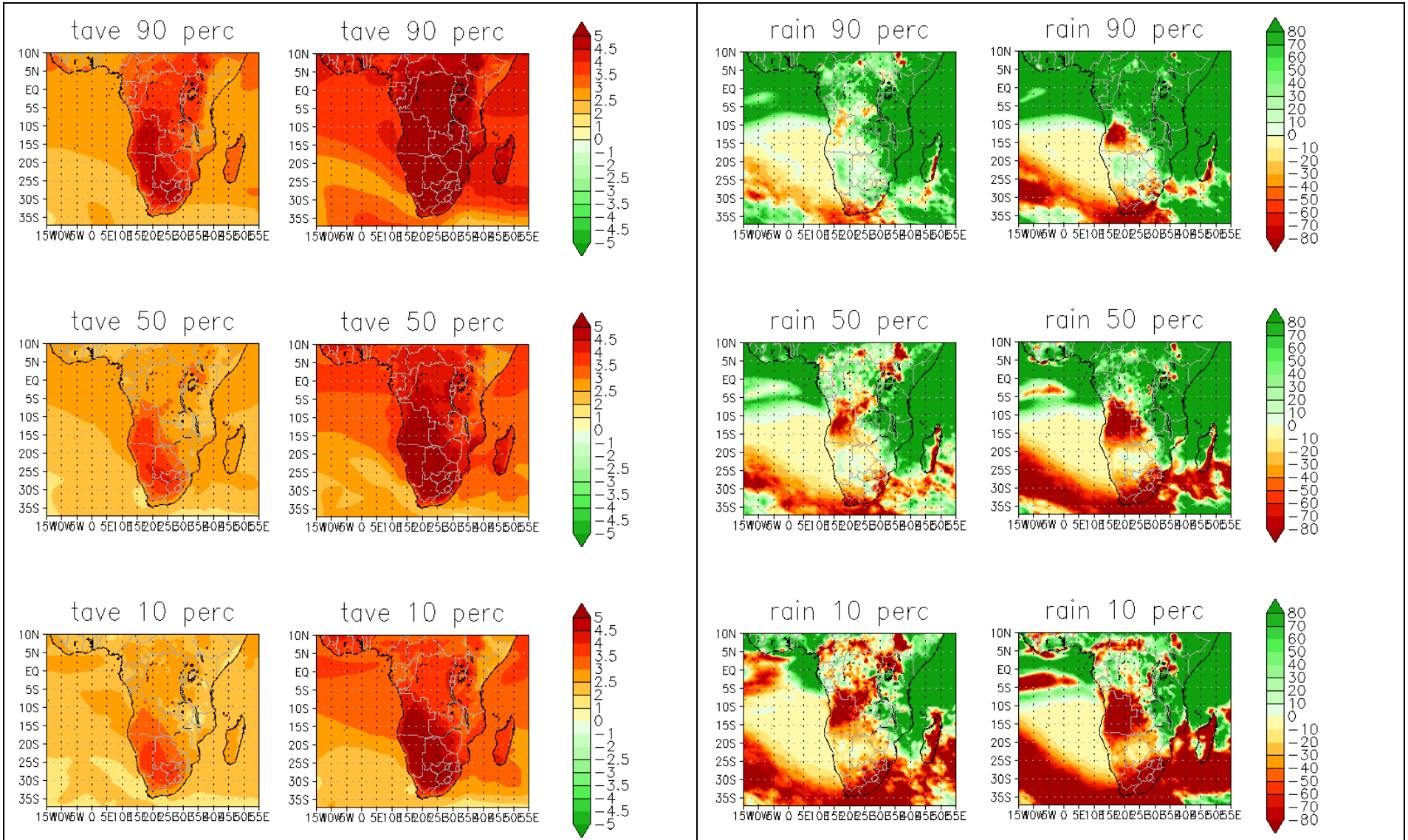
[1] IPCC. 2013. *Impacts, Vulnerability and Adaptation: Africa*. IPCC Fifth Assessment Report, draft for Final Government Review, Chapter 22.

[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. Figure 1 CGCM projections are for RCP4.5 and Figure 2 projections are 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.

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.

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 Zambia, given the country's vulnerability to the impacts of climate change (Box 1).

[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.

Box 1: Zambia's vulnerability to the impacts of climate change

Zambia National Adaptation Programme of Action (NAPA, 2007) states:

Zambia's main climate change-related human vulnerabilities and livelihood impacts lie within the areas of agriculture and food security; natural resources, wildlife and forestry; health; water and energy. Climate change impacts in the form of floods, extreme heat, and droughts have adversely impacted water quality, agricultural production, food security, water security, wildlife and infrastructure and resulted in the displacement of human populations. Persistent poverty and food insecurity will be aggravated by increasing environmental degradation and climate change. Zambian communities' strong dependence on rain-fed agriculture makes them particularly vulnerable to the current and expected climatic changes, which can precipitate widespread crop failure, negatively impact food and water security and, ultimately, affect the sustainability of rural livelihoods. Since the 1980s, agricultural production within Zambia's agro-ecological regions I and II, which are especially vulnerable to climatic effects, has been affected by late onset and shortening of the rainy season. The country faces potentially dramatic reductions in maize production.

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 topical 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** (ongoing 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

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

Dutch-funded Climate and Development Knowledge Network (CDKN). The Higher Education Management Africa consortium (HEMA) is coordinating the study on behalf of SARUA. This Zambian Country Report forms part of the mapping study.

The initiative is diagrammatically illustrated below.

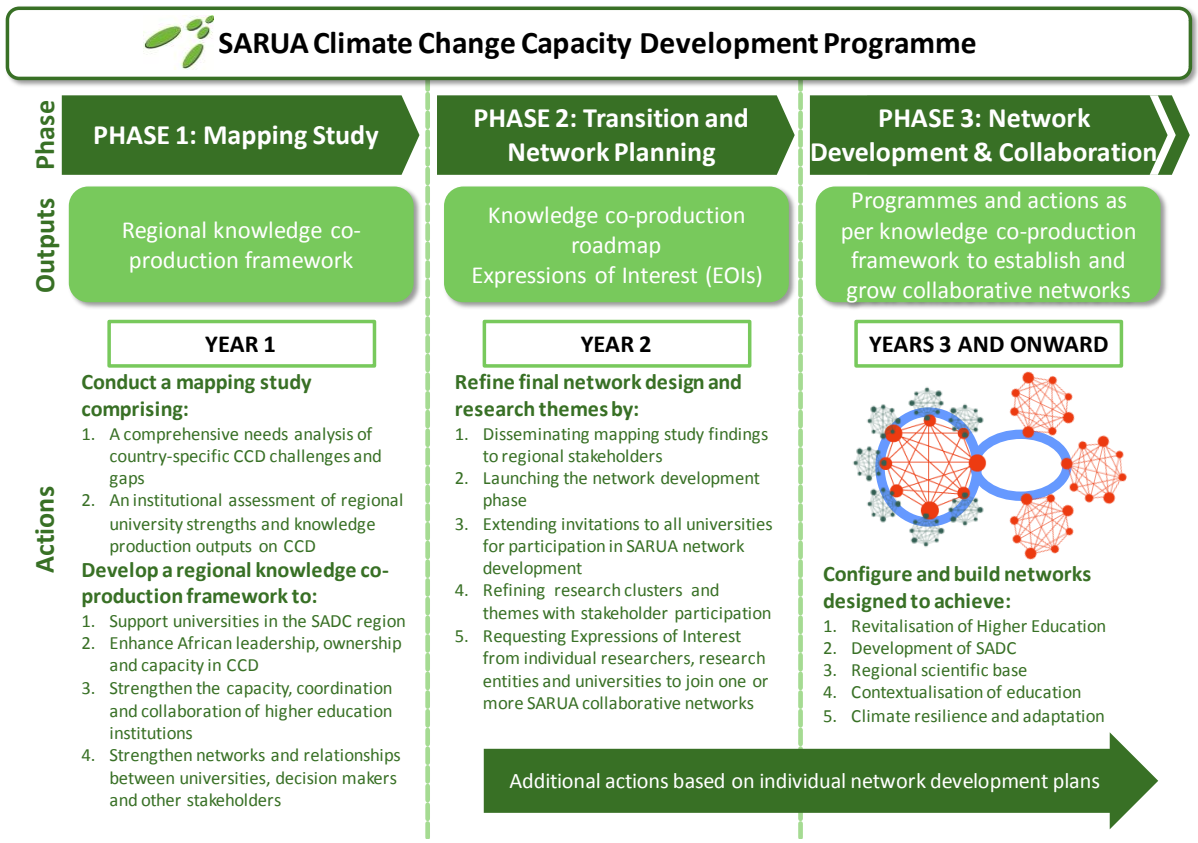


Figure 3: The SARUA Climate Change Capacity Development Programme, showing the mapping study

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');
- 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.

While the mapping process has used a country-by-country approach, this is 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 Zambia.

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.

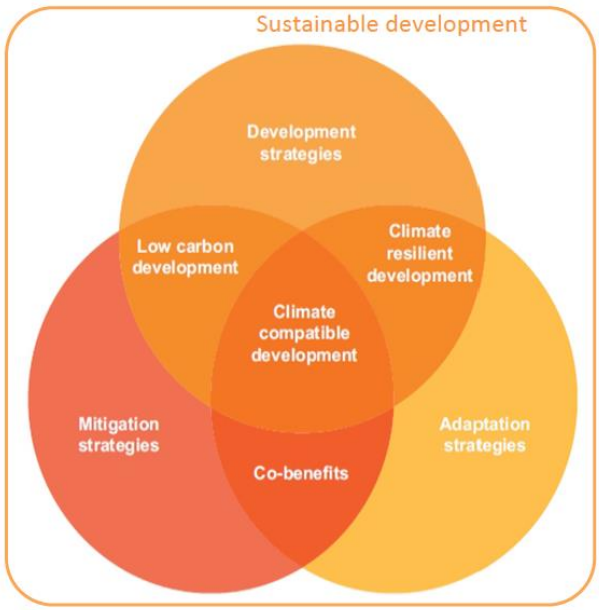


Figure 4: Conceptual framework for Climate Compatible Development (adapted from Mitchell and Maxwell, 2010)

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).

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

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-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 interrelated, 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

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

[7] Ibid.

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.

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 Zambia 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 Zambia, 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 Zambia Country Report:

- Initial National Communication (INC) to the United Nations Framework Convention on Climate Change (UNFCCC), 2002;
- Zambia National Adaptation Programme of Action (NAPA), 2007;
- National Capacity Self-Assessment (NCSA) for implementation of the Rio Conventions, 2007;
- Zambia National Climate Change Response Strategy, 2010;
- Zambia Sixth National Development Plan, 2011;
- Pilot Programme for Climate Resilience in Zambia – various documents, 2012; and
- Climate Risk Capacity Building in southern Africa: Zambia Needs Assessment, March 2012.

2.1.2 Stakeholder and university staff consultations (national workshop)

As part of the SARUA Initiative *Climate Change Counts*, country consultations were held for one and half days at the University of Zambia in Lusaka, Zambia on 9 and 10 July 2013. The workshop was run

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

with a combined group that included university, government, private sector and NGO participants. See Appendix A for the list of participants. A workshop report was produced from detailed workshop proceedings captured by a team of rapporteurs, and 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: Workshop programme outline

Time	Day 1: 9 July 2013	Day 2: 10 July 2015
INTRODUCTION	SARUA Initiative Overview	Recap day and Agenda for day 2
SESSION 1	Framing Climate Compatible Development	Breakaway groups and plenary ▪ Who is doing what, where and why in Universities in climate compatible development? (Research, Teaching, Community Engagement) ▪ Who is doing what and where amongst stakeholder groups? ▪ How does this respond to the identified needs and priorities? ▪ What are existing university plans? What are the gaps?
SESSION 2	Zambia priorities and needs Knowledge and institutional gaps and capacity	Plenary discussion ▪ Knowledge co-production introduction and example of trans-disciplinary research programme ▪ Gaps in enabling environment, and needs for policy and practice support.
SESSION 3	Group discussion (Breakaway) ▪ Zambia priorities and needs, knowledge and institutional gaps and capacity ▪ Plenary report-backs from group work	Opportunities for collaboration ▪ Policy implications for government, universities and donors
SESSION 4	What is the role of the university sector? Identifying other knowledge partners	Way forward and closure
SESSION 5	Framing Climate Compatible Development	

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

involved in climate change and CCD. For Zambia a total of 26 questionnaires were answered, which included 16 stakeholders and 10 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 Zambia, 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. Overall, the mapping study was further constrained by a budget cut imposed mid-way through the study.

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 Zambia, and in particular, University of Zambia, the Mulungushi University, Copperbelt University, the Ministry of Lands, Natural Resources and Environmental Protection, and the Ministry of Education, Science, Vocational Training and Early Education, 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 Zambia, 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 Zambia to understand the full scope of climate change and CCD responsiveness in Zambia, and to further develop the knowledge co-production capacity for CCD in Zambia. 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 Zambia, 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 Zambia. Ministries who could take this study forward could include the Ministry of Education, Science, Vocational Training and Early Education; the Ministry of Lands, Natural Resources and Environmental Protection Resources; 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 Zambia, 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 Zambia, which may also assist Zambia **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 Zambia's socio-economic context, which provides the baseline for addressing the climate change-related needs and priorities in the country (section 3.2), and a summary of the observed and projected climatic changes for the country (section 3.3). This is followed by an overview of the broader priorities for addressing climate change as identified by policy (section 3.4.1), in workshops (section 3.4.2) and via the questionnaires (section 3.4.3). The needs analysis then moves on to describe more specific priorities and needs, and their associated knowledge, research and capacity gaps (section 3.5). A summative discussion of the needs analysis is provided in section 6.1.

The following differentiation of knowledge, research and capacity gaps is used:

- **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 as definitive.

3.2 Socio-economic context

Zambia is a landlocked country located on the central plateau of the southern African region, with a land area of 752 614 km² and a fast-growing population of about 13,47 million (2011 figure). The country has a subtropical and tropical climate, modified by altitude, with three distinct seasons.[9] Rainfall increases from an annual average of 600 mm in the lower south to 1 300 mm in the upper north of the country. The country on the whole has high levels of climate variability, high evapotranspiration, and high risks of flash flooding, with the southernmost agro-ecological region (Region I) being prone to drought. Zambia is one of the few sub-Saharan African countries that is water secure. Miombo woodlands cover more than half of the country. Environmental problems include air pollution in mining towns, deforestation, water pollution and inadequate sanitation, wildlife depletion and land degradation, with associated biodiversity loss.

While categorised as a least developed country, Zambia has the goal to be a middle income country by 2030, helped by good economic growth over the past decade. However, about 73 percent of

[9] August to November is hot and dry; November to April is the rainy season; and May to August is cool and dry.

Zambians lives below the poverty line.[10] The per capita income is around $1 200 (2010 figure). Constraining factors to poverty reduction include poor infrastructure; undeveloped human capital; poor health indicators, such as high HIV prevalence and slow progress on maternal and child health and nutrition; environmental degradation and limited access to land; and inefficiencies in public management. While the mining sector (mostly copper) has driven growth, there is a need to diversify the still largely natural resource based economy, in which 85 percent of the Zambian labour force works in agriculture. Life expectancy in 2010 was 52 years for women and 48 for men.

3.3 Observed and projected climatic changes, impacts and vulnerabilities

3.3.1 Observed climatic changes

The Zambia Meteorological Department (ZMD) states that observed climate trends over the past decades include an increase in the frequency of extreme events – floods and droughts; delayed onset and early cessation of rainfall, resulting in a shorter season with more intense rainfall; and an increase in temperature in both the cool and warm seasons, particularly in the valleys. Drought conditions have been on the increase during the last 30 years with the 1991/92 drought being the worst experienced so far while the 1978/79 period saw the wettest conditions in Zambia. From 2000 to 2007, there have been two drought years, two flood years and two normal condition years. The severity and geographical distribution of floods and droughts is also changing.

The mean annual temperature has increased by 1.3 °C since 1960, an average rate of 0.29 °C per decade.[11] The rate of increase is most rapid in the winter, at 0.34 °C per decade. The mean annual rainfall over Zambia has decreased on average by 1.9 mm per month (2.3 percent) per decade since 1960, largely due to reduced rainfall between December and February. The severe droughts in the 1990s (1991/92, 1994/95, 1997/98) cannot all be linked to the El Niño phenomenon alone. Flooding in recent years, such as the above average rains in January 2008 that caused severe flooding, is linked to a combination of both the Inter-Tropical Convergence Zone and La Niña.

