climate change counts

STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA

Zimbabwe Country Report

sarua
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SARUA CLIMATE CHANGE COUNTS MAPPING STUDY

VOLUME 2 COUNTRY REPORT 12 2014

STRENGTHENING UNIVERSITY CONTRIBUTIONS TO CLIMATE COMPATIBLE DEVELOPMENT IN SOUTHERN AFRICA

Zimbabwe Country Report

Series Editor: Piyushi Kotecha

Authors: Heila Lotz-Sisitka and Penny Urquhart

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Note

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

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

AGRITEX	Department of Agricultural, Technical and Extension Services
AiBST	African Institute of Biomedical Science and Technology
BID	Background Information Document
BMS	Biodiversity Management Systems
BRTI	Biomedical Research Training Institute
CASS	Centre for Applied Social Sciences
CBA	Community-based Adaptation
CCAM	Conformal-Cubic Atmospheric Model
CCD	Climate compatible development
CDKN	Climate and Development Knowledge Network
CGCMs	Coupled Global Climate Models
CGIAR	Consultative Group on International Agricultural Research
COLAZ	College Lecturers Association of Zimbabwe
CORN	Community Organisations Regional Network
CPSE	Chemical Process System and Engineering
CSIR	Council for Scientific and Industrial Research
DfID	UK Department for International Development
DRI	Development Reality Institute
EMA	Environmental Management Agency
EMIS	Education Management Information System
FFEWS	Famine and Flood Early Warning System
FFS	Farmer Field Schools
GHG	Greenhouse Gases
GIS	Geographic Information Systems
GoZ	Government of Zimbabwe
HEI	Higher Education Institution
HEMA	Higher Education Management Africa consortium
HIT	Harare Institute of Technology
ICRISAT	International Crops Research Institute for Semi-Arid Tropics
ICT	Information and Communication Technology
IDS	Institute of Development Studies
IES	Institute of Environmental Studies

IIED	International Institute for Environment and Development
IMOD	Inclusive Market-Oriented Development
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated water resources management
MDG	Millennium Development Goals
MENRM	Ministry of Environment and Natural Resources Management
MTP	Medium Term Plan
NAMACO	National Manpower Advisory Council
NCCRS	National Climate Change Response Strategy
NGO	Non-Governmental Organisation
RCZ	Research Council of Zimbabwe
RWH	Rain Water Harvesting
SADC	Southern African Development Community
SADC REEP	Southern African Development Community Regional Environmental Education Programme
SARDC	Southern African Research Documentation Centre
SARUA	Southern African Regional Universities Association
SARVA	Southern African Vulnerability Assessment
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Use
SIRDC	Scientific, Industrial Research and Development Centre
SNC	Second National Communication
SWEDESD	Swedish Centre for Education for Sustainable Development
TFCA	Trans-Frontier Conservation Area
TMTHE	Ministry for Tertiary and Higher Education
TVET	Technical and Vocational Education and Training
UNDP	United Nations Development Programme
UNFCCC	UN Framework Convention on Climate Change
WASH	Water, Sanitation and Hygiene
ZERO	Zimbabwe Environmental Research Organisation
ZIDS	Zimbabwe Institute of Development Studies
ZIMCHE	Zimbabwe Council for Higher Education
ZIMDEF	Zimbabwe Manpower Development Fund
ZIMVAC	Zimbabwe Vulnerability Assessment Committee
ZOSS	Zimbabwe Occupational Standards Service
ZOU	Zimbabwe Open University

1 INTRODUCTION

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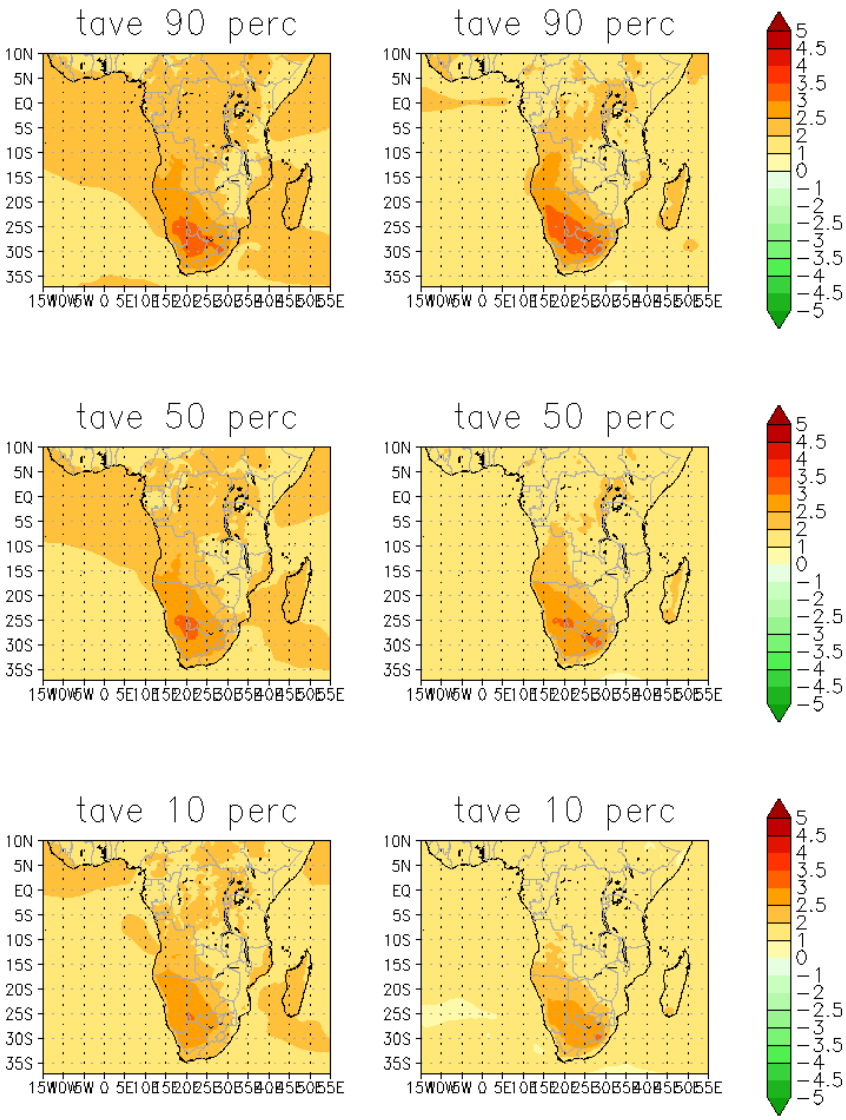
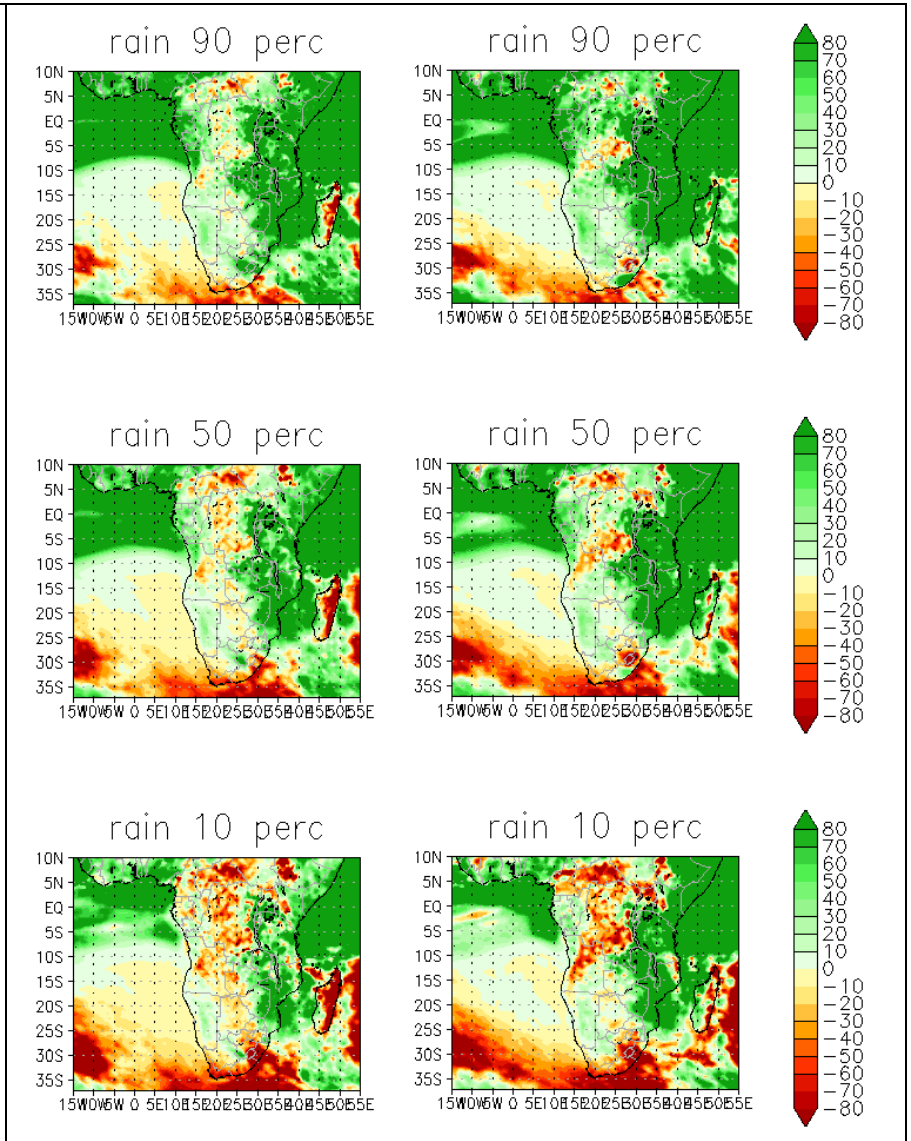
[1] IPCC. 2013. *Impacts, Vulnerability and Adaptation: Africa*. IPCC Fifth Assessment Report, draft for Final Government Review, Chapter 22.