3.3.2 Projected climatic changes

The mean annual temperature in Zambia is projected to increase by 1.2 to 3.4 °C by the 2060s, and 1.6 to 5.5 °C by the 2090s[12], with slightly more rapid warming in the southern and western regions. Rainfall projections do not indicate large changes in amount of mean annual rainfall. Seasonally, the range of projections from different models is large, but the multi-model averages indicate decreases in September-October-November (SON) rainfall and increases in December-January-February (DJF) rainfall, particularly in the north-eastern parts. The proportion of total rainfall that falls in heavy events is projected to increase annually, but mainly in DJF. All projections indicate substantial

[10] According to the Poverty Reduction Strategy and Action Plan (PRSAP).
[11] Figures in this paragraph are taken from the Zambia National Climate Change Response Strategy (NCCRS), 2010.
[12] Information in this section is taken from the UNDP Climate Change Country Profile and the NCCRS. However, note that workshop participants centrally involved in climate change in Zambia stated that there has been a 2°C increase over the past 50 years.

increases in the frequency of hot days and nights, which has implications for heat-related stresses on crop and livestock production, as well as on human health.

3.3.3 Impacts and vulnerabilities

Zambia's main climate change-related human vulnerabilities and livelihood impacts lie within the areas of agriculture and food security; natural resources, wildlife and forestry; health; water and energy. Climate change impacts in the form of floods, extreme heat, and droughts have adversely impacted water quality, agricultural production, food security, water security, wildlife and infrastructure and resulted in the displacement of human populations.[13] Persistent poverty and food insecurity will be aggravated by increasing environmental degradation and climate change. Zambian communities' strong dependence on rain-fed agriculture makes them particularly vulnerable to the current and expected climatic changes, which can precipitate widespread crop failure, negatively impact food and water security and, ultimately, affect the sustainability of rural livelihoods. Since the 1980s, agricultural production within Zambia's agro-ecological regions I and II, which are especially vulnerable to climatic effects, has been affected by late onset and shortening of the rainy season. The country faces potentially dramatic reductions in maize production – for example, crop yields from rain fed agriculture could drop by 50 percent in some African countries, including Zambia, by 2020.

Climate-change related reductions in runoff and increased evaporation can reduce hydropower generation potential.[14] Health impacts could lie in increased incidences of vector and waterborne diseases (including malaria and cholera), changing disease patterns and increased malnutrition. There are high risks of ecosystems shift in some parts of Zambia such as South Luangwa. Increased incidences of pests and diseases as well as forest fires can affect forestry; while droughts, especially in the southern region, threaten Zambia's valuable wildlife and tourism sectors. The NCCRS notes that climate change will result in increased climate-induced migrations as well as additional and disproportionate impacts, for example on women and children. Increased damage to physical infrastructure, especially the road network as a result of extreme weather events, is also expected. According to a 2010 study, *climate variability* costs Zambia *$4.3 billion* over a ten-year period and $7.1 billion under Zambia's worst rainfall scenario. The effects of current patterns of climate variability will dominate over those of potential climate change into the near future (until 2025).[15]

[13] The 2006/07 floods affected 1 443 583 people in 41 districts of the nine provinces of Zambia, and all sectors of the economy (DMMU, 2007).
[14] More than 90 percent of the country's electricity is generated through hydroelectric power generation.
[15] Professor Prem Jain, UNESCO Chair on Renewable Energy and Environment, University of Zambia, presentation at the Climate change Counts Workshop, Lusaka, 9 July 2013.

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

Section 3.4 focuses on the broad priorities and needs for addressing climate change and moving towards CCD in Zambia. Section 3.4.1 highlights key priorities and needs articulated in policy and strategy, after which some of the broader priorities articulated by workshop participants are discussed in section 3.4.2. This is followed by a presentation of the broader needs for CCD as specified in the questionnaire responses (section 3.4.3). A summative perspective on both broad priorities and specific identified needs (see section 3.5) for adaptation, mitigation and, ultimately, for CCD, is provided in section 6.1.

3.4.1 Identified adaptation and mitigation priorities articulated in policy and strategy

Zambia has identified key needs and priorities, related to the abovementioned observed and projected climatic changes, impacts and vulnerabilities. Zambia's NAPA identifies ten priority adaptation projects that focus almost exclusively on adaptation needs:

1. Strengthening of early warning systems to improve services to preparedness and adaptation to climate change;
2. Promotion of alternative sources of livelihoods to reduce vulnerability to climate change/variability in communities living around Game Management Areas;
3. Adaptation to the effects of drought in the context of climate change in agro-ecological region I of Zambia;
4. Management of critical habitats;
5. Promote natural regeneration of indigenous forests;
6. Adaptation of land-use practices (crops, fish, and livestock) in light of climate change;
7. Maintenance and provision of water infrastructure to communities to reduce human-wildlife conflict;
8. Eradication of invasive alien species;
9. Capacity building for improved environmental health in rural areas; and
10. Climate-proofing sanitation in urban areas.

Some adaptation measures already being implemented include: promotion of irrigation and efficient use of water resources, strengthening early warning systems and preparedness, and using GIS/remote sensing in mapping of drought and flood prone areas. With respect to adaptation and disaster risk reduction, the aim in Zambia's National Climate Change Response Strategy (NCCRS) is to ensure that the most climate-sensitive sectors are protected from climate impacts by putting in place climate-resilient adaptation actions and ensuring that disaster risk reduction is mainstreamed in all sectors of the economy. The NCCRS lists numerous sector-specific adaptation activities.

The following overarching barriers to adaptation can be discerned from national climate change documents reviewed:

- Lack of financial resources to implement adaptation measures for climate change;
- Lack of a clear and specific legal and policy framework;
- Inadequate institutional, system and individual capacity in issues related to climate change;
- Inadequate public awareness on climate change and its potential impact on the social-economic situation, livelihoods and ecosystems;

- Inadequate skills to translate strategies into action at the community level;
- Lack of private sector involvement in issues related to climate change;
- Limited understanding of concrete or best practices/activities for adaptation to climate change; and
- Monitoring and evaluation plans, including environmental impact assessments, are weak and lack best standards and practices that consider climate change implications and climate as a non-static element.

With respect to mitigation and low carbon development, the aim in Zambia's National Climate Change Response Strategy is to ensure that mitigation actions are implemented in the most greenhouse gas-intensive sectors of land-use (agriculture and forestry), energy, transport and mining, and to ensure that development proceeds using low carbon pathways. In the transport sector, they include promotion of mass public transport means for urban centres, promotion of non-motorised modes of transportation as well as building a modern railway network for long distance and low-carbon transportation of cargo and passengers. Mitigation actions recommended for the energy sector have been pegged on the Government's Renewable Energy Strategy (2010), which recommends enhanced investment in renewable energy sources such as solar, wind, geothermal, small and mini hydro-power. The Low Emissions Capacity Building Project will support the development of Nationally Appropriate Mitigation Actions (NAMAs), to reduce emissions from selected sectors. The UN-REDD Programme–Zambia Quick Start Initiative will prepare Zambian institutions and stakeholders for nationwide implementation of the REDD+ mechanism, including completion of a national strategy to reduce deforestation by 2013.

Thus Zambia's policy documents make a strong connection between climate change adaptation and disaster risk reduction, calling for DRR to be mainstreamed into all sectors of the economy. With respect to an integrated approach to adaptation and mitigation, this is recognised in the NCCRS, which specifies that development should proceed using low-carbon pathways.

3.4.2 Identified adaptation and mitigation priorities articulated by workshop participants

Participants provided a range of responses during the workshop, which indicated a strong level of engagement with the issue. They highlighted the following priority needs and issues to be considered in addressing CCD in Zambia:

Youth-related aspects:

- Full participation in policy making (60 percent of the population (13million) is youth);
- Awareness creation among youth;
- A youth consortium and focal point on climate change; and
- Youth capacity building.

Awareness, knowledge, education:

- Knowledge creation on climate change;
- Local scientific knowledge and application of Indigenous knowledge;
- Integration of CCD into the curriculum (at all levels); and
- Awareness creation, teaching and learning materials.

Implementation:

- Lack of implementation of Climate Change programmes;
- Gender mainstreaming;
- Linking the policy and legal framework to CCD;
- Monitoring, Reporting and Verification (MRV) in planning;
- Sustainable forestry resource management; and
- Mineral and water resources management.

Several issues emerged from the plenary discussion of the workshop and some key points were as follows:

- Climate change and environmental education, which could be main vehicles of implementing CCD and related issues, are not yet institutionalised at all levels of education. For example, Zambia Curriculum Development Centre (CDC) has untenable argument that the curriculum is too full to accommodate such emerging issues;
- Inadequate climatic data and poor institutional capacity to publish climatic data;
- Inadequate documentation and publications on climate change adaptation and mitigation;
- Inadequate technologies for climate adaptation and mitigation;
- Limited human capacity i.e. limited number of personnel with expertise in CCD;
- Limited research on climate change, compounded by poor information dissemination and uptake of research findings;
- Poor leadership and management among different stakeholders;
- Poor vulnerability mapping i.e. Disaster Management Unit in Zambia has only mapped few areas in Zambia; and
- Lack of coordinated efforts among stakeholders especially Civil Society Organisation (CSOs) and NGOs because they seem to compete against one another – in general, weak collaboration within and between sectors and stakeholders.

Regarding a frequently mentioned point on the *disjunction between policies and practice*, the non-implementation of policies was linked to the question of who sets the agenda – often this is donors, who provide the money to develop the policies.

There was discussion on whether the school curriculum was indeed overloaded, and if so, how this could be addressed to deal with important emerging issues such as climate change, while avoiding "adjectival education" – i.e. gender education, HIV education. Participants noted that there has been a recent curriculum review, which perhaps may result in removal of some of the repetitive elements, to create space for critical new issues like climate change which need to be fully incorporated. Finally, participants were in agreement that it is **essential to use a collaborative approach to set the research agenda**, as we need efforts from all sectors of society, including even religious organisations, to address the considerable challenges.

In addition to this discussion, Prof Prem Jain from the University of Zambia, who holds the UNESCO Chair in Renewable Energy and Environment, considered the following to be the amongst the key priorities for responding to climate change vulnerability in Zambia in a presentation at the SARUA workshop:

- Climate compatible approach should include practical matters such as reducing energy consumption and traffic decongestion; and

- Deforestation is an underlying factor for increased GHGs in the atmosphere in Zambia.

As noted in the workshop, other responses to climate change of relevance for Zambia include the following:

- Arrest deforestation and embark on reforestation/afforestation programmes;
- Conservation agriculture;
- Decreased use of fossil fuels – petroleum, coal and gas; and
- All round energy efficiency and increased use of renewable energy.

"Climate change is going to remain with us for rest of our life, thus it is our concern. The future environment will be determined by our actions now."

University professional, Zambia

3.4.3 Identified needs for CCD articulated in questionnaire data

Questionnaire data showed that while there is some relationship between institutional interest / mandate and/or disciplinary interest / mandate and the definition of priority needs, on the whole Zambia stakeholders who completed the questionnaires tended to highlight more cross-cutting priorities, regardless of their institutional/disciplinary mandate (see Table 2).

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

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
Issues of sin respect of CCD so as to be well aware is of importance	Statistics and Population Studies
Capacity building, networking, collaboration, partnerships	Language and Social Sciences Education
Strengthen policy and institutional frame work. Collaboration of stakeholders with regional and international institutions	Language and Social Sciences Education
CCD projects implemented in agriculture, municipalities and human health	Biological Sciences
People need to change this mindset towards the environment, if that can be done attaining CCD would be made much easier	Disaster Management Training Centre
Effective policy implementation concerning climate change is needed; Awareness creation on climate change among communities and schools	Disaster Management Training Centre
Population, the rate at which the number of people is increasing at a faster rate and it has to be considered in order for CCD to be achieved. Production levels have increased and are still increasing affecting the environment at whole.	Disaster Management Training Centre
Sustainable Energy development, Improvement of research and development	Language and Social Sciences
Need for sensitisation, most people do not even know issues concerning climate change. Behaviour change can only come with Education and sensitisation not only for those in schools but the entire community.	Language and Social Sciences

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
The most critical aspect is deforestation and poor waste management which results in the increase of carbon dioxide in the atmosphere due to burning of waste. Ignorance on the subject of climate change is also another aspect as people need to be educated on the dangers of these actions.	Soil Sciences
I think there is need for a balance to be struck between adaptation and mitigation strategies considering the country's context. This entails that adaptation should be the main priority in our development goals while at the same time embracing the opportunities of cleaner energy and other low carbon technologies that are being invented and availed to poor countries.	Development Studies
In the power sector, the discouragement of the usage of wood and charcoal for cooking and the encouragement of environmental friendly power sources such as solar systems. Proper waste management and drainage systems and usage of modern eco-friendly equipment in mines and other industries	UNICEF (Development)
Mindsets of people in the most rural of areas. Bring in more recycling facilities. Institutions being open to new technologies and innovations that help fight climate change or detect it	Unite 4 Climate (UNICEF), CCD
Cross/multi-sectoral planning and programme. Implementation and mainstream. Domestic resource mobilisation.	Disaster Risk Reduction (OXFAM)
Need to migrate smallholder agriculture production capacities to become less reliant on rainfall by supporting irrigation infrastructure – since impacts are already manifesting at an increased scale, urgent adaptation action is a must – crop, income and livelihood diversification will be very important to provide a safety net – improved information and knowledge system that address local needs and circumstances	Zambia Climate Change Network
Strengthening of policies on the environment Ensuring youth participation in decision making on climate change issues Improving on the dissemination of information about climate change to the public Introducing environmental education into the school curriculum and all the highest learning institutions	Environmental Education (Youth Environment Network)
Deforestation, charcoal production and management of forests; reducing traffic congestion.	CBNRM (World Wide Fund For Nature)
Deforestation and poverty	Unite 4 Climate (UNICEF) CCD
To increase environmental awareness and local participation of the youth, women and vulnerable people such as in decision making or policy making	Physics, Energy and Environmental Group
Advocacy, curriculum integration of the CCD. Teaching and learning materials	Climate Change Advocacy
Poverty, corruption. Relevant technical skills development. Reducing use of paraffin through increased use of solar lighting.	Remote Sensing and Technical applications

Table 2 shows that many stakeholders highlighted the need, as a priority in addressing CCD in Zambia, for cross-cutting actions on awareness raising, education, capacity building, communication and collaboration. Governance-related priorities mentioned by a range of stakeholders included strengthening policies, implementation, cross-sectoral planning and programmes, partnerships, and increased participation – for example of youth, women and marginalised people in policy and decision making. Specific or sectoral priorities mentioned included switching to cleaner energy sources such as solar power, reducing deforestation and sustainable forest management, considering the increased consumption on the part of a growing population, and climate-proofing resource-dependent livelihoods through climate-proofing small holder agricultural production and diversifying livelihoods.

Thus, while there are different perspectives on broad priorities to address in Zambia, these did not map out clearly at all along disciplinary or institutional mandates, but tended to focus on cross-cutting issues, or even issues beyond the apparent disciplinary or institutional orientation of the questionnaire respondent. This is positive for addressing the interdisciplinary and multi-sectoral nature of climate change, and for harnessing skills in Zambia to address CCD through knowledge co-production. Priorities expressed throughout the workshop and questionnaires seemed to be well related to the particular needs of Zambia, with regard to youth, energy, the need for increased awareness, education, capacity development, information sharing and partnerships, and development and policy challenges.

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

A second important part of the Needs Analysis undertaken in the context of the SARUA mapping study involved more detailed analysis of CCD knowledge, research and capacity gaps, related to the broad CCD priorities discussed above, with a focus on those identified in key national documents, and as articulated by stakeholders and university staff attending the workshops and completing questionnaires. These specific knowledge, research and capacity gaps, distilled from all three data sources, are discussed in this section.

3.5.1 Needs analysis: Specific research needs and knowledge gaps

At a policy level the documents reviewed showed a range of knowledge and research gaps, as well as individual and institutional capacity gaps, relevant to climate compatible development.

Human capital constraining factors identified in the Sixth National Development Plan include increased scarcity of skilled manpower, limited access to higher and tertiary education, and a mismatch between the existing supply of skills and the demand in the labour market. In the 2013 national consultations on the Post-2015 Development Agenda in Zambia, greater investment in a quality education that leads to decent job creation for Zambian youth was ranked as the highest

demand, as well as "the game changer to realise a prosperous middle income status for all Zambians".[16]

Zambia's NAPA does not contain any explicit text on knowledge and research gaps. Research and development is one of the seven pillars of the NCCRS, as is capacity building, and technology development and transfer. The NCCRS states that R&D is important not only in understanding the causes, manifestations and impacts of climate change, but also in responding to it.

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. A key point of relevance to the SARUA initiative highlighted by the NCSA is the "limited research capacity and expertise within the country and insufficient level of contemporary, up-to-date knowledge in certain specialised areas (especially concerning climate change); more capacity lies within NGOs".

The NCCRS (2010) highlights the importance of education, stating "A major concern in Zambia is the lack of adequate climate change information, knowledge and long-period data to researchers, planners, policy-makers and the general public on climate change impacts, adaptation and mitigation measures as well as the opportunities the problem presents. This calls for climate change education." The NCCRS notes that while many knowledge gaps are yet to be identified, the critical overarching shortfall is the lack of a coherent approach to tackle the climate change challenge in the development context.