[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

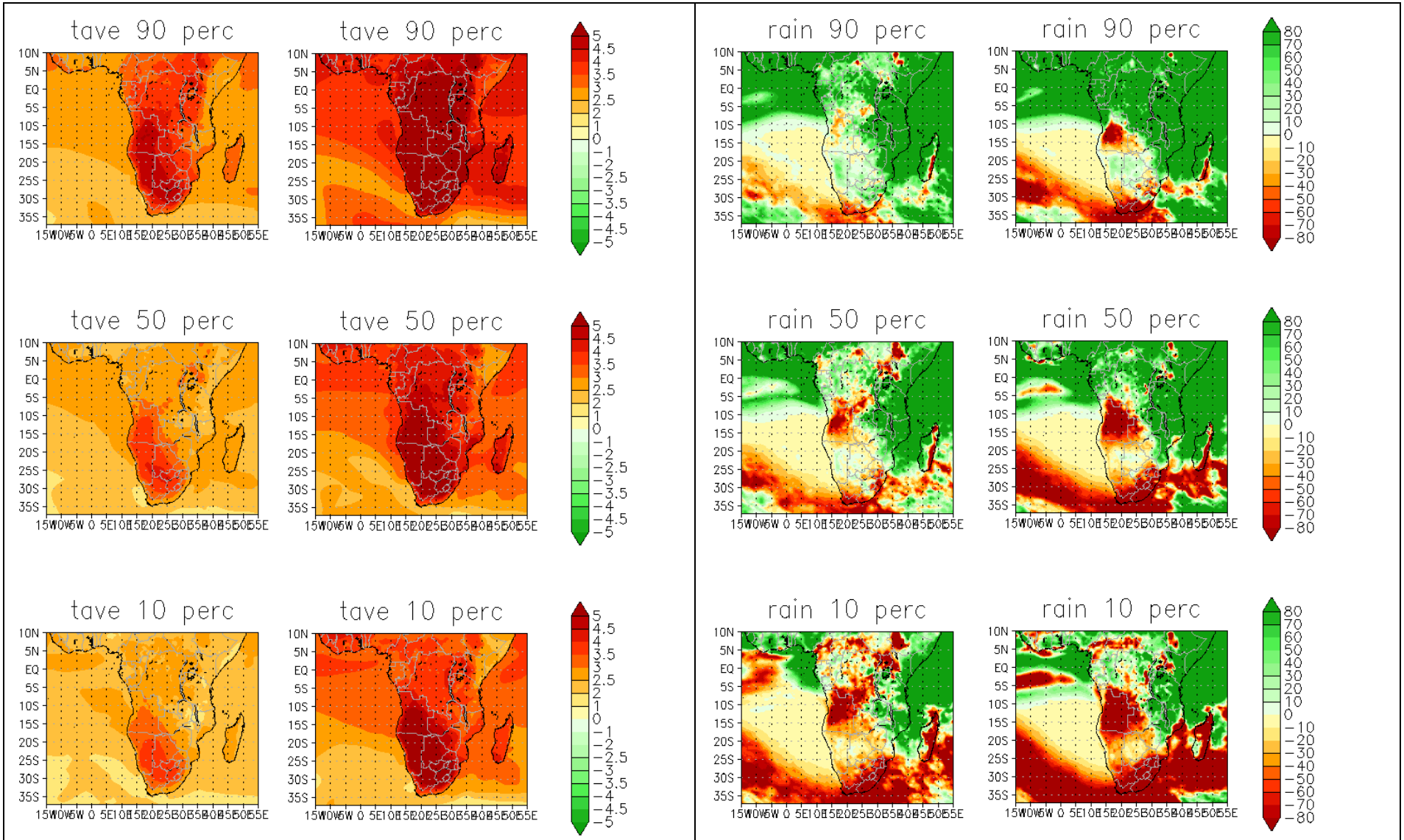


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Figure 2: Projected change in the annual average temperature (°C) and annual average rainfall (mm) over the SADC region, for the time-slab 2040–2060 and 2080–2099, relative to 1970–2005

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

Shifting perspective from 'development' to 'climate compatible development' requires significant scientific and social innovation. New forms of learning, leadership, planning, policy making and knowledge production are needed. New collaboration platforms will be needed within and between countries and their universities. Universities have a key role to play in supporting societal innovation and change for CCD. Not only do they develop the knowledge and competence of future leaders in government, business and civil society, but they also provide immediate societal responses given their pivotal role as centres of research, teaching, knowledge sharing and social empowerment. Given the risk multiplier effect of climate change, coupled with the multiple stressor context, it is clear that the impacts of climate change will be far-ranging, acting upon diverse sectors such as transportation, agriculture, health, industry and tourism. This necessitates a wide-ranging and cross-sector response, calling upon non-climate-related knowledge fields. The Zimbabwean government recognises the relationship between climate change and development, and in the draft National Climate Change Response Strategy (2013) the government indicates that ongoing impacts of climate change are likely to affect the economy, and especially the primary agro-based economy which affects over 70 percent of the population who live in rural areas, and who are dependent on climate sensitive livelihoods such as arable farming and livestock. The NCCRS suggests further that climate change could reverse development gains if a proactive approach to CCD is not taken.