Public awareness of climate change and its impact on economic and social livelihoods is further identified as a fundamental issue. A 2012 climate risk capacity needs assessment[17] highlighted the importance of conducting training at the sub-national level (10 provinces and 80 districts), where it is believed that awareness is lower. The critical role of district level planners, permanent secretaries and district development committees, or sub-national staff in critical sectors (like district agricultural commissioners, extension officers, forestry, fisheries, community development) was cited.

Regarding data from the workshop, the prioritised needs for CCD were developed through a combination of themes emergent in the workshop data. Workshop participants systematically identified knowledge, research and capacity (individual and institutional) gaps in relation to selected priorities under certain thematic areas. The thematic areas were developed based on the areas of interest and expertise of participants, and thus cannot necessarily be considered as rigorously developed priorities for the country. However, within these thematic areas, participants identified what they considered to be priority issues that needed to be addressed in order to respond better to the country's climate change challenges. The thematic areas focused on in the Zambia workshop were the following:

[16] Remarks made by the UNRC Ms Kanni Wigmaraja at the launch of the Economic Report for Africa, 18 June 2013, Lusaka, Zambia, available at http://www.oneun.org.zm/index.php/speeches-a-press-releases.
[17] "Climate Risk Capacity Building in southern Africa: Summary of Zambia Needs Assessment," March 2012. CSIR, Kulima and CSAG.

- Youth, education and awareness;
- Natural resource management and gender; and
- Planning and disaster risk reduction.

Table 3 lists knowledge, research and individual and institutional capacity gaps for selected priorities under the four thematic areas, as identified by workshop participants.

Table 3: Knowledge, research and individual and institutional capacity gaps identified by workshop participants

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
YOUTH SECTOR, and for EDUCATION AND AWARENESS in Zambia	▪ Inadequate knowledge among youth to ensure their active participation in environmental decision making; lack of libraries ▪ Lack of factual information about Climate Change ▪ Unconsolidated information sharing, dissemination and networking ▪ Lack of knowledge on designing fundable project proposals ▪ Lack of knowledge on management of programmes and projects on climate change ▪ Lack of updated information ▪ Inadequate quantitative evidence of climate change ▪ Inadequate knowledge on research methodology in climate change ▪ Inadequate information on CCD in the curriculum ▪ Inadequate public awareness ▪ Outdated climate change data	▪ Lack of documentation of knowledge on the role of the youth in environmental decision making ▪ Lack of research on impact of climate change on youth ▪ Lack of research on awareness creation techniques among the youth and role of youth in raising awareness ▪ No research on significance of youth networking in combating climate change ▪ Little or no research on youth capacity building for climate change adaptation ▪ Lack of feasibility and baseline studies on implementation of Climate Change programmes/projects ▪ Lack of documentation of knowledge on the role of the youth in environmental decision making	▪ Illiteracy among youths ▪ Lack of motivation, willingness and training ▪ Some youths are money oriented ▪ Lack of maturity ▪ Youth still competitors among themselves i.e. initiating competing NGOs ▪ Climate change leadership skills lacking ▪ Lack of specialisation in field of climate change, and lack of implementation skills ▪ Lack of personal skills and individual appraisal ▪ Little or no skill in project management ▪ Individual capacity gaps ▪ Shoddy research by individuals ▪ Too many individual opportunists who want to make a living out of a misfortune (climate change) ▪ Lack of knowledge application by individual learners and teachers ▪ Negative attitude toward CCD by teachers and learners ▪ Lack of trained staff to spearhead pre/in-service training in climate change ▪ Lack of behavioural and attitude change ▪ Inadequate trained authors and material developers	▪ Inadequate youth empowerment funds ▪ Bureaucratic delays on funding of youth initiatives ▪ Weak youth policy ▪ No clear institutional frameworks on environment al education and awareness ▪ Lack of local climate change resource centres ▪ Institutions work in isolation and have limited capacity ▪ Limited systematic exchange programmes ▪ Formalisation of institutional capacity lacking ▪ Lack of proper strategic plans ▪ Most institutions are donor-driven/led ▪ Misplaced human resources ▪ Lack of performance monitoring and evaluation system ▪ Political interference ▪ Poor research dissemination and uptake by major stakeholders ▪ Claims that the curriculum is overloaded to accommodate CC, ESD, etc. ▪ Inadequate funding for frequent curriculum review ▪ HEIs have limited courses in Climate Change Education to build teachers' capacity

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
				▪ Lack of institutional funding for research ▪ Insufficient resources for climate change material production, e.g. printing and publishing costs high ▪ Poor media coverage of climate change and environment
NATURAL RESOURCE MANAGEMENT AND GENDER	▪ Lack of knowledge on extent of the country's forestry ▪ Lack of knowledge on annual deforestation rate ▪ Unclear knowledge on rate of GHG emissions due to various land use practices (i.e. *chitemene*) ▪ Lack of knowledge on carbon trading ▪ Inadequate public awareness on the UN-REDD+ ▪ Lack of mapping to explore minerals and water in the country ▪ Lack of emissions data from mining industries ▪ Lack of concrete knowledge on the contribution of mining activities to climate vulnerability ▪ Poor documentation on deforestation due to mining activities ▪ Most women (especially in rural areas) are still unaware of their role in fight against	▪ Emission factors and collection relevant data ▪ Lack of detailed research on rate of deforestation ▪ Lack of research on the role sustainable forestry management in climate change mitigation ▪ Little or no research on the importance of the UN-REDD+ in addressing climate change ▪ Inadequate research on the level of environmental pollution and GHG emissions associated with the exploitation of mineral resources ▪ Impact of climate vulnerability on mining and vice versa ▪ Limited research on climate change's impact on water resources ▪ Inadequate research on the role of women in the fight against climate change and levels of vulnerability	▪ Little or no skills in emission calculations ▪ Most/all individuals are unable to do carbon trading even though Zambia presents great opportunities compared to other countries ▪ Lack of individual responsibility to protect forestry ▪ Inadequate human resources on climate change and forestry management ▪ Limited knowledgeable and skilled personnel on impact of mining on climate change and vice versa ▪ Residents in mining areas (i.e. Kankoyo in Mufulira Town of the Copperbelt) barely know how mining activities exacerbate climate change vulnerability ▪ Limited CCD and water experts ▪ Lack of individual awareness about climate change and misconceptions ▪ Lower self esteem	▪ Weak legislative and policy frameworks on sustainable management of forests ▪ Weak capacity to sensitise the public about existing forestry management activities/plans ▪ Inadequate capacity and technology to monitor forestry resources ▪ Lack of synergies across line ministries ▪ Weak policies on mining and environment ▪ Lack of proper implementation of adaptation strategies ▪ Lack of strong legislative and policy system on carbon taxation from mining activities, water management and conservation ▪ Poor mainstreaming of gender and climate change into policies and strategies ▪ Learning institutions do not have adequate courses in gender and climate change

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
	climate change as compared to men ▪ Lack of knowledge on differential impacts of CC on women	between men and women		
PLANNING AND DISASTER RISK REDUCTION	▪ There are certain legal frameworks and policies which do not integrate CCD ▪ Lack of climate specific knowledge, attitudes and practices ▪ Poor knowledge of the extent and role of indigenous knowledge in climate change adaptation ▪ MRV systems and indicators are weak, sometimes obsolete	▪ Lack of policy and legal research (codification) ▪ There is a knowledge gap between the international knowledge and local knowledge, hence, need for research ▪ Little research been done on the role of indigenous knowledge in Disaster Risk Reduction ▪ There is lack of appropriate technology oriented research to ensure resilient urban and rural planning	▪ The capacity to do legal research in climate change context is limited ▪ The capacity to research is limited and this is aggravated by lack of incentives to research into DRR and climate change ▪ The capacity of communities to document indigenous knowledge is limited ▪ Illiteracy ▪ Few trained personnel ▪ Inadequate levels of expertise	▪ Lack of harmonisation of legal and policy frameworks ▪ The financial capacity to promote mainstreaming ▪ The limited capacity of civil society to advocate for capacity building ▪ Lack of operationalisation of the contents of the policies and strategies on climate change ▪ Fragmented institutional mandates ▪ Fragmented information management system ▪ No proper national focal point for local scientific knowledge on climate change ▪ information collection systems are not designed to capture indigenous knowledge ▪ Indigenous knowledge is looked down upon and not integrated into DRR and lack of expertise ▪ No database for CC-related indigenous knowledge ▪ Lack of strategic planning in MRV ▪ Poor consultation processes ▪ Misplaced human resources or inadequately trained human resource

The individual and institutional capacity gaps identified in Table 3 are further discussed in sections 3.5.2 and 3.5.3.

Workshop and questionnaire identified research needs related to capacity building of youth in CCD development, as Zambian youth make up 60 percent of the population of 13 million. Key areas regarding youth and CCD were: Awareness creation, capacity building and improved implementation of Climate Change programmes and implementation of CCD into curricula. It was also suggested by workshop participants that a youth consortium should be established with a focal point on climate change. Improved resources and localised CCD literacy, and weak project management capacities were highlighted as key areas needed attention.

With regard to natural resource management, knowledge and research gaps for Zambian GHG emissions remain a key issue, as there are various forms of land use practices potentially contributing to these emissions. Of particular concern is in the forestry and mining sector, where little research in mining's effect on deforestation, as well as limited research on the role of deforestation on Zambia's GHG emissions. Connected to the Natural Resource Management knowledge, research, capacity and institutional gaps was the role of women in CCD. These knowledge needs were identified with some detail and nuance, as captured in Table 3.

Congruent with the emphasis on sociological / social change related priorities for CCD, as identified in workshop data, knowledge and research needs are recommended to not only move towards CCD, but also to deal with the social processes necessary to **implement policies and strategies related to CCD.**

The **knowledge gaps** highlighted in the workshops and questionnaires expressed the broad issue of lack of **baseline data** for various adaptation and mitigation initiatives. Connected to this was the need for a **framework to manage this data and share it** across sectors. Particular knowledge gaps raised included: climate change projections; applied weather and climate data for use in different sectors and baseline data relevant for synergies between mainstreaming climate change adaptation and disaster risk reduction (given the new strategy and Act). Generally it was felt that downscaled climate data would be useful to strengthen national policy and programmatic priorities; as well as knowledge and tools for anchoring CCD within local development plans. **Accessing climate finance** was a key knowledge area that was raised several times throughout the different data sets.

The impact of climate change on various sectors was considered to be a general research gap in both the questionnaire and the workshop data**.** The mapping study identified the impact of climate change on **health, biodiversity, traditional livelihoods, agriculture, fisheries, and water** as inadequately researched areas. Overall, there was a common concern about the limited understanding of concrete activities and **best practices for adaptation** in Zambia. Specific concern was raised about the **contextualisation and localisation of climate change research**, which included developing and disseminating climate change literature in local languages, research on projecting climate change manifestations and impacts at local levels, regional activities and best practices for adaptation. An evaluation of **current natural resource management schemes** was called for to determine their effectiveness for enhancing ecosystem services of utility for adaptation. **Mitigation research** was highlighted as insufficient; this included specific research needs on the sustainability of biofuels; improved

charcoal technologies to reduce biomass consumption; the disparity between female and male energy needs, use and how the gender groups are performing in terms of accessing modern energy sources/fuels. Other mitigation research needs included exploration into technologies and strategies to rehabilitate naturally degraded areas or those cleared for charcoal burning; and models for reducing landfills as a strategy to reduce methane production. Regarding the application and management of climate change and CCD-related research in Zambia, a **clear mechanism for research coordination** was raised as a need, which would include stakeholder mapping, policy and legal framework development and coordinated information transfer networks. From these networks, research into **climate change and mainstreaming CCD into the curriculum** could be developed and integrated at various levels.

Table 4 provides a more detailed overview of the research and knowledge needs associated with CCD in Zambia, drawing on all three data sources (policy, questionnaires and workshops).

Table 4: More detailed research and knowledge needs from Zambian policy documents, workshop and questionnaires

VULNERABILITY, IMPACTS AND ADAPTATION

Climate services

- Climate change projections
- Climate information (related to sparse meteorological network)
- Expansion and improvement of the national weather observation system, including improved weather and climate data collection, equipment, and transmission and exchange from outstations to the central database
- Insufficient staffing of meteorological stations
- Limited capacity to provide interpretation of seasonal forecasts
- Applied weather and climate data for use in different sectors
- Downscaled knowledge on climate change that strengthens national policy and programmatic priorities – knowledge and tools for anchoring CCD within local development plans

Water

- More research on hydrological predictions and water quality implications; better watershed vulnerability assessments; impacts of CC on water, waste-water and stormwater infrastructure

Natural Resource Management

- Research to determine the exact extent to which climate change impacts wildlife and its habitat, and agriculture (crops and livestock): regional vulnerabilities; combining traditional and modern methods of food preservation; alternative livelihood systems e.g. sericulture; better marketing strategies/new market niches; validating indigenous knowledge and integrating this with conventional technologies
- Fisheries: vulnerability assessments of fisheries resources; socio-economic impacts of CC on fishery-based livelihoods; appropriate adaptation methods; improving reporting standards and access to fisheries catch data to improve assessment of the impacts of climate change on fisheries; identifying extinction-prone species, and designing strategies to protect them (P)
- Evaluating current natural resource management schemes and determining their effectiveness in adapting to the impacts of climate change and providing ecosystem services; policy to support pro-poor payment for ecosystem services
- Research on the management of pests and invasive species in forestry

Health

- Understanding health impacts of climate change
- Assessing CC health risks; using GIS to map and manage responses; socio-economic implications and epidemiology of CC

Economy and Industry

- Appropriate strategies against the spill-over effects on tourism of possible mitigation measures in the international aviation industry
- Skills for economic diversification of livelihoods, including gender-differentiated

General research-related

- Baseline data relevant for various adaptation and mitigation initiatives
- Research on projecting climate change manifestations and impacts at local levels

MITIGATION

Sustainable Energy and Low Carbon Development

- Research on the sustainability of biofuels
- Improved charcoal technologies to reduce biomass consumption
- Research on the disparity between female and male energy needs, use and how the gender groups are performing in terms of accessing modern energy sources/fuels
- Research on ways to reduce landfills which are major contributors to methane in the atmosphere
- Research on emission factors, including measuring GHG emissions
- Skills for developing and applying localised renewable energy technologies

REDD+

- Regarding UN-REDD+, personnel skills in carbon markets; offsets mechanisms; documentation (e.g. developing Project Idea Notes (PINs) and Project Design Documents (PDDs)); Monitoring, Reporting and Verification (MRV); forest mapping, and participatory forest management

CROSS-CUTTING ISSUES

Governance and Institutions

- Lack of a clear and specific legal and policy framework
- Technical and policy support to prepare communications to the UNFCCC and for the international negotiations
- Stakeholder mapping, policy and legal framework relevant to CCD
- Weak monitoring and evaluation of plans
- Strengthening climate change institutions
- Integrated multi-sectoral, multidisciplinary approaches to climate change vulnerability and adaptation

Youth and Education

- Inadequate research on how the CCD can be integrated in the curriculum at all levels
- Inadequate human resources with skills to translate strategies into action at the community level
- Curricula review to integrate climate change into education systems
- Develop, strengthen and harmonise national education, research institutions and programmes regarding CC

Capacity Building, Training and Institutional Strengthening

- Training of personnel for climate modelling and research
- Increase in human resource skill training in climate change
- Funding for human resource development and a comprehensive capacity development strategy

Gender

- Inadequate integration of climate change, including the gender-differentiated and HIV/AIDS aspects, into policies, plans and strategies at all levels, including economic development planning
- Strengthened role for women groups and networks in CC initiatives

Public Awareness and Participation

- Inadequate public awareness on climate change and its impacts on the social-economics, livelihoods, and ecosystems
- Developing and disseminating climate change literature in local languages
- Involving local administration and community leaders in CC education and training
- Lack of private sector involvement in issues related to climate change
- Public computer libraries where people can access up-to-date and reliable information
- Engaging private sector to be involved in climate change (Q)
- Community sensitisation, media must go flat out to ensure that this is done (Q)

Knowledge Management

- Clear mechanism for research coordination
- Lack of national information management systems and databases
- Poor information exchange among individuals and organisations

Disaster Reduction and Risk Management

- Synergies between mainstreaming climate change adaptation and disaster risk reduction (given the new strategy and Act)
- Need to strengthen disaster risk reduction and management systems

Financial Resource Mobilisation and Management

- Accessing climate finance
- Lack of financial resources to implement adaptation measures for climate change

Technology Development and Transfer

- Localised technologies to address climate change
- Technologies and strategies to rehabilitate naturally degraded areas or those cleared for charcoal burning (P)
- Technologies for domestication and preservation of indigenous species
- Practical and applicable technologies for adaptation

The table above offers some indication of where the major needs are, which is of relevance for the further development of the draft National Policy on Climate Change and the implementation of the National Climate Change Response Strategy Plan. All of these CCD needs are highly reliant on research and knowledge (co) production processes, and it would be important that the diversity of these knowledge needs should be well articulated in such policy and in implementation of the strategy, at a suitable level of detail.