As also emphasised by the Minister Muchena in her opening of the SARUA consultative workshop in Zimbabwe, 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 particular, the Minister challenged universities to make climate change and climate compatible development more accessible to the majority of the country's people, and to consider the response opportunities provided by climate change for innovation and development.

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

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

Box 1: Zimbabwe's vulnerability to climate change

Zimbabwe is projected to experience a significant temperature increase and decline in rainfall that will potentially result in the decline of woodlands and grasslands; and an expansion of semi-arid conditions as well as scrub savannah. Research in Zimbabwe has revealed that over five million Zimbabweans live in semi-arid zones, and will suffer disproportionately from the emerging impacts of climate change and variability including disasters associated with extreme weather events such as droughts, periodic flooding, disease outbreaks for both human and livestock and loss of crop lands. See section 3.3.3 for a more detailed picture of Zimbabwe's vulnerability to climate change.

1.2 The SARUA Climate Change initiative: History and objectives

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

- **Collaborative network development** (establishment of six interesting collaborative networks);
- **Policy and community outreach;**
- **Research** (140 PhD students (average 10 per country) in two themed research programmes);

- **Teaching and learning** (integration of CCD into undergraduate and Masters degree programmes);
- **Knowledge management** (regional database and knowledge management systems); and
- **Institutional learning and support** (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 Dutch-funded Climate and Development Knowledge Network (CDKN). The Higher Education Management Africa consortium (HEMA) is coordinating the study on behalf of SARUA. This Zimbabwe Country Report forms part of the mapping study.

The initiative is diagrammatically illustrated below.

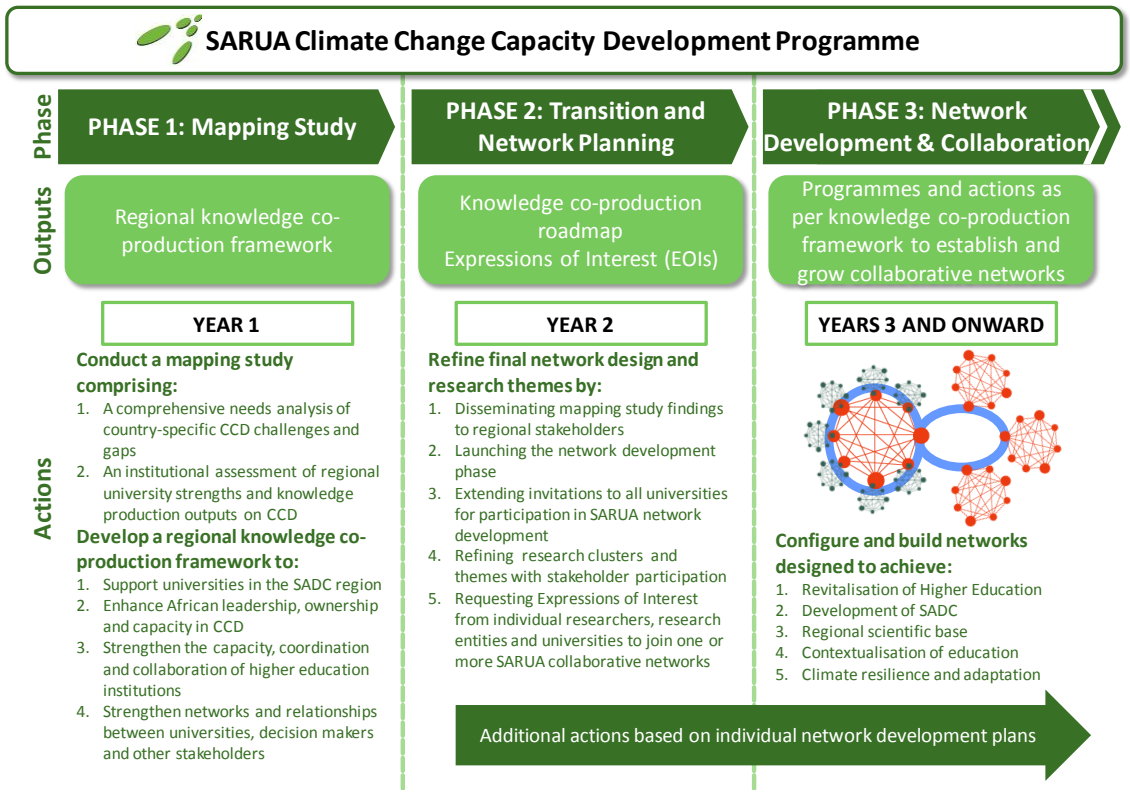

Figure 3: The SARUA Climate Change Capacity Development Programme, showing the mapping study

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

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

universities and policy and community stakeholders. This framework will form the basis for the realization 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 Zimbabwe.

The mapping process was designed to be scientifically informed, participatory and multi-disciplinary. 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. CCD emphasises climate strategies that embrace development goals and 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.

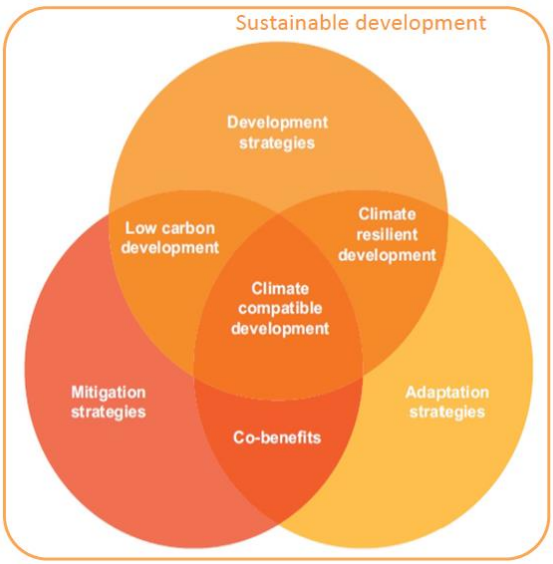

Figure 4: Conceptual framework for Climate Compatible Development (adapted from Mitchell and Maxwell, 2010)

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

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

Climate-resilient pathways

The following definition of climate-resilient pathways is taken from the glossary of the Fifth Assessment Report prepared by the Intergovernmental Panel on Climate Change (IPCC)[6]:

> *"Evolutionary processes for managing change within complex systems in order to reduce disruptions and enhance opportunities. They are rooted in iterative processes of identifying vulnerabilities to climate change impacts; taking appropriate steps to reduce vulnerabilities in the context of development needs and resources and to increase the options available for vulnerability reduction and coping with unexpected threats; monitoring emerging climate parameters and their implications, along with monitoring the effectiveness of vulnerability reduction efforts; and revising risk reduction responses on the basis of continuing learning. This process may involve a combination of incremental changes and, as necessary, significant transformations."*

The IPCC highlights the need for a focus on both adaptation and mitigation, as indicated by the following sentence: "Climate-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

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

[7] Ibid.

necessitates a systems approach to understanding and solving interlinked social, environmental and economic problems.

In 2002 South Africa hosted the World Summit on Sustainable Development, and the Johannesburg Plan of Implementation re-affirmed commitment to Agenda 21, and the Millennium Development Goals. These are currently under review and will be expanded through Sustainable Development Goals. In 2012 the Rio+20 Conference was held in Rio de Janeiro, and the outcomes of this global summit on sustainable development are captured in a document entitled 'The Future We Want'. One major shift in discourse and objectives from the early 1992 Summit and the Rio+20 Summit is a stronger concern for climate change and climate compatible development, especially the emergence of a low carbon future, accompanied and partly implemented by Green Economies. These international commitments, together with ongoing assessment of national sustainable development concerns and goals, have driven the development of sustainable development policy and practice. The concept of CCD highlights the necessity of integrating current and future climate risks into development planning and practice, in the ongoing goal of achieving sustainable development.

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 Zimbabwe 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 Zimbabwe, 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 Zimbabwe Country Report:

- Zimbabwe National Capacity Self Assessment, 2006;
- Climate Change Vulnerability and Adaptation Preparedness in Southern Africa: Zimbabwe Country Report, 2010;
- The Zimbabwe Mid-term Plan (2011-2015), 2011;
- Southern African Vulnerability Assessment (SARVA) report, May 2012;
- Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2013; and
- Draft Zimbabwe National Climate Change Response Strategy, May 2013.

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

2.1.2 Stakeholder and university staff consultations (national workshop)

As part of the SARUA Mapping Study Initiative *Climate Change Counts*, the second round of country consultations was held in the Jameson Hotel, hosted by the Zimbabwe Open University on 9-10 October 2013.[9] The consultations were structured as a 1.5 day programme, with a combined group of participants, which included university, government, private sector and NGO stakeholders. See Appendix A for the list of participants. A summary of the content of the different sessions is provided below in Table 1. From detailed workshop proceedings captured by a team of three rapporteurs a workshop report was produced, which was circulated to all who participated in the workshop for verification and accuracy. Data produced in the workshops was also verified and added to during plenary sessions. The workshop report forms a substantive basis of the data used for this Country Report, combined with document analysis and questionnaire data.

Table 1: Workshop programme outline

INTRO-DUCTION	▪ 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	▪ Zimbabwe priorities and needs ▪ Knowledge and institutional gaps and capacity	▪ Plenary discussion ▪ Knowledge co-production introduction and example of transdisciplinary research programme ▪ Gaps in enabling environment, and needs for policy and practice support.
SESSION 3	▪ Group discussion (Breakaway) ▪ Zimbabwe 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	

[9] The Zimbabwe consultations were made possible through the kind contribution of the Zimbabwe Open University (ZOU)

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 B and C). One was designed for university professionals and the other for national and regional stakeholders who are involved in climate change and CCD. For Zimbabwe, a total of 38 questionnaires were answered, which included 16 stakeholders and 22 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 Zimbabwe, and b) by time and resource constraints that did not allow for **in-depth field visitation, individual interviewing or observation** before, during and after the consultation process. Moreover, the information generated at the country workshop relates to the number of participants, their expertise and the number of different sectors and institutions present. Further, while every

effort was made to obtain questionnaire responses from as wide a range of stakeholders as possible, and follow-ups were made post-workshop to enhance this, the range of questionnaire responses obtained does provide certain limitations to the data set. However, the **best available information was carefully consolidated, reviewed and verified** in the construction of this Country Report.

While much information could be obtained on climate change- and CCD-related knowledge gaps, research needs and capacity gaps, there is obviously more to be learned about these. Similarly, as much information as possible was obtained on 'who is doing what' and on existing research, knowledge co-construction practice and possibilities, but there is clearly also more to learn about these.

This Country Report therefore presents as a useful 'initial document' and it is hoped that Zimbabwe, and in particular, Chinhoyi University of Technology; Bindura University of Science; Zimbabwe Open University; University of Zimbabwe; Chinhoyi University of Technology; Lupane State University; National University of Science and Technology; Midlands State University; Ministry of Higher Education, Ministry of Environment, Climate and Water; Ministry of Health, Ministry of Energy; Ministry of Agriculture as well as national stakeholders can take this analysis forward in ongoing mapping and planning activities related to CCD research and knowledge co-production.

2.3 Expanding the mapping study

There are numerous ways to expand this study, most notably by administering the questionnaires (included in Appendices C and D) in a manner that would include every academic at universities in Zimbabwe, 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 C) involved in environment and development initiatives in Zimbabwe to understand the full scope of climate change and CCD responsiveness in Zimbabwe, and to further develop the knowledge co-production capacity for CCD in Zimbabwe. 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 Zimbabwe, 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 Zimbabwe. Ministries who could take this study forward could include Ministry of Environment, Climate and Water; Ministry of Health; Ministry of Education; Ministry of Agriculture and the Ministry of Energy 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 Zimbabwe, 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 Zimbabwe, which may also assist Zimbabwe **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 Zimbabwe's socio-economic context and a summary of the observed and projected climatic changes for the country (section 3.2) as these are key drivers for the 'need' for CCD identified by policy, in workshops and via the questionnaires (section 3.3). The needs analysis then describes **more detailed knowledge, research and capacity** needs (section 3.4) using the following differentiation of knowledge, research and capacity gaps:

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

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

3.2 Socio-economic context and projected climate change impacts and vulnerabilities

3.2.1 Socio-economic context

Zimbabwe is a landlocked country lying between 15° and 22° south of the Equator, and between 25° and 33° east of the Greenwich Meridian. It covers an area of 390 757 km², with a population of 12 973 808 (2012 figure). The climate is generally warm to hot in summer and cool to cold in winter. Rainfall decreases from east to west and from the highlands to the lowlands, with a mean annual rainfall of 650 mm. While the eastern highlands receive over 1 000 mm, the country is mostly semi-arid[10], with only 300 mm falling per annum in the Limpopo Valley. The high inter-annual variability ranges from 16 percent in the higher altitudes to 48 percent in the low-lying areas. Floods and droughts are common. Surface water resources meet 90 percent of the country's needs, with the remaining 10 percent being met by groundwater. Water utilisation is 22 percent of the mean annual runoff. Annual evaporation rates range from 1 400 mm in the highlands of the eastern districts to 2 200 mm in the low lying areas in the south and north of the country. Forestry resources cover 66 percent of the

[10] Agro-ecological regions IV and V cover 63.5 percent of the country.

total land area, with large parts consisting of dry Miombo woodland. Current environmental problems include deforestation, soil erosion, land degradation and air and water pollution.