What is of interest in this analysis (as presented in Table 4), is that the potential national research and knowledge needs (as partially identified in Table 3) are more nuanced when considered in thematic context. This is an important point to note for knowledge co-production processes, so as not to lose the specificity of the research problems and/or contexts. However, it is notable that there is very little information on knowledge or research needs related to adaptation in the industry sector, or generally for the economy; needs in this regard tend to be largely focused on mitigation-related needs. This highlights an important area in which further country-level consideration is required, in order to identify priority areas for climate-proofing the economy.

A further point to note is that while the needs in Table 4 are grouped under the customary 'vulnerability, impacts and adaptation' and 'mitigation' categories, many of these needs may in fact encompass both adaptation and mitigation elements, and may lend themselves to an integrated approach as encapsulated in the CCD concept. An example of this is 'technologies and strategies to rehabilitate naturally degraded areas or those cleared for charcoal burning', which could clearly have both adaptation and mitigation benefits. A further example lies in the needs related to the development and implementation of the UN-REDD+ programme in Zambia, in which it is highly desirable to consider mitigation and adaptation goals in an integrated fashion, to ensure equitable, pro-poor and developmental outcomes.

A further part of addressing the process question related to CCD policy implementation is a strong analysis of individual and institutional capacity gaps, which are addressed in the following two sections.

3.5.2 Needs analysis: Individual capacity gaps

When discussing individual capacity gaps in the workshop, as highlighted in detail in Table 3, the overall inadequate human resources across the climate change and CCD sector was raised. With regard to monitoring and modelling, limited training of personnel for climate modelling and research was of concern and subsequently insufficient staffing of meteorological stations was highlighted. Limited capacities raised from the workshops and questionnaire data sets focused on limited skills to translate strategies into action at the community level, and capacities to develop and apply localised renewable energy technologies. Other capacities

mentioned included skills for economic diversification of livelihoods, including gender-differentiated research.

Even with these new achievements in capacity development and CCD related education, there are still significant gaps identified. As shown by the more nuanced assessment of individual capacity gaps presented earlier, insufficient staffing emerges from lack of training and capacity development in various CCD related fields, from climate modelling, research, renewable energy technology, carbon marketing, monitoring, reporting, verification, mapping, natural resource management, economic diversification, gender-related issues and fundraising.

In 2010, the Southern African Development Community Regional Environmental Education Programme (SADC REEP) assessed the capacity of SADC and its Member States to implement Multilateral Environmental Agreements (MEAs), including the United Nations Framework Convention on Climate Change (UNFCCC). It identified the following human/individual capacity shortages in Zambia: risk assessment and risk management; climate change and adaptation specialists; atmospheric scientists; environmental lawyers and economists; environmental educators; predictive skills and integration. The main cross-cutting issues identified in this study were the ability to build individual skills and motivation to address environmental and sustainable development issues; coordinate multiple actors; develop and enforce policy, legislation and regulations; collect, manage and exchange information; and plan and manage monitoring and evaluation processes.

3.5.3 Needs analysis: Institutional capacity gaps

Despite valuable institutional developments (see section 4.2.3), there are still considerable gaps that need to be considered in the institutional architecture for managing the response to climate change in Zambia. As raised in the policy document analysis, the workshops and the questionnaires, there is a need to expand and **improve the national weather observation system**, for enhanced weather and **climate data collection, equipment, and transmission, including data exchange** from outstations to the central database.

There is also a need to strengthen disaster risk reduction and management systems, as well as improve **financial resources** needed to implement adaptation measures for climate change. Overall there seemed to be an inadequate integration of climate change, including the **gender-differentiated and HIV/AIDS aspects, into policies, plans and strategies at all levels**, including economic development planning. In conjunction with this, a well funded human resource development and a **comprehensive capacity development strategy** is needed, along with an appropriate action plan. Institutional capacity for monitoring and evaluation of such plans was also mentioned. Of concern in the workshop and questionnaire responses was the need to create a **specific** and locally contextual **legislative and policy framework**. **Public awareness and youth participation** infrastructure is needed at various levels, of which formal **curriculum development and integration** was seen as an urgent priority. A national **information management system and national database** was also suggested.

Regarding financial needs identified in the workshop and questionnaire data, **financial resourcing** to implement adaptation and mitigation measures was noted as being limited. Specifically, noticeable funding and other resource shortages for human resource

development; curriculum development; monitoring and evaluation of plans; technical and policy support; integrated multi-sectoral, multidisciplinary approaches to climate change vulnerability and adaptation; community sensitisation and media; consultation with NGOs, government, faith organisations; and information exchange among individuals and organisations. Other more specific institutional capacity gaps involved developing and **strengthening national education**, research institutions and programmes regarding climate change. Connected to this, the involvement of **local administration and community leaders in climate change education and training** was suggested. Finally although there is a variety of research and action regarding disaster risk reduction in Zambia, it was thought that the **management systems could be improved**.

Institutional capacity needs seemed to be the most spoken about and discussed in the workshop and questionnaires, perhaps revealing a clear lack of institutional support. The diversity of specific needs that require attention will benefit greatly from **improved collaboration efforts and partnerships** across stakeholders, disciplines and wider national and international institutions. This must be carefully considered when further developing action plans and implementation responses.

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 analysis begins with a summary of wider institutional arrangements for CCD, including any relevant research and development frameworks. It then discusses some of the current CCD initiatives and programmes in Zambia, and identifies some of the key stakeholders that could form part of a Zambia CCD knowledge co-production framework.

Following that, 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. It further 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 Zambia[18]

The three public universities in Zambia operate under legislation that makes them responsible to parliament through the Ministry of Education. The legislation confers academic freedom and managerial autonomy on each university. Academically, each university is responsible for determining its own programmes of instruction at undergraduate and postgraduate level, determining and regulating the requirements for admission, regulating and conducting examinations, and conferring degrees and other awards. The universities are also responsible for promoting, co-ordinating and controlling the direction of academic research. Each university engages its own staff, manages its own internal and institutional affairs, charges fees and carries out its business as it perceives fit. The universities derive their income from annual government grants, student fees and income-generating undertakings.

The higher education policy environment in Zambia is increasingly diverse and complex, with more institutions, students and regionalisation. It is regulated by autonomous, semi-autonomous and government institutions. The main regulator of higher education is the

[18] This short summary is derived from a SARUA 'Country Profile' compiled by Godfrey Hampwaye and Liberty Mweemba. 2011. "Chapter 15: Zambia," in *A profile of Higher Education in Southern Africa. Volume 2.* (www.sarua.org).

Higher Education Authority through the Ministry of Higher Education. There are various pieces of legislation, regulation and policy governing education in Zambia. Goals and objectives for the higher education sector have been set through consultative processes, involving all stakeholders (including civil society, non-governmental organisations and co-operating partners). In addition, Zambia's Poverty Reduction Strategy Paper (2007) identifies a series of broad roles for higher education.

4.2.2 Policy context for climate change

Zambia developed a National Climate Change Response Strategy (NCCRS) in 2010, to establish a coordinated national response to climate change. The NCCRS recognises that climate change is a cross-cutting issue demanding integration across the programmes of many government departments and stakeholders, including industry, private sector and communities. A National Climate Change Communications and Advocacy Strategy has also been developed. The NCCRS is intended to contribute also to the ongoing development of the draft National Policy on Climate Change.

Additional relevant national policies include the National Disaster Management Policy and National Disaster Management Act. Government is also committed to ensuring that the vulnerable communities who suffer the most are supported with safety-net initiatives which would enhance their adaptive capacity in reducing their vulnerabilities.

While climate change is addressed in Zambia's Second National Development Plan, there are large variations in the level of integration of climate change issues between different sectors. The Energy chapter includes several programmes for both adaptation and mitigation, including programmes for the development of renewable energy. However, these are very small compared to the budget allocation for major hydro-power expansion which may actually increase the vulnerability of the energy sector to climate change.[19] Zambia's Pilot Programme on Climate Resilience (PPCR) will place further emphasis on mainstreaming climate change into national development.

4.2.3 Institutional arrangements for climate change

The Government of Zambia has established the Disaster Management and Mitigation Unit under the Office of the Vice President, in order to respond nationally to disasters. The Climate Change Facilitation Unit (CFFU) was established in 2009 within the (now) Ministry of Lands, Natural Resources and Environmental Protection, to facilitate the development of the NCCRS and strengthen national coordination of all efforts intended to respond to the climate crisis, as well as integrate climate change responses into national strategic planning. With respect to governance of climate change, the NCCRS created a dedicated semi-autonomous coordinating

[19] http://sidaenvironmenthelpdesk.se/wordpress3/wp-content/uploads/2013/04/Zambia-Environment-and-climate-change-policy-brief-EEU-Final-version-2010.pdf

institution called a National Climate Change and Development Council (NCCDC), to be overseen by an Inter-ministerial Committee on Climate Change and administered by a committee of Permanent Secretaries. The Environmental Council of Zambia plays a key role in coordinating the National Communications to the UNFCCC.

Some of the major achievements of the CCFU are:

- National Climate Change Response Strategy (NCCRS) including the long-term institutional arrangement;
- Policy on Climate Change;
- Climate Change Awareness, including media training;
- Climate Change Communication and Advocacy Strategy – this is seen as an excellent document that is unfortunately not being used;
- Climate change mainstreamed into SNDP;
- Economics of Climate Change in Zambia study;
- Information needs assessment and identification of gaps; and
- Effective participation in climate conferences and capacity building within the Ministry.

The CCFU was closed down in favour of the interim Climate Change Secretariat. After many discussions, it was agreed that this should be set up as a stand-alone unit, headed up by Council of Ministers. This is now running the Pilot Programme for Climate Resilience (PPCR) in Zambia.

Stakeholder engagement: One of the goals of Zambia's NAPA was to promote an interdisciplinary approach to reduce climate vulnerability in the priority sectors, through active stakeholder engagement. The NAPA itself was formulated by a multidisciplinary assessment team, and community-level participatory vulnerability assessments were carried out in Eastern and Southern Province. Six national and regional stakeholder workshops were held to develop the NCCRS.

4.3 Research and development frameworks

The Zambia National Science and Technology Council coordinates all forms of scientific and technological research and innovation. The Ministry of Education, Science, Vocational Training and Early Education has recently stated that there has been inadequate funding for research and development in general, and lack of infrastructure and equipment to support R&D in the country. The National Institute for Scientific and Industrial Research has the mission to provide **solutions for sustainable socio-economic development of the nation through innovation, scientific and technological research.** Zambia is a member of the recently inaugurated Southern Africa Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL).

4.4 Some current CCD initiatives and programmes

While there are a number of CCD initiatives and programmes active in Zambia, driven by government, NGOs, donors, and the private sector, limitations and the required focus of this institutional analysis meant that only a few of these have been identified. Table 5 sets out some of these initiatives. This list is not comprehensive, but rather illustrative of how some of the priorities and needs identified above are already being addressed. More comprehensive national analysis would be able to expand the insights into existing active programmes.

Table 5: Some CCD initiatives and programmes in Zambia

Programme / initiative	Driving agency / department	Focus and time frame	Status / additional comments
YEN Zambia: ▪ CCD-related community development and project implementation	Implementer: ▪ Youth Environment Network	Ongoing: Sensitisation workshops, tree planting activities, waste management in Mongu, work hand-in-hand with council; translation of information into local language	▪ Ensure full participation of youths ▪ Requires improved collaboration and networking support
Adaptation to the effects of drought and climate change in agro-ecological zones 1 and 2 in Zambia	Implementer: ▪ Govt of Zambia ▪ UNDP ▪ GEF-LDCF	2009-Unknown Capacity development to conduct and apply climate risk assessments to planning processes; Adaptive practices in water and land management in drought-prone areas piloted	▪ Replication of demonstration projects; lessons learned component
UNICEF Climate Ambassadors	Implementer: ▪ UNICEF with Government of Zambia	▪ A network of television and radio stations radio programs ▪ Making of art objects from paper ▪ Collaboration with clubs such as Chongololo and Chipembele in training of ambassadors	▪ Have challenges in talking to elderly people, so there is a need for enhanced engagement of elderly people ▪ Require some capacity building
Strengthening Climate Information and Early Warning Systems in Eastern and Southern Africa for Climate Resilient Development and Adaptation to Climate Change - Zambia	Implementer: ▪ Government of Zambia, Meteorology Department ▪ UNDP ▪ Funded by GEF-LDCF	2012–2015 To strengthen the climate monitoring capabilities, early warning systems and available information for responding to climate shocks and planning adaptation to climate change in Zambia	▪ Includes developing the necessary systems for climate change-related information to permeate into decision-making processes

Programme / initiative	Driving agency / department	Focus and time frame	Status / additional comments
SADC mainstreaming environment and sustainability into African (MESA) universities chair in teacher education	Implementer: ▪ SADC and School of Education ▪ Dept of LSSE, UNZA	Ongoing: SADC Regional training programme in education for sustainable development (focusing on teacher education)	▪ It has a re-orientation focus towards sustainability across SADC teacher education institutions. Works with climate change experts to do this
Enviro Green Care: ▪ A Community Development ▪ Sustainable Production ▪ Capacity building Project	Implementer: ▪ Enviro Green Care	Ongoing: Works on climate change adaptation in central province: ▪ Chisamba and Chibombo areas; as well as sensitisation against unsustainable charcoal burning	▪ Also offer training in conservation farming in Central Province of Zambia; reforestation with local people in Central Province; fish farming in Chisamba area of Central Province
Renewable Energy-based Electricity Generation for Isolated Mini-grids	Implementer: ▪ National Electricity Utility of Zambia ▪ UNIDO ▪ UNEP ▪ GEF-funded	Ongoing: Technical and economic viability of different renewable energy technologies demonstrated in remote non-grid connected areas in the north of Zambia; including a biomass-gasification power plant, a small hydropower station; and a solar energy minigrid for solar lighting to support fishing and other productive activities at night	▪ Includes developing legal, institutional and policy framework that enhances commercial deployment of renewable energy based mini-grids in rural areas of Zambia
Green Enviro Watch: Research and capacity building	Implementer: ▪ Green Enviro Watch	Solid waste management in George Compound; conservation agriculture; wildlife and tourism advocacy; organisation of workshops and conferences.	▪ Would like to establish an alliance for CCD
Greening the tea industry in East Africa	Implementer: ▪ East African Tea Trade Association ▪ UNEP ▪ AfDB ▪ ProInvest	2012– unknown Climate proof vulnerable livelihoods & infrastructure. Includes sustainable land management activities in priority sub-basins of the Zambezi River; and index-based micro insurance for floods & droughts	▪ Will include a feasibility study on the engagement of the private sector in enhancing climate resilience in the agriculture sector and in the natural capital of priority sub-basins
UN Joint Programme on Climate Change and Disaster Risk Reduction (CCDRR),	Implementer: ▪ Government of Zambia and United Nations agencies	2012–2015: ▪ Improve institutional and individual capacities at national and local levels for an effective multi-sectoral and multi-level response to climate change	

Note: The list is not comprehensive.

Additional relevant initiatives include the Low Emissions Capacity Building Project, which will support the development of Nationally Appropriate Mitigation Actions (NAMAs), to reduce emissions from selected sectors; the UN-REDD Programme–Zambia Quick Start Initiative will prepare Zambian institutions and stakeholders for nationwide implementation of the REDD+ mechanism, including completion of a national strategy to reduce deforestation by 2013; and the million solar lanterns in rural Zambia project. The table above does not include many initiatives of government, for example through the work of the Zambia Wildlife Authority. Further expertise is being developed in the country through the work of NGOs, for example on DRR through Oxfam, and more broadly on climate change through the WWF Africa Regional Climate Change initiative.

Considering these initiatives, which do not constitute the full range of action on climate change by Zambian organisations, it is clear that the agencies of the United Nations are playing a valuable role in supporting the Government of Zambia in developing systems for DRR, and various adaptation-related actions specifically targeted at drylands, including piloting adaptive soil and water management activities. A further area where there is collaborative action is in exploring renewable energy technologies and the related enabling environment. It appears that NGOs have some conservation agriculture experience, as well as broader awareness raising and sensitisation on climate change. From the (incomplete) list above, it appears there is limited involvement of the private sector at this stage, apart from in the regional East African programme on enhancing climate resilience in the tea industry. However, other initiatives may well involve the private sector, this has not been identified in the current analysis. This shows the strong need for a database for registering activities on CCD, for coordination and to locate potential partners.

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

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

Zambia has a number of existing legislative and institutional platforms to respond meaningfully to climate change and engender CCD, including the National Climate Change Response Strategy, the National Disaster Management Policy and National Disaster Management Act. Although the policy direction is not specifically articulated as CCD, there is clearly emphasis on both adaptation and mitigation, as well as policy commitment for enhancing adaptive capacities of communities and reducing vulnerability. Further developing a common understanding of the core issues of CCD, and implications for the required knowledge co-production in Zambia, could be a consideration for inclusion in the National Policy on Climate Change under development.

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

- Life free from diseases, floods and reduced mushrooming of unplanned settlements
- Finding the process of solving climate change in the context of Developing Countries (DCs), e.g. building policies and focus in line with other policies in DCs who are doing something along the same lines
- Resilience aspect and low carbon development at the household level and in our work environments CCD should look at adaptation and resilience – it should be on building resilient structures and buildings, farming and agriculture
- Incorporation of political, economic and social aspects that are in line with CCD
- Heat-resilient building, agriculture and livelihood as well as improved water and sanitation
- Reduced vulnerability from the angle of disaster risks – the focus should be on climate proofing to reduce the risks and dangers of climate change. Adaptability is aimed at building legal and structural frameworks, compatibility is about generating ideas that will reduce carbon emission and carbon footprints
- Food security and sustainable supply of water; educating about CCD through scientific knowledge as a way of finding solutions; intensive tree planting to boost bio-sequestration

Of interest is the emphasis on practical measures, in line with the way in which the discussion was framed in the workshop – that is, in terms of what CCD means in daily life and work, and also of the relatively strong inclusion of mitigation aspects in the discussion. This was not always the case in other countries participating in the mapping study.

Within Zambian universities, there were somewhat different understandings of CCD, as shown by these extracts from the questionnaire data obtained from nine university respondents:

- The harmonisation of developmental efforts as policies toward climate change in the region
- It's a forum about climate change awareness, mitigation and adaptation measures, reduction of GHG
- Development which focuses on enabling systems and sectors to enhance climate resilience
- Development that considers climate mitigation opportunities
- Mainstreaming of climate implications into development to ensure resilience of low-carbon development for poverty reduction of per capita improvement
- This is more of development that minimises the harm caused by climate change
- Emphasises on strategies that embrace development goals and development that integrates CC
- It is a concept that is developed in order to reduce the level of greenhouse gases in the atmosphere that causes climate change and it also finds mitigation and adaptation measure that can be used in order to fight the change in climate
- Climate compatible development is the process where, in order to develop, there is need to adapt to climate change measures
- Development that puts into consideration various aspects of climate change

- Climate compatible development simply means development that has less or no effects on the environment and well-being of Mother Earth. Somehow it has to do with issues of sustainable development. Making sure development is in harmony with the well-being of Mother Earth
- This is the emphasis on climate strategies that embrace development goals and development strategies that integrate the threats and opportunities of a changing climate. As a result, it heralds a new generation of development processes that safeguard developmental climate impacts
- It is the integration of development goals and the climate strategies of mitigation and adaptation
- Development strategies should integrate the threats and opportunities presented by a changing climate

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 both **adaptation *and* mitigation**, and between climate compatible development and **sustainable development**. It is also apparent that **the concept of CCD is relatively new** to some of the stakeholders. The context of those researching or implementing and adapting CCD will influence how CCD is understood, as well as influence meaning making and understanding of the concept. This has important implications for knowledge co-production processes, and will require careful engagement to develop mutual understanding in such processes.

National stakeholders and university stakeholders seemed to have a strong understanding of CCD and the needs and potential gaps in future CCD responses. Of interest, as noted in section 3 above, are their interpretations of the priorities and needs, which were not mainly contextually defined nor overly influenced by disciplinary interest / mandate and/or role and type of responsibility, but rather focused on cross-cutting themes and response to Zambia's key climate and development challenges.

While Zambian participants in the mapping study were in agreement broadly with the concept of CCD, several people highlighted that adaptation should be the main priority in the country's development goals, while at the same time embracing the opportunities of cleaner energy and other low carbon technologies. This echoes the NCCRS (2010: iii), which states that "Although climate change mitigation is not a priority area for Zambia since the country is a low emitter, some mitigation actions can go a long way in cushioning the country against climate change extremes as well as addressing some current developmental challenges the country is facing. In addition, Zambia stands to benefit monetarily from the Clean Development Mechanism (CDM) or its future successor as well as from a future REDD+ mechanism as a result of implementing mitigation measures. Thus, the Strategy has also captured some mitigation actions that Zambia can undertake."

> *"CCD is an excellent concept, I really like it. Climate is not going to go away. It will remain with you for the rest of your life, it is not a transient issue. The globe has to fix this problem. Our priority remains adaptation, but there are many opportunities that we can embrace as a win-win situation."*
>
> Experienced university professional, Zambia

4.5.2 Current research related to climate compatible development

4.5.2.1 General view

Zambia has a growing legislative response to climate change, which includes an integrated disaster risk reduction capability, enabling more adaptive, responsive, and potentially reflexive forms of CCD. Mitigation responses focus primarily on energy, with little mention of transport and industrial transformation. Multidisciplinary research agendas also seem to be relatively non-existent, with several participants calling for improved collaborative approaches to research. Despite progress with the policy and legislative framework for CCD, there seems to be limited implementation. This is consistent with most, if not all countries in the region, where implementation has largely been limited to pilot projects, usually donor-funded, involving government, researchers, NGOs and civil society/communities.

A detailed database search of all research published on climate change / sustainable development research in Zambia would provide substantive detail on what research is already being conducted in Zambia. 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 Zambia.

Zambia's 2007 National Adaptation Programme of Action (NAPA) shows the following recent research-based initiatives for climate change in Zambia (taken from the reference list of the report):

- Siamwiza, M.N. 1998. "The Effects of Desertification on Local Communities: The Case of Lusitu". Paper Presented at the First National Forum on the Development of Zambia's National Action Programme for the Convention to Combat Desertification and Mitigate the Effects of Drought; Pamodzi Hotel, Lusaka.
- CEEEZ. 2006. "Climate, and Climate Change/Variability". Centre for Energy and Environment, Lusaka.
- Carney, D. 1998. "State of Environment in Zambia 2000". ECZ, Lusaka, Zambia. Sustainable Livelihoods. DFID. London.
- GRZ. 2002. "Zambia National Action Programme for Combating Desertification and Mitigating Serious Effects of Drought in the Context of the United Nations Convention to Combat Desertification". Lusaka: MTNER.
- IUCN. 2007. "Climate Change Vulnerability Assessment in Zambia". Climate Change and Development Project, World Conservation Union.
- GRZ, MTENR. 2002. "Zambian Action programmes for combating Desertification and mitigating serious Effects of Drought in the Context of the United Nations Convention to combat Desertification". Florumy.
- Muchinda, M.R. 2001. "Drought Incidence in Zambia Over the Thirty-year Period – 1970 – 2000". Paper Presented at the 2nd International Conference on Tropical Climatology, Meteorology and Hydrology, December 12-14, 2001. Brussels, Belgium.

The above list shows a strong focus on drought and desertification, with several of the reports being linked to the development of Zambia's National Action Programme for the UN Convention to Combat Desertification (UN-CCD).

Zambia's Initial National Communication to the UNFCCC (2002) shows the following relatively recent research-based initiatives for climate change in Zambia (taken from the reference list of the report):

- Daka, J.B. 1999. "Climate Change Mitigation analysis for the Agriculture Sector". Report prepared for the Environmental of Zambia, Lusaka.
- Yamba F.D. and E. Matsika. 2002. "Sustainable Development Goals and Indicators from Clean Development Mechanisms (CDM) Perspectives". Lusaka: Centre for Energy, Environment and Engineering Zambia Limited.

There are several initiatives that are being taken to build climate change capacity. Some of these capacity building initiatives are:

- School of Mines and Mineral Sciences, Dr Cosmas Lungu, email: cosmas.lungu@cbu.ac.zm. Postgraduate course for environmental engineers, skills development, capacity building.
- Lusaka Regional Centre of Expertise (LRCE), School of Education, Department LSSE (UNZA), Mirriam Moonga, email: mirriammoonga@unza.zm. Research, community engagement, training and capacity building. Brings to together various stakeholders on ESD Policy developments, regulatory activities and project implementation. Develops capacities on ESD and sensitise the public.
- Ministry of Science and Technology, Vocational Training. National Remote Sensing Centre, Dr Augustine Mululwa, email: amulolwa@gmail.com. SASSCAL-climate change adaptive land use programme with many components. Remote sensing for UN-REDD+ programme through forestry department provides internships for undergraduate students, providing technical support to MSc and PhD students.
- UNITE4CLIMATE (UNICEF), Peter Slavin Patrick Slavin, Chief Communications UNICEF Zambia, email: pslavin@unicef.org. Empowering youths on climate change and HIV AIDS. Media training on climate change. Project implementation through workshops, seminars, radio programmes for community outreach.

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

Table 6: First ten articles listed with 'Climate Change' and 'Zambia' in the search, with first author origin

Article	Origin of first Author
Thierfeldera, C. and P.C. Walla. 2010. "Investigating Conservation Agriculture (CA) Systems in Zambia and Zimbabwe to Mitigate Future Effects of Climate Change," *Journal of Crop Improvement* (24)2: 113–121.	Zimbabwe
Kurjia, P., D. Nanja and R. Stern. 2011. "Exploring daily rainfall data to investigate evidence of climate change in southern Zambia and its implication for farmers in the area," Biometrics and Research Methods Teaching Resource Case Study 7. Nairobi, Kenya: ILRI.	Kenya
Magadza, C.H.D. 2011. "Indications of the effects of climate change on the pelagic fishery of Lake Kariba, Zambia–Zimbabwe," *Lakes & Reservoirs: Research & Management* 16(1): 15–22.	Zimbabwe

Article	Origin of first Author
Marshall. B.E. 2012. "Climate change does not explain historical changes in the pelagic ecosystem of Lake Kariba (Zambia–Zimbabwe)," *Lakes & Reservoirs: Research & Management* 17(4):265–274.	Zimbabwe/New Zealand
Nyanga, P.H., F.H. Johnsen, J.B. Aune and T.H. "Kalinda Smallholder Farmers' Perceptions of Climate Change and Conservation Agriculture: Evidence from Zambia".	Zambia/Norway
R.D. Stern and P.J.M. Cooper. 2011. "Assessing Climate Risk and Climate Change Using Rainfall Data – A Case Study from Zambia," *Experimental Agriculture* 47(2): 241–266.	United Kingdom
Thurlow, J., T. Zhu, and X. Diao. 2012. "Current Climate Variability and Future Climate Change: Estimated Growth and Poverty Impacts for Zambia," *Review of Development Economics* 16: 394–411.	Finland
Chaudhury, M., O.C. Ajayi, J. Hellin and H. Neufeldt. 2011. "Climate change adaptation and social protection in agroforestry systems: Enhancing adaptive capacity and minimising risk of drought in Zambia and Honduras". ICRAF Working Paper No. 137. Nairobi: World Agroforestry Centre. http://dx.doi.org/10.5716/WP11269.PDF	Kenya
B.E. Marshall. 2012. "Does climate change really explain changes in the fisheries productivity of Lake Kariba (Zambia-Zimbabwe)?" *Transactions of the Royal Society of South Africa* 67(1): 45–51.	Zimbabwe

While this Google Scholar search reveals a variety of different research publications available regarding climate change in Zambia, only one of the first ten articles sampled here had a Zambian first author, which was also a Zambian/Norway collaboration/joint fellowship. It must also be noted that seven of these papers were authored by researchers from other nearby African countries, indicative of a strong research presence regarding climate change in the region, despite the limited presence of Zambian researchers in this rapid literature assessment. This finding is surprising as there is active Zambian-based climate related research underway in Zambian universities and other institutions. In addition to this, climate change research has been actively commissioned to develop:

- The initial National Communication (INC) to the United Nations Framework Convention on Climate Change (UNFCCC), 2002;
- Zambia National Adaptation Programme of Action (NAPA), 2007;
- National Capacity Self-Assessment (NCSA) for implementation of the Rio Conventions, 2007;
- Zambia National Climate Change Response Strategy, 2010;
- Zambia Sixth National Development Plan, 2011; Pilot Programme for Climate Resilience in Zambia – various documents, 2012;
- Climate Risk Capacity Building in southern Africa: Zambia Needs Assessment, March 2012.

The majority of the articles/chapters focus on adaption (specifically rainfall and food security issues).

Literature screened from the National Climate Change Response Strategy (NCCRS) (2010) shows that many of the sources used for national environmental and climate change reporting were provided by government and other organisations. Several of these sources were produced by local researchers or research groups.

The most recent publications used by the NCCRS (2010) authored by Zambian researchers include the following:

- Jain S. 2007. "An empirical economic assessment of the impacts of climate change on agriculture in Zambia". The World Bank, Policy Research Working Paper 4291.
- Kamanga A., P. Moono, G. Stresman, S. Mharakurwa and C. Shiff. 2010. "Rural health centres, communities and malaria case detection in Zambia using mobile telephones: A means to detect potential reservoirs of infection in unstable transmission conditions," *Malaria Journal* 9: 96.
- Wandiga, S.O., M. Opondo, D. Olago, A. Githeko, F. Githui, M. Marshall, T. Downs, A. Opere, C. Oludhe, O.G. Ouma, P.Z. Yanda, R. Kangalawe, R. Kabumbuli, J. Kathuri, E. Apindi, L. Olaka, L. Ogallo, P. Mugambi, R. Sigalla, R. Nanyunja, T. Baguma and P. Achola. 2010. "Vulnerability of epidemic malaria in the highlands of Lake Victoria basin: the role of climate change/variability, hydrology and socioeconomic factors," *Climate Change* 99: 473–497.

It is not surprising that the NCCRS (2010) relied mainly on these government based reports, many of which were in all likelihood commissioned by the Ministry of Tourism, Environment and Natural Resources, such as the sectoral vulnerability assessments (Forestry, Health, Livestock and Agriculture). It is also likely that a number of the active researchers based at Zambian universities and other research nodes contributed to the development of the NCCRS, although this is not apparent from the reference list. However, it does point to the need for these contributions to be made explicit, to showcase Zambian research, and it also indicates the need for additional support to Zambian researchers to enhance their level of publication in peer-reviewed journals**.**

4.5.2.2 University-based research

The Zambia 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 faculties and departments involvement in climate change research

Faculty / School / Centre	Department	Programmes / Institutes
UNZA Faculty of Science	Physics	Energy and Environment Research Group (EERG); three sub-groups: Solar Energy Materials and Photovoltaic Systems, the Climate Group, and Distance learning in Sustainable Energy Engineering Group
Faculty of Science	Statistics and Population Studies	Adaptation: Flood Analysis, and a climate change Research Group

Faculty / School / Centre	Department	Programmes / Institutes
UNZA: School of Education	Languages and Social Sciences Education	Geography Education and Environmental Education unit
Copperbelt University: School of Mathematics and Natural Sciences	Biological Sciences	BSc in Biological Sciences MSc in Biology Sciences Involved in assessment of climate vulnerability in Kitwe City of Zambia, as well as livelihood impact of climate
Mulungushi University: Disaster Management Training Centre	Disaster Management Training Centre	Includes dedicated module on CC and DRR B Enviro. Studies
UNZA: School of Agricultural Sciences	Soil Science	BSc. Soil Science: Land and water management; Agriculture and Renewable Energy programme
UNZA: School of Humanities and Social Sciences	Development Studies	Bachelor of Arts, includes module on global environment and sustainable development Vulnerability assessment in Agro-ecological regions I and II of Zambia Climate smart Agriculture in southern Zambia

Note: Table is likely to be incomplete, and is therefore indicative rather than definitive.

Table 7 above shows both faculty-based diversity and departmental level diversity of participation in CCD-related research and teaching at the University of Zambia, Copperbelt University and Mulungushi University. The table also shows that there are some *dedicated research programmes* at faculty / school level of relevance to climate change and CCD, including the Climate Group in the EERG, located in the Physics Department of UNZA; as well as the dedicated programme within the Disaster Management Training Centre at Mulungushi University.

The Energy and Environment Research Group (EERG) includes the Solar Energy Materials and Photovoltaic Systems Group, which gets financial support from the International Programme in Physical Sciences (IPPS) based at Uppsala University in Sweden. Its major activities have been in both undergraduate and postgraduate training in Solar Energy Materials and applications. The group has graduated two PhD students, 10 MSc students have been enrolled since 2007 and a number of undergraduate projections have been done at fourth year level of study in Physics. Some of the major activities in the group include undergraduate teaching and research projects supervision in Solar Energy Materials and Photovoltaic research, Doctoral and Masters Degree training and research in energy and environment related fields, consultancy work with government and private institutions, collaborative work with regional and international institutions, and research in sustainable energy development such as the optimisation of Solar Photovoltaic systems and the analysis of the selective solar absorbers.