Roughly 70 percent of the population is dependent on agriculture, with a significant proportion of farmers living in semi-arid areas which are prone to droughts. Classified as a Least Developed Country, Zimbabwe experienced severe economic decline between 2000 and 2008. Agriculture and tourism are major sectors contributing to the GDP. The country's GNI per capita is about US$660 (Atlas method). The country has an overall energy shortfall, and generates 1 200MW from thermal and hydro-power plants. HIV/AIDS continues to threaten human capacity in the country, and resulted in a decrease in life expectancy from 61 years in 1990 to 43 years in 2003; this has risen again to 51 years in 2011.[11] The proportion of people living in urban areas rose from 31 percent in 1992 to 35 percent in 2006. Poverty remains high in Zimbabwe, and is estimated to be around 63 percent for Total Consumption Poverty and 16 percent for Food Poverty for households.

3.3 Observed and projected climatic changes, impacts and vulnerabilities

3.3.1 Observed climatic changes

Zimbabwe is experiencing increases in temperature, recurrent droughts and unpredictable rainfall patterns, according to the Southern African Risk and Vulnerability Assessment report (2012). The warming trend is already established, with an increase of at 0.4°C since 1900, with the last decade of that century as the warmest. Rainfall declined by 5 percent during the twentieth century, with the driest years experiencing in the 1990s. The country is experiencing more hot and fewer cold days than before as a result of climate change and variability. The timing and amount of rainfall received are becoming increasingly uncertain, with the last 30 years having shown a trend towards reduced rainfall or heavy rainfall and drought occurring back to back in the same season. The frequency and length of dry spells during the rainy season have increased while the frequency of rainy days has declined.

3.3.2 Projected climatic changes

Future scenarios have predicted increases in global mean temperature of between 1.3°C and 4.6°C by 2100, representing global warming rates of between 0.1 and 0.4°C per decade. Zimbabwe's continental interior location means that it is predicted to warm more rapidly in the future than the global average. The projected rates of warming range from 0.15 – 0.55 °C per decade, with higher temperature changes in the dry seasons compared to the wet seasons. Increasing temperatures of around 2.5°C by 2050 have been projected. Rainfall is predicted to decrease in all seasons; this is more conclusive for the early and late rains than for the main rainy season months of December to February. Projections are that by 2080 mean annual

[11] Zimbabwe Data Profile by the World Bank, 2013.

rainfall will be between 5-18 percent less than the mean annual rainfall in the 1961–1990 period.

3.3.3 Impacts and vulnerabilities

The projected temperature increases and decline in rainfall will result in the decline of woodlands and grasslands; and an expansion of semi-arid conditions as well as scrub savannah. Climate change impacts differently on various groups in Zimbabwe. For example, one study showed that in the agricultural sector, the most vulnerable groups are poor and female-headed households that did not have access to irrigation. At sub-national level, people living in semi-arid regions are more vulnerable to climate change than those living in the wetter areas. Research in Zimbabwe has revealed that over five million Zimbabweans live in semi-arid zones, and will suffer disproportionately from the emerging impacts of climate change and variability including disasters associated with extreme weather events such as droughts, periodic flooding, disease outbreaks for both human and livestock and loss of crop lands. According to the NCCRS, farming communities have moved deeper into marginal lands in their efforts to cope with negative climatic impacts, unsustainably extracting natural resources and using unsuitable agricultural practices.

Zimbabwe's Mid-term Plan (2011) notes that climate change will greatly impact on the key sectors of the natural resource based economy – agriculture, energy, tourism, forestry and water as they are climate sensitive. Climate change will greatly impact the natural resources of Zimbabwe, threatening the resource-based livelihoods of the majority of people who live in rural areas. The Second National Communication to the UNFCCC (2013) summarises vulnerabilities and the need for adaptation responses in the following areas: agriculture; biodiversity; rangelands; water resources; health and human settlement and tourism. Vulnerability to climate change differs between agro-ecological regions, with the semi-arid areas being worst affected. While all sectors and groups engaging in agriculture will be affected, this will be most severe for poor people living in marginalised areas, where the complex interaction of socio-economic stressors in subsistence farming households (poor health, inequitable access to land, gender inequality, population growth, and increasing competition for shared resources) will be exacerbated by climatic changes.

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

3.4.1 Identified adaptation and mitigation priorities articulated in policy and strategy

Adaptation

The Second National Communication to the UNFCCC (2013) commits the country to low-carbon development and to secure appropriate long-term sustainable resources for adaptation to the effects of climate change. Associated with identified vulnerabilities, adaptation responses are prioritised in the following areas: agriculture and food security, water resources, energy, and health. Some specific adaptation priorities are:

- ***Agriculture and food security***: Establishing early warning systems; conducting vulnerability and adaptation assessments; improving crops and livestock for drought; soil fertility improvement and moisture conservation; conservation farming; and adjusting planting dates;
- ***Biodiversity*****:** Reducing non-climatic stresses; controlling and minimising wild fires; strengthening protected area networks and increasing conservation efforts outside protected areas;
- ***Rangelands***: Using livestock feed to supplement grazing; increasing animal disease surveillance and control mechanisms; and land use (re)planning to ensure competitive land use practices;
- ***Water*****:** Integrated management of water resources; water harvesting and storage; increasing water utilisation to reduce loss through runoff; increasing efficiency of water use especially in agriculture where irrigation efficiencies range between 40 percent and 60 percent;
- ***Human settlements and tourism*****:** Designing and implementing climate proofed settlements; implementing rainwater harvesting; constructing dams throughout the country; increasing/improving water recycling in urban areas; and protecting biodiversity within and outside protected areas;
- ***Industry and energy*****:** Photovoltaic pilot project supported by GEF/UNDP;
- ***Economic planning (and infrastructure*****):** Establishing an irrigation fund and national budgeting for droughts.

3.4.1.1 Barriers to adaptation

The NSCA (2006) identifies the following barriers to adaptation to climate change:

- Informational barriers: Brain drain, inadequate research and development facilities, low levels of awareness about climate change;
- Political and institutional barriers: Inadequate planning capacity and weak institutions, inadequate local training facilities and programmes;
- Socio-cultural barriers: Resistance to use biogas for cooking or efficient woodstoves in place of open fires; and
- Financial barriers: lack of financial resources.

Mitigation

An inventory of sources of greenhouse gases (GHG) conducted in 2000 noted that the energy and agriculture sectors were by far the most significant contributors of GHGs, at about 69 percent and 22 percent respectively. The Second National Communication (2013) identifies energy and urban waste management as the most important areas for mitigating the impact of climate change, with agriculture and forestry also important, especially for carbon sinking. The following **mitigation measures** have been identified:

- ***Industry and energy****:* Creating an enabling environment for energy investment, industrial energy management through integrating energy in business management principles and activities towards lower energy intensity production; identifying and utilising highly energy efficient technologies; installing more efficient coal-fired industrial boilers and furnaces; reducing nitrous oxide emissions from fertiliser

production; and waste composting. Investing in renewable energy is a further key mitigation strategy, including implementing solar energy projects, generating hydropower from irrigation dams and perennial rivers, utilising wind and biogas technology, and producing biofuels from sugarcane and Jatropha;

- ***Waste management:*** Educating citizens about source reduction; encouraging re-use practices; establishing salvage and re-use programmes; implementing backyard composting programmes; implementing volume-based refuse collection fees and regulating packaging;
- ***Agriculture:*** Construction of biogas digesters in communities; more efficient tobacco barns; use of solar PV power; efficient motors; zero tillage; and research on livestock diet and genetics;
- ***Forestry:*** Reforestation and afforestation; promulgation of environmental management legislation; and involvement of local leadership in protecting forests, and reducing the incidence of forest fires.