The EERG's Climate Group has been involved in Climate Modelling and Weather predictions according the Agro-ecological Zones. Its major activities include meteorological data analysis, statistical and dynamical down-scaling, detection and attribution of climate change, climate

change impacts, mainstreaming climate change in various national institutions and government.

The Distance Sustainable Energy Engineering (DSEE) group is involved in the training of Master of Science students (MSc) in Sustainable Energy Engineering through e-learning with the Royal Institute of Technology (KTH) in Sweden. It was formed in 2006 after a collaborative effort of Dr. Geoffrey Munyeme with KTH colleagues. The main purpose of the group is to provide state-of-the-art education in the field of power generation by means of economically and environmentally sustainable systems and technologies. The programme runs parallel with programmes at KTH and students are connected on-line for lectures in English.

Workshop and questionnaire data showed that there is research taking place on a number of topics that are related to CCD, including (but not limited to) those outlined in Table 8.

Table 8: Research projects currently being undertaken in response to CC and the need for CCD

Institution, Faculty, Department	Research project	Researcher/s or Deans / HODs	Type of research project
University of Zambia, UNZA: School of Education, Department of Language and Social Sciences Education (LSSE)	Gender and climate change	Mirriam Moonga mirriammoonga@unza.zm	Has a focus on CCD and gender issues (mitigation, adaptation and development)
UNZA: School of Education, Department of LSSE	A review of the CCD content in the curriculum in Zambian education system	Manoah Muchanga and Matilda Nakazwe matildanakazwe@hotmail.com	Existing Climate Change content in Zambian school and tertiary education curriculum
UNZA: Lusaka Regional Centre of Expertise (LRCE), School of Education, Department LSSE (UNZA)	Capacity development on ESD	Mirriam Moonga mirriammoonga@unza.zm	Research, community engagement, training and capacity building on education for sustainable development (ESD)
UNZA: School of Education, Department of LSSE	SADC mainstreaming environment and sustainability into African (MESA) universities chair in teacher education	Prof. C.M. Namafe mutumban@yahoo.com	Re-orientation focus towards sustainability across SADC teacher education institutions. Works with climate change experts to do this

Institution, Faculty, Department	Research project	Researcher/s or Deans / HODs	Type of research project
Copperbelt University: School of Mathematics and Natural Sciences, CBU	Assessment of campus carbon footprint at Copperbelt University	Professor Overson Shumba overson.shumba@cbu.ac.zm	Focus is on institutional environmental and operational sustainability
Copperbelt University: School of Mathematics and Natural Sciences	Assessment of environmental and social-economic drivers of climate vulnerability in the slums of Kitwe town	Dr George Kasali kasali_george@yahoo.com	Strengthens resilience of Kitwe Municipality to climate impact
UNZA: School of Education, Department of LSSE	Research on effects of mining on CC	Muyunda Joseph Muyauka muyundajmuyauka@yahoo.co.uk	Published article on environmental impact of small scale mining and quarrying in Lusaka
UNZA School of Natural Sciences, Physics Department	Sustainable Energy Technology: Solar energy	Prof. Prem Jain pjain@unicrolink.zm	Range of topics under Energy and Environment umbrella; Solar Energy Materials and Photovoltaic research; Research and project implementation-reduction of carbon emissions; climate modelling, statistical and dynamical down-scaling, detection and attribution of climate change, climate change impacts
Mulungushi University, Disaster Management Training Centre	DRR and climate adaptation	Dr Mitulo Silengo mitulo.silengo@gmail.com	DRR, environment and natural resources

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

Table 8 shows a range of research projects and programmes related to CCD. The mapping study data, which is highly likely to be incomplete, given the constraints of the study, indicates particular research strength at two of UNZA's departments: Language and Social Sciences Education, and the Physics department. Copperbelt University's School of Mathematics and Natural Sciences has been involved in urban climate vulnerability assessment, as well as

research on the university's carbon footprint. The data did not provide any entries for Mulungushi University, and it is not clear to what extent the considerable training experience and expertise in the Disaster Management Training Centre at MU is underpinned by research.[20] Despite the data limitations, it is evident that Zambia has considerable depth of expertise in certain areas of climate change research, including the physical science-related areas of the EERG, and the teaching and curriculum related research in the LSSE department.

Associated with these research programmes and other smaller scale research initiative are a number of active researchers, who were mentioned in workshop and questionnaire data. Please see Appendix B for a list of these researchers. The list indicates that while some researchers have only been active in the field of climate change and CCD for less than five years, Zambia has a number of researchers with over ten years experience specifically on climate change and which is relevant for CCD. This shows that while there is a group of emerging researchers in the field, Zambia is fortunate enough to have a small cadre of very experienced researchers working on different aspects of climate change.

Gender and PhD profile: Of those responding to the questionnaire, five were female and six male, showing that there is participation of women researchers in climate related questions in Zambia. Respondents to the questionnaire had between 3–14 years experience in their disciplines, and only two had ***five or more years of experience with climate change research*** / climate compatible development research. This is likely to be an effect of the limitations of the study data, rather than a definitive situation, given the existence of centres such as the EERG and the DMTC, as well as the development of climate-related policies since 2002.

4.5.2.3 Centres of Expertise

Some centres of expertise[21] in climate change and climate compatible research in Zambia were identified as being:

- University of Zambia: Agricultural Sciences, Languages and Social Science Education, Development Studies and the Lusaka Regional Centre of Expertise in Education, UNZA;
- Copperbelt University: School of Mathematics and Natural Sciences;
- Mulungushi University: Disaster Management Training Centre;
- Disaster Management and Mitigation Unit;
- Climate Change Facilitation Unit (CFFU);
- National Climate Change and Development Council (NCCDC);
- UNESCO Chair in Renewable Energy and Environment was set up in the Physics Department and has been serving as a Centre of Excellence in the fields of Solar Energy and Climate Change; and

[20] Unfortunately, the MU website does not contain this information either.

[21] 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 research network refers to interest-based research groupings that convene regularly to discuss or debate research or concerns that are relevant to CCD.

- National Institute for Scientific and Industrial Research.

See also the table in Appendix E, which summarises sources of expertise for CCD in Zambia.

Research Networks cited include:

- Zambia Climate Change Network (ZCCN);
- Lusaka Regional Centre of Expertise;
- Nationally Appropriate Mitigation Actions (NAMAs), to reduce emissions from selected sectors;
- The UN-REDD Programme–Zambia Quick Start Initiative;
- Environmental Council of Zambia, which plays a key role in coordinating the National Communications to the UNFCCC; and
- Southern Africa Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL).

4.5.3 Curriculum innovations and teaching for CCD

Some HE institutions in Zambia have made commendable strides in integrating climate change into the curricula, including the Energy and Environment Research Group (EERG) at the Physics Department, UNZA, which has been at the forefront in integrating climate change studies in the curriculum over the past two decades both at the undergraduate and postgraduate levels; and the Copperbelt University which has made progress in integrating climate change into the environmental engineering and biological studies curricula.

Questionnaire responses indicate that all the participants from the various universities showed a high a willingness to get involved in new issues such as climate change and/or climate compatible development with regards to their curriculum innovation and teaching; the questionnaire data further showed that staff ability for this involvement was good.

University of Zambia and Mulungushi University showed the greatest incidence of CCD issues and opportunities incorporated into their current curriculum. Few respondents claimed a high competency for inter- and/or transdisciplinary teaching approaches to CCD. All three universities offer courses that clearly focus on development of social and/or technical innovation and ethical actions, with University of Zambia's Language and Social Sciences Education department focusing specifically on these themes.

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 – rather, identification of climate change content in courses requires comprehensive engagement with those that teach the courses, beyond the scope of this study. Data presented is therefore limited by this factor.

Table 9: Courses oriented towards climate compatible development

Course/s being developed and run	Who is involved	Type and level of course
UNIVERSITY OF ZAMBIA, Physics Department ▪ Solar Energy Materials and Photovoltaic research ▪ Various energy and environment related fields ▪ Sustainable Energy Engineering Group UNIVERSITY OF ZAMBIA ▪ Statistics and Population Studies: Environmental Education	Prof Prem Jain Isaak Naama	Undergraduate Postgraduate Distance learning Undergraduate course
UNIVERSITY OF ZAMBIA ▪ School of Education, Department of Language and Social Sciences Education (LSSE), Gender and climate change course (second year undergraduate course)	Mariam Moonga	Undergraduate course
MULUNGUSHI UNIVERSITY ▪ Department of Disaster Management Training Centre: Course titled: "Environment and Energy"	Francis Sichilima	Undergraduate course
COPPERBELT UNIVERSITY ▪ School of Mines and Mineral Sciences, climate change course for environmental engineers	Dr Cosmas Lungu	Postgraduate course
UNIVERSITY OF ZAMBIA ▪ School of Education, Department of Language and Social Sciences Education Environment and Development Course	Joseph Muyauka Muyunda	Undergraduate course
COPPERBELT UNIVERSITY ▪ School of Mathematics and Natural School, Course on climate change and environmental education at fourth year	George Kasali	Undergraduate course
UNIVERSITY OF ZAMBIA ▪ School of Education, Department of Language and Social Sciences Education. Courses on Solar Energy, Climate Change and Gender	Albert Chinjenge	Undergraduate course
UNIVERSITY OF ZAMBIA ▪ School of Education, Department of Language and Social Sciences Education Geography Education and Environmental Education	Matilda Nakazwe	Undergraduate course
UNIVERSITY OF ZAMBIA ▪ School of Humanities and Social Sciences: ▪ The global environment and sustainable development DS945 – third and fourth year	Matildah Kaliba	Undergraduate course

Note: This list is not exhaustive; it can be updated and extended.

In addition to the above, Manoah Muchanga of the UNZA LSSE department has been piloting a UNESCO teaching tool on climate change in the classroom. The Bachelor of Environmental Studies (BES) at Mulungushi University (MU) focuses on current environmental issues facing

the world today, including climate change mitigation and adaptation, disaster risk reduction, waste management, pollution, land degradation, energy use and sustainable resource use. The Disaster Management Training Centre offers a variety of short courses, including 'Disaster Risk Reduction and Management for Senior Government Officers, Provincial and District Administrators and Non-Governmental organisation Executives'. The School of Agriculture and Natural Resources at MU, which was only started in 2008, offers a Bachelor of Land and Water Resources Management that includes entrepreneurial training to facilitate self-employment options.

As shown in Table 9, all three universities (UNZA, CBU and MU) are involved in designing and running courses that integrate climate change and CCD aspects into their modules. The EERG at UNZA has graduated a number of PhD and MSc students – numbers provided on the website are for two PhD students and 10 MSc students since 2007, although it is not clear how up to date these numbers are – the actual number of postgraduate degrees conferred through the EERG may be higher. Major activities in the group include undergraduate teaching and research projects supervision in Solar Energy Materials and Photovoltaic research, as well as Doctorial and Masters Degree training and research in energy and environment related fields. UNZA's LSSE department offers an undergraduate climate change and gender course, which reveals some interdisciplinary innovation for University of Zambia.

A further relevant innovation, particularly given the call for greater leadership on CCD, is the Mulungushi University signature course entitled 'Ethics and sustainable behaviour in society'. This includes a unit on Responsible, Accountable, Relevant and Ethical (RARE) principle-based value system personal leadership. The data also shows that most of the lecturers involved in climate change-related research are involved in some sort of curriculum innovations in this area. This highlights the need to understand more clearly the relationship between climate change and CCD research and curriculum innovation, which implies a need to examine *how research drives curriculum innovation* in new knowledge areas such as CCD in universities.

As can be seen from Table 9, both UNZA and Mulungushi University appear to have **dedicated CC / CCD courses at postgraduate level,** while the rest of the courses are only offered to undergraduates. **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 (especially Section C) in Appendix C can be used for this purpose. The questionnaire would, however, need 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 existing programmes or the 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 as being potentially effective for CCD in courses encompassed the following, as provided in the questionnaire data:

- "Field assignments can be one of the effective teaching methods for imparting knowledge about climate change"
- "We use a combination of lectures, field trip, research, open class discussion and written assignments"
- "Lectures and field work" (Same response for three respondents)
- "Involved in advocacy by MUESA, writing flyers, as well as traditional lecture methods"
- "Laboratory works, publication of brochures, and presentations"
- "We adopt a Learner Centred Approach"
- "I usually invite an expert dealing with practical solutions in the cooperate world to give a talk or seminar to the students"

It seems that contextualising and embodying theory through field assignments seemed to be a common form of teaching method used in the various courses offered in Zambian universities. Those respondents involved in more interactive, social forms of learning, i.e. those from student organisations, focused on the significance of learning obtained through advocacy work and drafting flyers etc. The EERG in the Physics Department at UNZA has a sub-group that focuses on Distance learning in Sustainable Energy Engineering Group.

Inter- and transdisciplinary approaches to curriculum innovation are discussed in section 5.

4.5.4 Community and policy outreach

While questionnaire data showed only two university staff actively contributing to the policy processes in Zambia, Professor Prem Jain of UNZA's Physics Department was for several years the Technical Coordinator of the Climate Change Facilitation Unit (CFFU) at the Ministry of Tourism, Environment and Natural Resources, which was the leader in developing the National Climate Change Response Strategy. In addition to this high-level policy engagement role, two lecturers from UNZA's Department of Education, Manoah Muchanga and Mariam Moonga, highlighted their role in policy development, mainly through recommendations from their research. The workshop and questionnaire data indicate that despite positive developments, there is still the need in Zambia to improve climate change policy research.

In contrast to the more limited policy contributions indicated in the data, the workshop and questionnaire data showed that several respondents were involved in community outreach or engagement. Researchers such as Isaak Naama, Matildah Kaliba and Jane Zelia Mbewe are involved in supporting climate/environment related student clubs and networks. Others such as George Kasali and Kabaso Nkandu are involved in district council engagement from local community members, to ward councillors and local municipality. At Mulungushi University, students pursuing environmental studies have the option to visit Mopani Mines in Kitwe, where students contribute to education programmes with the company and the surrounding community on the impacts of climate change, and explore ways in which the mines could engage CCD.

4.5.5 Student involvement

The University of Zambia cited higher levels of student involvement in climate change and CCD-related matters, than other departments who responded to the questionnaire. The

following student organisations were cited as having potential for engaging more with CCD issues:

- University of Zambia Environmental Education Student Association – UNZAEESA;
- Copperbelt Environment Student Union;
- Mulungushi University Environmental Education Student Association – MUEESA;
- University of Zambia Environmental Education Association;
- University of Zambia Youth United Nations Association; and
- University of Zambia Natural Resources Association.

While no further information was provided, the Zambia workshop was enlivened by strong participation on the part of a number of students and youth organisations, indicating fertile ground for further enhancing student involvement in CCD-related matters.

4.5.6 University collaboration and networking

Researchers responding to the questionnaire and discussions in the workshop identified the following important **research networks** that university staff were either involved in, or which had potential for future involvement, which supported knowledge production and use relevant to climate change:

- Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL) http://www.sasscal.org/;
- Zambia Climate Change Network (ZCCN);
- Lusaka Regional Centre of Expertise;
- Nationally Appropriate Mitigation Actions (NAMAs), to reduce emissions from selected sectors;
- UN-REDD Programme–Zambia Quick Start Initiative; and
- Environmental Council of Zambia plays a key role in coordinating the National Communications to the UNFCCC

4.5.6.1 Potential knowledge co-production partners

The institutional analysis also shows that there is good *potential* for knowledge co-production partnerships, with numerous knowledge partners existing for CCD knowledge co-production in Zambia.

Table 10 shows these 'mapped' out (as per workshop discussions) with different roles ascribed to different partners involved in the knowledge co-production process.

Table 10: Roles ascribed to the different partners involved in the knowledge co-production process

Partners	Roles
▪ Universities	▪ Generation of new knowledge through research and leading research practice ▪ Engaging in curriculum review practice to mainstream CCD ▪ Facilitate institutionalisation of Climate Change and Environmental Education in all faculties ▪ Awareness creation through teaching, learning and training ▪ Translating Environmental Education and climate change knowledge into local languages ▪ Engage in public service. i.e. community projects and engagement ▪ Monitoring and evaluating students prior and post-knowledge on CCD through administering pre- and post-questionnaires to them as they enter the university and as they are about to graduate and/or after undergoing a CCD-related course
▪ Civil societies, NGOs and government ministries	▪ Co-financing and implementing CCD projects and programmes
▪ Local communities and environmental clubs	▪ Collaborate with HEIs to raise public awareness, behavioural and social change
▪ Business and industry	▪ Funding university projects on CCD through corporate social responsibility
▪ Faith organisations	▪ Partner with HEIs to raise moral and value- based environmental protection
▪ Traditional leaders	▪ Support HEIs' research/teaching /learning on the role of indigenous knowledge/cultural practices in CCD

Engaging with such knowledge partners in / for knowledge co-production requires capacity for collaboration. The discussion on university collaboration (and data on this in the questionnaires) revealed the 'status quo', also outlining possibilities of how such collaboration could be enhanced. These insights are captured in Table 11.

Table 11: CCD Knowledge co-production partners (potential, with some already actualised)

Collaboration inside the university	Collaboration between universities in country	Collaboration with partners nationally	Collaboration regionally (in SADC region and in Africa)	Collaboration internationally
UNZA: There is a strong inter-faculty or departmental collaboration in terms of research as well as curriculum development CB: Inter-school collaborations within the university in teaching, research on	UNZA: Establishment of research groups between MU and CB in terms of climate change can easily be initiated given the expertise at both institutions CB: In the process of creating a collaboration	UNZA: UNESCO The university stands a better chance to partner with international organisations and institutions on climate change/compatible development International Institute for Environment and Development (IIED), World Bank, NGOs CB: The DTMC have	UNZA: The university has more opportunities regionally by engaging other countries and universities in the region on CCD COMESA, SADC	UNZA: UNESCO, CDKN - DFID CB: At international level, the Dean for DTMC has been representing the school at UNFCCC conferences University has opportunities only with the NGOs especially

Collaboration inside the university	Collaboration between universities in country	Collaboration with partners nationally	Collaboration regionally (in SADC region and in Africa)	Collaboration internationally
climate compatible development MU: MUESA has been creating awareness of climate change and other environmental issues	with UNZAEESA MU: Nothing is been done yet but recently through MUESA, we have planned to carry out an outreach to UNZA-EESA	been working in conjunction with UNEP and USAID on research programme that is in knowledge production MU: Chances of acquiring funding through partners such as the regional bloc with a focus on climate change (SADC, COMESA)		UNDP and United Nations agencies on climate change, but not with universities

It appears that currently there is limited engagement in collaborative research between Zambian universities, but the opportunity to establish climate change-focused research groups, for example between Mulungushi University and Copperbelt University, is felt to be good, given the expertise at the relevant institutions. Earlier sections of this report have indicated the different areas of CCD experience at all three of the public universities, which seem to be complementary rather than duplicating, thus providing a landscape for collaborative research across the disciplines. There is also clearly scope for enhanced collaboration on the part of HEIs for CCD knowledge co-production with other universities in the SADC region, and further afield in Africa. Section 5 provides further discussion on barriers and constraints to collaborative research.

4.5.7 University policy and campus management

The questionnaire responses provided limited information on university policy for climate change and CCD. At Copperbelt University, there was mention of a Strategic Sustainability Plan (2014 – 2018) in which Sustainable Operations and Capacity Development for the university is outlined. Mulungushi University (MU) has some aspects of policy that focus on strengthening student participation in environmental issues and climate change. A respondent from MU explained that the university policy states that students pursue the frontiers of knowledge by having a clean, green environment that is free from pollution. The University of Zambia's mission statement and vision incorporate sustainability aspects.

With regard to campus management at the universities, respondents from CBU mentioned that they have undertaken a carbon footprint project. At MU it was stated that the university engages in activities such as farming at the school farm. Lecturers discuss CCD and application of theory, and offer brochures by MUESA on advocacy, awareness in environmental issues. Respondents from UNZA mentioned the Keep UNZA Clean Campaign, which apparently is conducted by all university members, both staff and students.

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

4.6.1 Co-ordination, collaboration and improved partnership building

Discussions from the workshop revealed several key issues with regards to the multi-faceted process of CCD in Zambia. A fundamental issue was the need to develop a detailed data base containing all organisations engaged in CCD-related initiatives in Zambia. Participants felt that multi-sectoral and interdisciplinary incorporation into all CCD projects was crucial.

The mapping study has identified scope for enhanced collaboration on the part of Zambian HEIs for CCD knowledge co-production, both within the country, as well as with other universities in the SADC region, and further afield in Africa. Generally, participants noted the need for greater coordination and collaboration amongst the range of stakeholders on CCD, including building partnerships across disciplines and out into the community. Disjointed engagement between policy makers and researchers was another point of concern and recommended area of attention.

> *"We need to work together to tackle this climate change issue, but instead, what do we do, we work separately, we see each other to be competitors … it's like you are fighting one enemy, you need to work together to do that, but instead you try to fight the enemy on your own."*
>
> Zambia youth organisation spokesperson

4.6.2 Strengthen and expand understandings of CCD

As shown in section 4, CCD is a relatively new concept to some stakeholders and university researchers, while for a few others it was a very familiar and integral part of their research and teaching. Workshop participants stressed the importance of integrating CCD into Zambia's education system. Environmental Education seemed to be the strongest area for potential enhanced CCD understanding and further expansion.

4.6.3 Capacity building for CCD and staffing

There was a strong call for capacity building, particularly for undertaking research but also for integrating CCD into curriculum and teaching. 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 Language and Social Sciences Education department at UNZA and the Disaster Management Training Centre at Mulungushi University seem to have the most useful experience in multidisciplinary research and capacity development, and could play a valuable role in CCD capacity development going into the future.

Document review has highlighted the importance of conducting training at the sub-national level (10 provinces and 80 districts), where it is believed that awareness on climate change is lower. The critical role of district level planners, permanent secretaries and district development committees, or sub-national staff in critical sectors (like district agricultural

commissioners, extension officers, forestry, fisheries, community development) has been emphasised. Activities identified by the mapping study that begin to contribute to filling these needs include the technical training and consultancy in rural electrification conducted by the EERG group. The recent consultancy work with the Department of Energy in the Ministry of Energy and Water Development saw the training of Energy Service Company (ESCO) technicians and the installation of over 400 Solar Home Systems (SHS) in the Eastern Province of Zambia. The training of the Energy Regulation Board (ERB) personnel in 2005 on the procurement, design, installation and maintenance of Photovoltaic Systems is another vivid example. These positive examples should be supported and used as models to significantly enhance and upscale training on adaptation and other CCD-related matters.

4.6.4 Curriculum development and curriculum innovation

The 2010 'Information Needs Assessment and Identification of Information Gaps on Climate Change in Zambia" (MTENR 2010) includes the following recommendations for climate change education, training and capacity building: (i) formally integrate climate change related topics at primary, secondary and tertiary levels to further entrench climate awareness and develop skills in climate related analysis, (ii) develop an aggressive awareness strategy at country level to include various stakeholders, (iii) develop a climate expertise development strategy through learning by doing and involving as many institutions as possible.

As shown in the institutional analysis above, CCD is currently mainly being 'integrated' into existing courses, with a few dedicated courses on offer. From October 2013, Manoah Muchanga noted that UNZA will offer a new course on climate change and education, which will be offered for a full year, and will allow for going into greater detail on the issues. There is further the need to introduce a range of courses in the various disciplines on climate change. Apart from the existing courses in environmental education, more courses that are relevant to CCD are to be added into the University of Zambia curriculum. These courses should be relevant and practical so that the labour market for the graduates could be widened. Discussion centred around how the universities could engage the government better on the issue of lack of jobs for graduates, so that there is a better fit between qualifications offered and available jobs. The participant from PELUM noted that courses are often too theoretical, resulting in ill-equipped graduates, and challenged the universities to come up with something practical, so that the student can be employed immediately.

Zambia appears to have strong expertise in environmental education and ESD, and subsequent curriculum development, as well as in mitigation focused research and courses through the EERG. While there seems to be growing climate change-related policy development in the country, as well as growing research networks, there seems to be a disconnect between these policies and networks and integration into the curriculum. Universities can play a significant role in training and teaching for CCD. Community engagement is essential in addressing climate change related issues. Youth need detailed capacity building in various adaptation skills, including how to reach out to their peers to raise awareness about CCD.

4.6.5 Research recommendations

Generally, it was noted that Zambia has several gaps in CCD-related research and that various stakeholders and universities are engaged in research activities, which still have a lot of room for improvement. Several recommendations were made on how research for CCD could be improved in Zambia's universities and between other stakeholders. Nationally accessible research databases need to be established as well as improved coordination and communication within Zambia climate change and CCD related networks. Improved partnerships and collaborative forms of research were also highlighted. Other respondents felt that institutional barriers were hindering their research expansion in the CCD field, as further discussed in section 5. Research cultures that struggled with elitism and superiority complexes may also be hindering further expansion of CCD-related research in Zambia.

4.7 The role of university leaders

The role that university leaders play in supporting CCD research and development mostly focused on policy development which would require university wide infrastructure (legislative, financial and capacity) to promote CCD related research across all departments and disciplines and across all universities. In connection to this, it was agreed that managers and leadership have a responsibility to develop incentives for developing new study fields with regard to CCD. This includes fundraising and supporting funding applications by university staff. It was also raised that leaders in universities should play a strategic role in facilitating the development of CCD-related institutes, units and centres. It was also mentioned that academic monitoring by university leadership inhibits the development of collaborative research between departments as well as between universities and other partners. It was therefore suggested that university leaders have a role to play in promoting collaborative research, and developing new performance management tools that incorporate collaborative research projects and collaborative published work. Human resources skills development and capacity development was also highlighted as a core responsibility of university leaders. George Kasali of Copperbelt University indicated that the university could develop a university sustainability strategy and action plan, to incorporate climate change issues.

5 KNOWLEDGE CO-PRODUCTION POSSIBILITIES

5.1 Current knowledge co-production practices via multi-, inter- and transdisciplinary approaches

5.1.1 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.[22] 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.[23]

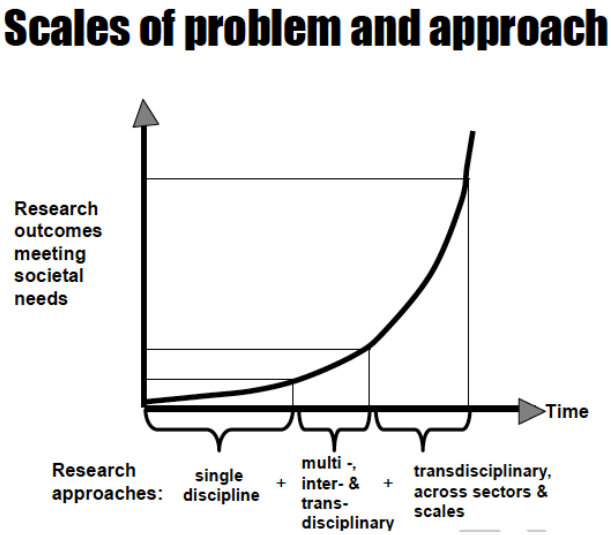


Figure 5: Research approaches

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

[23] 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[24].

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 inter-penetration of disciplinary perspectives or understandings, and a 'creative re-deployment' of these in contexts of practice[25]; 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[26] across sectors and at different scales.

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[24] 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.

[25] 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.

[26] 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[27]. 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.[28] Knowledge co-production is also referred to as knowledge co-creation. This requires working to bring together different contributions in the knowledge production process.

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

The Zambia workshop highlighted some examples of interdisciplinary research on climate change in Zambia, although this is not properly catalogued. For example Dr. Gorge Kasali cited an interdisciplinary research project done in the Mazabuka area, specifically in Magoye, which targeted agriculture and livestock in the context of climate change adaptation. Nevertheless, concerns were raised on the extent to which such approaches are available and applicable in Zambia. Professor Namafe provided the example of the interdisciplinary nature of the Environmental Education programme at the University of Zambia, designed to create a platform to understand social-ecological complexity. It was learnt that in the past, there has been more of a single disciplinary research approach. Now there is a growing realisation of the desirability of applying multi- and interdisciplinarity, although some researchers are still resistant to this, reportedly as they feel their disciplines are superior to others. This speaks to a larger question of the individuation and commodification of knowledge, precisely at the time

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

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

when collaborative forms of inquiry and co-produced research are needed to respond to complex dynamic issues such as climate change.

5.2 Multi-, inter- and transdisciplinary research possibilities: Benefits and constraints

5.2.1 Benefits and constraints

In discussing the benefits of this kind of research, it was noted that research carried out by scholars from different faculties helps to build a broader perspective on issues such as climate change. Professor Namafe further commented that when experts come together to do research, you are assured of deeper knowledge because information comes from a number of fields. From a trans-disciplinary context, Dr. Gorge Kasali said that universities should help communities and should be drivers of change. The responsibility of universities should be to take technology into villages and translate it to local understanding. Manoah Muchanga added that multidisciplinary and interdisciplinary research has merits because it helps bring factual and transfactual information about climate change into a complementary focal point. An example cited was that the 2^{o}C rise in temperature over 50 years in Zambia means a lot to a factual scientist, but appears negligible to a common person on the ground and probably to an average educated mind. In this regard, a factual scientist needs to work with a trans-factual scientist who has wider ability to explain in simpler terms the meaning of the observed 2 ^{o}C rise in temperature over the past 50 years to current socio-economic livelihoods.

The following list summarises the identified *benefits* of inter and multidisciplinary approaches in research:

- Collaborative production and use of information;
- Multiple benefits to the research community and other fields;
- There is bigger picture advantage from inter and multidisciplinary;
- It would assist the university to answer problems of society realistically; and
- Helps in development of factual and transfactual information resulting into behavioural and social change.

When discussing *concerns* of inter- and multidisciplinary approaches to research, Morgan Katati noted that transdisciplinary research has an inborn problem in Zambia, due to the broken communication between researchers and policy makers. The influence of research on policy makers (e.g. those involved in the REDD+ programme) is not understood at local and community levels. Nevertheless this concept helps governments understand the wants and needs of the grass roots in community. Some of the isolated *constraints or barriers* to multi- and interdisciplinary research can be summarised as follows:

- Superiority complex on the part of some disciplines;
- Researched communities feel ‘used’ when research recommendations do not turn into reality – although the emphasis of transdisciplinary research on deployment of knowledge into praxis may help with this concern;
- Limitation of roles and fragmented approach in the universities;
- Our communities fail to make us accountable for research; and

- Disjointed engagement between policy makers and researchers.

> *"The very very important lesson that I have learned is the importance of transdisciplinary research and its importance in driving sustainability research and addressing CCD."*
>
> Zambia workshop participant from the youth sector

5.2.2 Possibilities to strengthen this kind of research

Workshop participants raised a number of possibilities for strengthening this more collaborative kind of research:

- Break down the barriers between those who feel their fields have more solutions than others;
- Engage the local and researched (subject), involve community members to feel engaged;
- Higher education policy and strategic engagement to support these approaches;
- Connection with university and communities to act as consultants – there is need of universities and government to come up with task forces so the projects should be implemented; and
- Scholarship support for PhD outputs – needs to be emphasised.

The concerns raised regarding the limitation of roles and fragmented approach in the universities, as well as the "superiority complex" of some disciplines, point to a consideration by SARUA and other similar bodies to look not only at capacity development, but also at institutional norms and cultures which further inhibit co-produced knowledge.

> *"We are all coming from different faculties, different universities, different sectors, but systems of governance force us to operate in silos. We get the satisfaction of fulfilling mandates. But climate change makes it necessary for us to move out of the silos, we need to cross the disciplinary boundaries, and have a systemic and holistic approach to challenges. There are also language boundaries – we need to be able to articulate the climate change challenges in the local languages."*
>
> Regional SADC ESD programme manager

> *"Universities should help communities and should be drivers of change. The responsibility of universities should be to take technology into villages and translate it to local understanding."*
>
> Zambia university professional

6 SUMMARY AND CONCLUSION

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

Climate change has multiple impacts at diverse scales on both the economy and on people's livelihoods. Zambia has already observed a 2 ^{o}C rise in temperature over the past 50 years, which is significantly higher than the global average, and has further experienced flooding and decreased potential for hydropower. Projections are for up to a 6 ^{o}C increase by 2100, substantial increases in the frequency of hot days and nights, and increased rainfall intensity. Workshop participants emphasised that climate change is a major threat to sustainable development in Zambia. Attaining CCD will require coordination of all of the pillars of sustainable development, as well as integration of current and future climate risks, necessitating actions across sectors and disciplines. Existing mechanisms and capacity are insufficient to deal with the complex and diverse climate issues, which will require a strategic, coordinated and harmonised approach to increase the effectiveness of actions. The identified general mismatch between the existing supply of skills and the demand in the labour market exacerbates this situation. As noted in the NCCRS and upheld by the mapping study findings, the critical overarching shortfall is the lack of a coherent approach to tackle the climate change challenge in the development context.

Within this context, the mapping study needs analysis for Zambia revealed that, despite progress on identifying research and capacity needs in broad terms, the status of CCD knowledge and research will need to be enhanced significantly in both specific and cross-cutting ways to address the considerable observed and projected impacts. In this regard, findings of the Needs Analysis could be helpful in future policy development and implementation in Zambia.

While Zambian participants in the mapping study were in agreement broadly with the concept of CCD, and strongly exemplified an approach that prioritised both adaptation and mitigation, or framing this often as resilient and low carbon development, several people did highlight that adaptation should be the main priority in the country's development goals, while at the same time embracing the opportunities of cleaner energy and other low carbon technologies.