3.4.1.2 Barriers to mitigation

The constraints to the mitigation of climate change include lack of or inadequate:

- Government policy on energy efficiency;
- Information on energy efficient technologies;
- Technical knowledge on renewable energy to promote available technology;
- Funds to procure energy efficient technologies;
- Technical capacity to tap into clean technology funds;
- Community ownership of renewable energy projects, which get vandalised;
- Co-ordinated waste handling approaches, markets for recycled materials; and
- Consumer awareness.

A number of cross-cutting needs are also identified in the NCCRS which are seen as 'strategy enablers':

- ***Capacity building, research and technology transfer:*** Capacity development at multiple levels, building capacity for vulnerability assessments, risk analysis, intervention strategies, mainstreaming of CCD and disaster risk reduction; and community empowerment. Capacity building includes a focus on strengthening the role of the meteorological services which involves: strengthening systematic observations, data collection and management, and climate modelling; establishing enabling knowledge sharing platforms; building a climate knowledge repository; strengthening documentation of indigenous knowledge; building capacity of the Department of Meteorological services. It also involves a focus on technology transfer involving energy efficiency, clean technology development, management of effluent and pollution and promote use and production of more appropriate inputs for agriculture, mining, industry, energy etc.
- ***Education and raising awareness***: Curriculum innovation at all levels, teacher education, strengthening public awareness of climate change and its impacts, enhancing public participation, and strengthening scientific training for CCD.
- ***Governance:*** Strengthening mainstreaming of climate into policies and all levels of governance; adopting multi-stakeholder approaches, providing appropriate financial

and technical support, strengthening early warning systems for vulnerable groups especially, and strengthening provision of emergency response services.

3.4.2 Identified needs associated with CCD articulated in workshop interactions

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

- Improved **technologies** (assessment of the technological needs);
- Integration of **knowledge in climate change** in the Government's development programmes;
- Establish opportunities for **exchange programmes** between the sectors and the communities;
- Develop **agricultural practices** more resistant to drought and more productive
- Improve resilience and adaptability of **food production**, and focus on overall **food security** in the country;
- **Soil erosion** and saline intrusion;
- Combating illegal fires;
- Species **reforestation** for multiple use and mangrove protection;
- Rezoning of **conservation areas** and establishment of new conservation areas; and
- **Revision of legislation** for the integration of climate changes aspects in the different sectors (e.g. education, mining, etc.) and development of a national climate change strategy.

3.4.3 Identified needs for CCD articulated in questionnaire data

Questionnaire data showed a relationship between institutional interest / mandate and/or disciplinary interest / mandate and the definition of priority needs (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
Coordination of climate change work so that there is no duplication of effort but rather strengthening of projects with all relevant disciplines An agreed institutional framework for climate change work	Environmental Sciences Institute
Promote afforestation, use of biofuel and also promote organic farming	AGRITEX: Training
Sustainable water use and management; sustainable waste management; Climate smart agriculture including soil and water conservation; Wetlands protection including deforestation; Land use nationalisation	UN world food programme: VAMM/E

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
Industrial development, agriculture, livelihoods and biodiversity	Environmental Management Agency: Environmental Planning and Monitoring
Increase water harvesting infrastructures (dam construction) and implementation of viable irrigation schemes	Grain Marketing Board: Farmer Support Services
Irrigation development	Ministry of Agriculture: AGRITEX
Policy implementation and monitoring would be the major issue; Aggressive awareness drives that unpack the technical nature of the field of climate change into ways that the ordinary individual could relate to; Stakeholder cooperation and consolidation for the purpose of fighting or progressing in one accord	Consumer Council of Zimbabwe: Public Relations/Administration
Design curricula that include climate change aspects; Build capacity of other institutions of higher learning; Participate in awareness raising Design short courses (accredited and non-accredited) for those with interest in climate change	Oxfam: Food Security and Livelihoods and Climate Change
Climate change needs to be clearly defined and have a common understanding of what it really means across the entire populace	Scientific and Industrial Research and Development: GRSI
Increased appreciation of the use of climatic information. Development of a climate policy. Increased coordination of climate related activities / programmes	Department of Agricultural Technical and Extension Services: National Early Warning Unit
Weather or climate data should be easily accessible to all researchers. All initiatives must include the communities at all stages of the project cycle. Adoption of technologies	Ministry of Agriculture: Matopos Research Institute
Clear coordination of research outputs and policy development	ZIMVAC: Assessment, Research, Monitoring and Evaluation
Conducive policies development; Resources support to research and development including climate compatible development; Strong networking and linkages with other international and regional climate change knowledge partners	UN world food programme: C/FFA
Biodiversity; Agriculture; Mining activities	CPSE Department: Chemical Process System & Engineering
A revision of the education curriculum from primary school to university to mainstream ''climate change'' to the education system Make agriculture, especially tobacco production, climate compatible Integrate laws and regulations into a single climate change legislation	Agricultural Sciences and Technology, Crop Science and Post Harvest Technology
Application of results from research; Establishing mechanisms of influencing policy	Geography

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
Loss of urban wetlands to urban spatial development; Deforestation linked to tobacco production; Inadequate water resources – need to develop ground water resources; Need to develop renewable energy resources	Ministry of Science and Technology, Geography and Environmental Sciences
Education to embrace CCD approaches across the curriculum starting from Early Childhood Development (ECD) to tertiary level. Research and innovations into 'green' technologies	Department of Education (Science and Maths Education)
Tackling of the poor economic situation to cater for funding Improvement of rural road network Development of ICT infrastructure and TV and radio network for communication etc.	Arts and Education, teacher development
Community participation; drought tolerant crops and varieties; training; considering farmers' perceptions; contextualising the climate change issues; livestock and small livestock management; small grains development; food security; indigenous vegetables and fruits; holistic development	Faculty of Agriculture, Environmental and Natural Resource Economics
Use of climate smart agricultural practices that reduce emissions of GHG; Use of agriculture technologies that increase water use inefficiency; Increasing use of technologies that use solar power to generate electricity	Directorate of Research, Ministry of Agriculture
Water harvesting techniques; Development of new crop varieties - compatible with the environment; Enhancing water through building of dams; Information dissemination; Development of new animal breeds - compatible for new environment; Rehabilitate areas; Control fires	Science and Technology, Agriculture
Addressing the MDGs; Agricultural sector – adaptive crops; Address environmental health issues	Science and Technology, Nursing Science
Growing of short season variety of crops and more emphasis on the growing of indigenous small grains to ensure food security. Development and growing of seeds for those varieties should be prioritised.	Humanities and Social Science
There has to be a multisectoral response in the pursuit of CCD. Issues of funding, research will then be brought into an environment where all stakeholders are geared towards the pursuit of CCD	Humanities and Social Science
Protection of rangelands from fires; Water harvesting is more efficient method of irrigation; Awareness campaigns to help communities to reduce activities that contribute to climate change; Include impacts of climate change in education curricula of schools and tertiary institutions	Agricultural Sciences, Animal Science and Rangeland management
Rural electrification; Community awareness through community participation; Staff development in climate change and development of educational programmes on climate change Research	Science and Technology, Health Science
We need to reach out to the communities and convince them; We need to reduce resource use	Research and Scholarship