6.1.1 Broad adaptation and mitigation needs

There is consensus amongst the three data sources (policy, workshop, questionnaires) on the *broad priority focus areas for responding to climate change,* namely integrating adaptation and disaster risk reduction; land use, forestry and wildlife, which includes reducing deforestation and sustainable forest management; water management; health and social infrastructure; climate-proofing smallholder agricultural production and diversifying livelihoods; climate-proofing physical infrastructure and transportation systems; and making the economy resilient through low-carbon growth. Mitigation-related priorities centre around ensuring that mitigation actions are implemented in the most greenhouse gas-intensive sectors of land-use (agriculture and forestry), energy, transport and mining, and ensuring that development

proceeds using low carbon pathways, including switching to cleaner energy sources such as solar power.

6.1.2 Specific knowledge and research gaps

Knowledge gaps of concern mainly involve mainstreaming climate change adaptation and disaster risk reduction into relevant policy, and programmatic priorities, most noticeably in local development planning. Information sharing was also a significant knowledge gap in Zambia. Significant research gaps focused mainly on resource management research, contextualising research for Zambia and curriculum development. While there seems to be a growing supportive institutional foundation in Zambia, with new policies, units and networks emerging that support climate change and CCD related research and project action, there still seems to be significant hurdles with regard to collaboration, information sharing and partnership development.

Cross-cutting needs: The mapping study found the most significant needs were for training and capacity development in various CCD related fields, including both adaptation- and mitigation-oriented research. **Capacity building, networking, collaboration and partnerships** (between sectors and stakeholders as well as international and national) were constantly referred to as key priorities, as was the need to **strengthen policy and institutional frameworks**, as well as decision making processes, even though compared to many other SADC countries Zambia has a variety of relatively well-developed action plans and policies. **Policy implementation** was also a key concern area, and translating policy implementation from existing policies was discussed regularly in both the workshops and questionnaires. Improvement of **research and development regarding forms of sustainable development**, particularly energy development was highlighted. Finally **curriculum development and integration** within schools and higher learning institutions, was a key area explored in both the workshops and the questionnaires.

6.1.3 Notable themes

Emerging from the Zambia workshop and questionnaire data were the importance of **contextualising and localising CCD research and technology development to Zambia**, which could improve policy development and implementation. Related to the significant youth presence at the workshop, but also supported by the country's demographics, there was considerable emphasis on **youth participation in all CCD related actions**, particularly in decision processes and policy development. Furthermore, priorities expressed throughout the workshop and questionnaires were not aligned along institutional or disciplinary mandates and interests, but rather seemed to be well related to the particular needs of Zambia, with regard to youth, energy, the need for increased awareness, education, capacity development, information sharing and partnerships, and development and policy challenges. Valuing, recording, studying and applying indigenous knowledge was a further notable theme.

6.1.4 Individual capacity gaps

The most significant of these were **lack of training and capacity development in various CCD related fields**, including climate modelling, research, renewable energy technology, carbon

marketing, monitoring, reporting, verification, mapping, natural resource management, economic diversification, gender related issues and fundraising. Limited skills to translate strategies into action at the community level constitute a cross-cutting individual capacity gap.

6.1.5 Institutional capacity gaps

While there appears to be a growing supportive institutional foundation for CCD in Zambia, with new policies, units and networks emerging that support climate change and CCD related research and project action, significant hurdles remain with regards to collaboration, information sharing and partnership development. Specific institutional capacity gaps relate to the need to **improve the national weather observation system,** for enhanced climate services; and to strengthen disaster risk reduction and management systems. The mapping study data sources consistently highlighted the need for improved **financial resources** to implement adaptation measures, as well as a well-funded human resource development and **comprehensive CCD capacity development strategy**.

6.2 Synthesis perspective on the institutional assessment

This mapping study has identified existing initiatives amongst the HEIs in Zambia and their partners where activities such as research, teaching, policy engagement and community outreach are addressing climate change-related needs. The study has shown that HEIs in Zambia do have some expertise and capacity for responding to climate change and moving towards CCD, as do other stakeholders. Active researchers identified in this mapping study are listed in Appendix B, and CCD areas of expertise in Zambia, mainly with respect to universities, are summarised in the table in Appendix E. Zambian universities have been central in defining best practices in the area of climate change and CCD, for example through the EERG at UNZA, the DMTC at Mulungushi University and the Biological Sciences department at Copperbelt University. However, as highlighted also by the NCSA, there is in general limited research capacity and expertise on climate change within the country and insufficient level of contemporary, up-to-date knowledge in certain specialised areas. There is arguably more capacity within the NGO sector. Thus, in order to respond better to new challenges arising in the climate area, and to enhance and deepen the country's implementation of CCD, existing areas of capacity for work on CCD will need to be supported though a range of mechanisms, and broader areas of relevant capacity developed. The various knowledge, research, individual and institutional capacity gaps offer a substantial route map for the specific needs for higher education institutional CCD development in Zambia. The institutional assessment has highlighted a number of mechanisms for this route map: these include the need for scholarship support for PhD outputs, to enhance, widen and deepen CCD coverage across the disciplines; as well as for making climate change and CCD a compulsory subject in the school curriculum, building on the recent curriculum review. Positive curriculum innovations on CCD identified in this study will need to be built on by mainstreaming climate change and CCD across the range of undergraduate courses, developing new focused postgraduate courses, and ensuring a good match between graduates and the demands of the labour market, including through extra attention to practical aspects of training. This will assist with addressing a fundamental, non-climate change related issue of ensuring greater investment in

quality education that leads to decent job creation for Zambian youth, as prioritised in the 2013 national consultations on the Post-2015 Development Agenda in Zambia.

The institutional analysis shows that there is limited experience in knowledge co-production partnerships, while numerous knowledge partners exist for CCD knowledge co-production in Zambia. The mapping study on the whole found the need in Zambia for a collaborative approach to set and implement the research agenda. There is clearly scope for enhanced collaboration on the part of HEIs for CCD knowledge co-production within the country, and with other universities in the SADC region, as well as further afield in Africa. This will require actions to remove the barriers identified in section 5, including through university policy and strategy reform. When discussing the need for efforts from all sectors of society, workshop participants stated that religious organisations should be included too, to partner with HEIs to raise issues of moral and value-based environmental protection; as should traditional leaders, to raise the profile of indigenous knowledge and cultural practices.

6.3 A broad map of Zambia 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 CCD capacity development pathways for Zambia. One example is offered here (Table 12) for a key CCD priority area in Zambia, namely **Curriculum Development and Youth Capacity building.** This is an important cross-cutting priority that should be addressed with a focus on adaptation, mitigation and integrated adaptation-mitigation approaches to CCD. The table provides a synthesised perspective of key knowledge, research, individual and institutional capacity gaps for Zambia for this priority area, providing insight into the research, capacity building and institutional development pathways needed for enhancing future contributions to CCD.

Table 12: CCD knowledge, research, capacity building and institutional capacity gap analysis for one of the Zambia cross-cutting priorities: Curriculum Development and Youth Capacity building

CCD PRIORITY	Knowledge and Research Gaps (Research agenda)	Individual Capacity Gaps (Education and Training agenda)	Institutional Capacity Gaps (Institutional Development agenda)
CROSS-CUTTING: ▪ Curriculum Development, general educational opportunities, youth development	KNOWLEDGE: ▪ Inadequate information on CCD in the curriculum ▪ Inadequate public awareness ▪ Outdated climate change data ▪ Unconsolidated information sharing, dissemination and networking RESEARCH: ▪ Inadequate research on importance of integrating climate	YOUTH: ▪ Youth still competitors among themselves e.g. initiating competing NGOs ▪ Climate change leadership skills lacking ▪ Lack of specialisation in field of climate change, and lack of implementation skills RESEARCH SCIENTISTS: ▪ Lack of behavioural and attitude change ▪ Inadequate trained authors and material	▪ Claims that the curriculum is too overloaded to accommodate climate change, environmental education, ESD, etc. ▪ Inadequate funding for frequent curriculum review ▪ HEIs have limited courses in Climate Change Education to build teachers' capacity ▪ Lack of institutional funding for research ▪ Insufficient resources for climate change material

CCD PRIORITY	Knowledge and Research Gaps (Research agenda)	Individual Capacity Gaps (Education and Training agenda)	Institutional Capacity Gaps (Institutional Development agenda)
	change in the curriculum ▪ Inadequate curriculum review-oriented research ▪ Lack of research on the influence of awareness on behavioural and social change ▪ No research on material needs assessment ▪ Lack of research on impact of climate change on youth ▪ Lack of research on awareness creation techniques among the youth and role of youth in raising awareness	developers LOCAL GOVERNMENT: ▪ Lack of trained staff to spearhead pre/in-service training in climate change TEACHERS AND LEARNERS: ▪ Lack of knowledge application by individual learners and teachers ▪ Negative attitude toward CCD by teachers and learners	production ▪ Printing and publishing costs high ▪ Poor media coverage of climate change and environment ▪ No clear institutional frameworks on environment al education and awareness ▪ Lack of local climate change resource centres

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. Key is to integrate mitigation, adaptation and development priorities into the CCD knowledge co-production pathways, as per the CCD framework.

Critical issues to be addressed for Zambia 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 12), to guide further action at country level.
- Expand the capacity of the research institutions that have been identified as having some capacity and expertise for research, teaching and learning on CCD. Develop strategies 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 a Centre of Excellence.
- Strengthen the collaborative, transdisciplinary potential within Zambian universities and other institutions to improve the opportunities for more reflexive and dynamic forms of research that can contribute to meaningful CCD in Zambia.
- 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 Zambia.

- Improve co-operation, communication, knowledge management and shared access to data at all levels.
- Develop motivation and incentives for researchers, especially for engaging in multi-, inter and transdisciplinary research approaches. Support capacity development of researchers in these areas.
- Strengthen research partnerships and research infrastructure, including research funding and incentives for students.
- Support ongoing processes of curriculum innovation to mainstream CCD into existing courses and programmes, and engage in development of Masters degree curriculum design, potentially in partnership with other southern African universities.
- Strengthen existing policy and community outreach activities within a knowledge co-production framework, building on promising activities; and develop tools for monitoring and dissemination to make the impact of such work visible within the university system.
- Develop campus management policies and practices that demonstrate commitment to CCD at the institutional level, and support student organisations that are beginning to tackle CCD-related matters.

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

Zambia has CCD-related research and teaching strengths in the broad areas of climate change adaptation, mitigation and cross-cutting issues. Particular areas of strength identified in Zambia include:

- **Disaster risk reduction and adaptation:** Developing early warning systems and systems for integration of climate information into decision making in this regard
- **Climate change adaptation research and implementation**: Research and piloting of adaptation interventions in drylands, including effects of desertification on local communities and mitigating serious effects of drought; conservation agriculture; adaptive practices in water and land management in drought-prone areas
- **Integrated mitigation/adaptation approaches**: Technical and economic viability of different renewable energy technologies; renewable energy-based electricity generation for isolated mini-grids; developing legal, institutional and policy framework to enable commercial deployment of renewable energy
- **Climate change mitigation research**: Various renewable energy-related competencies, including solar energy materials and photovoltaic systems (EERG at UNZA)
- **Cross cutting issues research**: Conducting and applying climate risk assessments to planning processes; indigenous knowledge and climate risk research; gender and climate change research
- **Teaching and curriculum innovation:** Longstanding experience with integrating climate change into under- and postgraduate curricula; gender and climate change course; mainstreaming environment and sustainability into African (MESA) universities chair in teacher education; integration of CC into engineering courses, e.g. distance learning in sustainable energy engineering (EERG at UNZA Physics Department) and integration of CC into environmental engineering at Copperbelt University

APPENDIX A: WORKSHOP ATTENDANCE LIST

List of particpants at Zambia workshop, 9 July 2013 (Day 1)

School of Education Conference Hall: University of Zambia

Full name	Department/Faculty/Organisation	Designation	Contact number/s	Email address
Sophie Nanyangwe	Mulungushi University	Student	0966551898	Sophie.Nanyangwe@yahoo.com
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List of particpants at Zambia workshop, 10 July 2013 (Day 2)

School of Education Conference Hall: University of Zambia

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APPENDIX B: ACTIVE RESEARCHERS IDENTIFIED WHO ARE CONTRIBUTING TO CC /CCD RELATED RESEARCH ACTIVITIES

Table 13: Active researchers who are contributing to CC/CCD related research activities in Zambia

Name and qualification	Department / Area of expertise	Years of experience: Years of experience in CC research	Contact details
Mirriam Moonga (MEd)	School of Education: Climate Change Education	7 years: 5 years	University of Zambia (UNZA) – Language and Social Sciences Education mirriam.moonga@unza.zm
Professor Prem Jain (PhD)	Physics Department: Sustainable/Renewable Energy Technology; Solar PV; various CC areas, including mainstreaming		University of Zambia (UNZA) – Physics Department pjain@unicrolink.zm
Joseph Muyauka Muyunda (MSc)	Environmental Education	13 years: 4 years	University of Zambia (UNZA) – Language and Social Sciences Education muyundajmuyauka@yahoo.co.uk
George Kasali (PhD)	Biological Sciences	14 years: 6 years	Copperbelt University, School of Mathematics and Natural Sciences, kasali_george@yahoo.com
Mitulo Silengo (PhD)	DRR, environment and natural resources		Mulungushi University, Disaster Management Training Centre mitulo.silengo@gmail.com
Jane Zelia Mbewe (BSc)	Environmental Science	3 years: 3 years	Mulungushi University, Disaster Management Training Centre janezmbewe@yahoo.com
Prof. Charles Namafe (PhD)	Education for Sustainable Development		University of Zambia (UNZA) – Language and Social Sciences Education mutumban@yahoo.com
Manoah Muchanga			University of Zambia (UNZA) –Language and Social Sciences Education
Matilda Nakazwe (M Ed)	Environmental Education	6 years: 2 years	University of Zambia (UNZA) – Language & Social Sciences Education Geography Education and Environmental Education unit matildanakazwe@hotmail.com
Matildah Kaliba (MA)	Development Studies	4 years: 2 Years	University of Zambia (UNZA) School of humanities and social sciences deanhss@unza.zm

Note: This list is based on information provided in the country workshop and from completed questionnaires, plus limited additional internet research, and is therefore indicative rather than definitive.

APPENDIX C: UNIVERSITIES 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 **inter-disciplinary** 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 focused 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 FOR ZAMBIA

Table 14: Identified sources of expertise for CCD in Zambia

University/ organisation	Nodes of expertise	Centres of expertise	Centres of excellence	Active CCD related Research Networks
Zambia	*Faculty of Science:* *Department of Physics* – see next column *Faculty of Education:* Department of Language and Social Sciences Education (LSSE), UNZA – second year Gender and CC course; teaching, research and community outreach on CCD and gender *Faculty of Agriculture:* Department of Soil Science – adaptive land and water management	*University of Zambia, UNESCO Chair in Renewable Energy and Environment*; chair is held by Prof Prem Jain; *Energy and Environment Research Group (EERG),* research and consultancy group in Department of Physics; over 20 years experience. EERG has three sub-groups: Solar Energy Materials and Photovoltaic Systems, the Climate Group, and Distance learning in Sustainable Energy Engineering Group. EERG leads in integrating CC into undergraduate and postgraduate curricula and institutional mainstreaming of CC. The Climate Group conducts inter alia climate modelling, statistical and dynamical down-scaling, detection and attribution of CC, CC impacts *SADC MESA Chair in Teacher Education* (mainstreaming environment and sustainability into African universities) *Lusaka Regional Centre of Expertise (LRCE) on Education for Sustainable Development*, School of Education, Department LSSE (UNZA): multi-stakeholder /institutional; research, community engagement, training and capacity building on E		▪ Zambia Climate Change Network (ZCCN) ▪ Lusaka Regional Centre of Expertise ▪ The UN-REDD Programme–Zambia Quick Start Initiative ▪ Environmental Council of Zambia, which plays a key role in coordinating the National Communications to the UNFCCC ▪ Southern Africa Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL)

University/ organisation	Nodes of expertise	Centres of expertise	Centres of excellence	Active CCD related Research Networks
Copperbelt University		*Copperbelt University*: vulnerability and other climate-related research in the Biological Sciences department; progress in integrating climate change into the environmental engineering and biological studies curricula		
Ministry of Science and Technology		*Ministry of Science and Technology – National Remote Sensing Centre:* involved in SASSCAL-climate change adaptive land use programme with many components. Remote sensing for UN REDD+ programme through forestry department provides internships for undergraduate students, providing technical support to MSc and PHD students		
Mulungushi University		Disaster Management Training Centre of Mulungushi University – established centre of excellence in disaster studies in the sub-region; long history of association with the Disaster Management and Mitigation Unit (DMMU)		
	Youth-related initiatives: *Several groups involved in increasing engagement of youth in CC and CCD-related activities, e.g. ZEN and UNICEF Climate Ambassadors;* require additional support			

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