Need identified	Institutional interest / mandate and/or disciplinary interest / mandate
Climate information generation and dissemination; More climate science in secondary school and tertiary education curriculum	Science, Agriculture meteorology
Policy; Awareness raising on climate issues; Education	Applied Social Science, Disability Studies and Special Needs Education
The challenges of the availability of expertise dealing with sports people in the circumstances. Do they understand that performance could be affected by climate change?	Science and Technology, Health Science, Physical Education and Sports Science
Awareness of climate change and its effects; Developing appropriate mitigation and adaptation strategies; Capacity building of researchers, extension agencies and the general community	Natural Sciences Management and Agriculture
Reduction in poverty; Political and economic stability; Rule of law	Science and Technology, Geography and Environmental Sciences
Development of CCD curricula from primary school level to university level	Science and Technology, Agriculture
Introduction of development of green technologies in the manufacturing, agriculture and mining activities	Commerce, Economics

Table 2 above shows that stakeholders and university staff observe a wide range of priority needs that require attention for CCD in Zimbabwe. The diversity of responses shows that different institutions / disciplines and levels of interdisciplinary management often shape the perceptions of what the most important climate compatible development 'needs' are. Interestingly the responses from questionnaires shown above show a general agreement that the needs for CCD involve policy change and implementation, various mitigation and adaptation strategies in agriculture, energy, water, biodiversity, mining and technology development which is not unlike the policy documents. There is also strong support for integrating CCD into education and training systems, for curriculum innovation, and for strengthening research practices and knowledge sharing. While it is important to identify these common areas and needs, it is also important to identify and recognise these different perspectives in knowledge co-production processes and approaches, as personal experience and context can shed light on the specific priority areas that need to be addressed. The diversity of responses from such a varied range of experts in their field, show the interdisciplinary and multi-sectoral nature of climate change. *How to harness such perspectives, and the associated expertise that informs such perspectives is the ultimate challenge of a knowledge co-production framework and process.*

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

A second important part of the Needs Analysis undertaken in the context of the SARUA Mapping Study involves more detailed analysis of CCD knowledge, research and capacity gaps, with a focus on those identified in key national documents, and as articulated by stakeholders and university staff attending the workshops and completing questionnaires.

3.5.1 Research needs and knowledge gaps

According to the National Climate Change Response Strategy (NCCRS), capacity building, technology transfer, education, communication and public awareness are critical enablers for the implementation of the strategy, as noted above. While capacity development is required at community, district, provincial, national and regional levels, meagre resources are often devoted to capacity development initiatives.

The NCCRS provides an assessment of the extent to which climate change is incorporated into Zimbabwe's tertiary education sector, which is consists of teacher training colleges, agricultural training colleges, polytechnic colleges and universities. The strategy notes that generally both primary and secondary schools' curricula do not adequately address climate change. Teacher training and agricultural colleges cover climate change as part of the carrier subjects which their graduates then teach at primary and secondary schools and to farmers, respectively. Thus, the NCCRS notes the same weaknesses pointed out for school curricula also apply to the tertiary colleges, in that the course content is not broad enough and will need enhancement. There is also a need to retrain national extension officers (e.g. Agricultural Extension, Environmental Management Agency), agro-service providers, and NGOs to implement action plans for climate change adaptation with communities. At the universities, climate change is taught as part of Geography and Environmental Studies or of Atmospheric Studies that include Meteorology and Climatology or is mainstreamed into other courses in the disciplines of Crop, Animal, Soil Sciences and Agricultural Economics at most Zimbabwean universities. The NCCRS further notes, "Indeed, nowhere is climate change offered as a stand-alone course at all universities", and calls for a situational analysis of climate change curricula in all tertiary institutions to be carried out as a starting point. The NCCRS also recommends strengthening of scientific capacity for CCD across all sectors, and in particular, it suggests a need for the following research:

Climate Sciences, Observation and Modelling

- Modelling and prediction for time scales between weather forecasts and seasonal forecasts and between seasonal forecasts and multi-decadal climate change projections
- Modelling, ground truthing and assessment of high levels of surface ozone and exploring their possible contribution to global warming and climate change
- Data generation on rainfall and runoff and implications of reduced rainfall on socio-economic activities, agriculture, and water quality
- Establishment of a strong national monitoring system and network

Water

- Risk analyses (modelling) to predict the various climate change scenarios on water availability and on the various use sectors
- Regular yield assessments for surface and groundwater storage
- Intensify monitoring networks for hydro-meteorological parameters (e.g. rainfall, temperature, evaporation, river flow, aquifer levels)
- Promote accessibility of hydro-met data
- Exploration and analysis of groundwater sources

Land Use and Forestry

- Development of information systems to capture and manage land-use changes
- Develop instruments for accounting for carbon stock changes (including soil carbon) and for emissions of GHGs from land use and land-use change
- Strengthen research, planning and financial support to forestry and natural resources management to develop cost effective adaptation options
- Strengthen education and training in forestry and climate change adaptation, and forestry extension
- Identify and map forest areas and other lands that can be managed for carbon mitigation under different schemes
- Identify and map designate areas that are suitable for management of forests to enhance environmental services and climate change mitigation
- Develop capacity for measurement, reporting and verification (MRV) of carbon stocks (including soil carbon) in forests and other treescapes; to enable better use of the Clean Development Mechanism (CDM) and similar carbon funding programmes

Biodiversity and Ecosystems

- Develop comprehensive biodiversity inventory and monitoring programmes to determine the status of biodiversity, land-use change and to assess the carrying capacity of the landscape
- Develop indicators and monitoring systems to measure the impacts of climate change on biodiversity and livelihoods
- Develop a monitoring system to analyse the role of Transfrontier Conservation Areas as a mechanism for expanding biodiversity habitat
- Strengthen the monitoring of water quality and quantity in lakes and dams to ensure sustainable fishing

Agriculture and Food Security

- Harness available scientific and indigenous knowledge and technologies to increase productivity; stimulate industrial growth and participate in regional and global markets to support diversified livelihoods
- Support research on how indigenous knowledge can be integrated into evidence-based planning frameworks, informed by good science.
- Conduct assessment of vulnerability and adaptive capacity of communities, and their relative dynamics across the rural-urban divide, agro-ecological zones and social groups within communities

- Co-learning and participatory research and development for communities, local leaders/authorities, extension, private agro-companies, researchers and policy makers to jointly evaluate adaptation options against current and future vulnerabilities to climate change
- Long term research on diversification and improvement of crops and livestock for stress tolerance against climatic and environmental factors
- Research and innovations in fertiliser development that increase productivity without emitting GHGs
- Investigate and document livestock breeds that are drought and climate resistant and other coping strategies that livestock farmers have employed, and promote and support them
- Establish monitoring systems for GHGs in agricultural systems

Industry and Commerce

- Research into appropriate technologies that do not use excess resources
- Research to develop the required technologies, monitor and assess GHGs in the mining sector
- Research on extreme events such as droughts and floods and their implications for tourism products including wildlife, water bodies and major tourist attractions
- Strategic research on carbon dioxide emissions associated with tourism related to transportation and accommodation

Physical and Social Infrastructure

- Research into renewable energy (solar energy, mini hydro-power stations, generation of energy from waste and wind energy)
- Conduct local carbon footprint measurements
- Assess infrastructure sectors in terms of low, moderate, high and extreme climate change scenarios and commission studies on the potential risks to infrastructure that could be caused by climate change and on infrastructure interdependencies
- Conduct research to determine the quantity and composition of waste generated in Zimbabwe
- Promote research to develop appropriate technology for value addition of recovered waste products
- Promote research and development into use of solid waste for energy recovery/electricity generation

Health, Gender and Disaster Risk Management

- Strengthen programmes for monitoring human, crop and animal health under a changing environment.
- Research to fill existing knowledge gaps on risks associated with climate induced disasters
- Assess impacts of climate change on women, men, girls, boys, youth and vulnerable groups
- Collect gender disaggregated data on climate change issues especially in rural areas where women carry out most of the household and agricultural work

Capacity Building Research

- Adopt a case study approach to determine appropriate intervention strategies that enhance capacity in disaster risk management and climate change

General

- Build a climate change knowledge repository, based on reliable data, international best practice and scientific evidence, with the support of development partners
- Strengthen the documentation of, and tapping into indigenous knowledge to complement scientific knowledge for climate change adaptation
- Support research and development of technologies for the benefit of all relevant sectors

Table 3 compares the knowledge, research, individual and institutional capacity gaps identified by workshop participants.

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

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
AGRICULTURE AND AGRICULTURE MANAGEMENT	▪ Seasonal forecasts: knowledge on seasonal forecast is limited ▪ Communication: Interpretation of seasonal forecasts to lay people i.e. language used in forecasts ▪ Lack of general knowledge on climate change mechanisms and mitigation which needs to be taken up in the education system e.g. implications of deforestation burning on the atmosphere ▪ Lack of knowledge on appropriate drought tolerant varieties and breeds ▪ No information on relationships between indigenous knowledge systems and scientific ▪ Poor information on stress physiology- how plants and animals adapt to changes in temp and others factors ▪ Inadequate knowledge of adaptation mechanisms and modelling. ▪ Inadequate knowledge of value addition of indigenous crops	▪ Improved climate forecasting, modelling and communication of climate forecasting for the general public ▪ Explore use of ICTs in modelling and forecasting ▪ Lack of information from Meteorological Department for modelling ▪ No information on extent of public appreciation of climate change issues and their ability to adapt to climate change ▪ Research gaps on varietal and breed adaptation to drought and heat, disease resistance ▪ More exploration between indigenous knowledge systems and scientific knowledge ▪ Research into mechanisms of adaptation and stress tolerance	▪ Individuals lack capacity to receive and effectively use climate change forecasts ▪ Manpower shortages in breeding, biotechnology, and related research ▪ Mentoring of new scientists is lacking ▪ Research skills, especially use of sophisticated ICT based modelling approaches	▪ Educational system needs to mainstream CC knowledge ▪ Research skills and appreciation of the importance of this issue ▪ Little knowledge of what is taught in schools and colleges about climate change ▪ Institutional capacities need to be restored in Zimbabwe

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
MANAGEMENT OF AVAILABLE WATER: Water Harvesting Techniques Wetland Rehabilitation / Management Water Hyacinth Management	▪ Limited knowledge on the effects of climate change on future water availability ▪ Limited understanding of indigenous knowledge systems for water harvesting ▪ Limited knowledge of choice of water harvesting technology and relationships between these choices and soil type ▪ Limited knowledge on wetland management ▪ Limited knowledge of indigenous knowledge systems and wetland management	▪ Use of models to predict/project the effects of climate change on water resources ▪ Surveys of wetlands need to be updated ▪ Database creation ▪ Experimental research on appropriate water harvesting techniques ▪ Appropriate research methodology for data collection and models for use ▪ Documentation and evaluation of indigenous knowledge related to Rain Water Harvesting (RWH) and wetland management	▪ Lack of expertise with capacity to use models and modelling techniques	▪ Lack of expertise to train modellers ▪ Lack of coordination ▪ Lack of collaboration among institutions ▪ Systems and structures e.g. missing links, interface and connections to properly house climate change, water issues being overshadowed in some organisations by other issues, not getting adequate attention ▪ Appropriate technology, computers and inadequate financial resources to buy super computers
CLIMATE SCIENCE KNOWLEDGE	▪ Limited data collection points or weather stations ▪ Lack of context specific models	▪ Contextualised modelling ▪ Applied research ▪ Participatory research on linkages between indigenous knowledge and western scientific knowledge ▪ Reclassification of agro-ecological or climate zones	▪ Shortage of climate modelling experts ▪ Shortage of climate science researchers and lecturers ▪ Research skills, especially for contextualised modelling	▪ Low uptake of climate science disciplines amongst students ▪ Limited funding for climate science research areas ▪ Lack of institutional framework to mainstream knowledge of and participation of communities in data collection, verification and utilisation ▪ Institutional structures for disseminating climate science knowledge to end users is weak

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
COMPREHENSIVE MONITORING FRAMEWORK FOR CCD	▪ Limited knowledge on realistic targets and impacts across sectors	▪ Holistic or systems approach towards consolidating interdisciplinary research outcomes across different disciplines ▪ Process for collaborative and multidisciplinary research, targets and impacts	▪ Experienced CCD monitoring experts shortages	▪ Collaborative or interdisciplinary networking to develop credible and realistic monitoring frameworks and models ▪ Limited access to data generated from surveys, monitoring, modelling due to prohibitive costs ▪ Low uptake of short courses or refresher courses on CCD ▪ Scientific nature of research publications prohibit non-technical audiences from utilising the same information
EDUCATION AND COMMUNICATION	▪ Lack of or inadequate communication ▪ Language gap ▪ CC knowledge and CCD systems knowledge is understood differently ▪ Laxity in awareness drives ▪ Lack of appropriate literature ▪ Climate change education not incorporated in elementary school ▪ Policy implementation and monitoring	▪ No study to ascertain levels of knowledge ▪ Failure to impart technical information in an understandable manner ▪ Documentation and publication of statistics and figures ▪ Research into policy gaps and policy development	▪ Human resources for communication and education lack expertise in CC and CCD	▪ Media gaps related to the degree and amount of information and knowledge provided ▪ Top down approaches ▪ Teacher education systems not including CC / CCD adequately

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
WATERBORNE DISEASES	▪ Limited knowledge on the importance of use of safe water for domestic purposes ▪ Limited knowledge of CC will impact on waterborne diseases	▪ Community assessment on knowledge of diseases caused by poor WASH facilities ▪ Research into WASH facilities and CC influences and possible impacts	▪ Community health expertise with CCD knowledge ▪ Environmental Health expertise with CCD knowledge ▪ Village health workers with CCD knowledge	▪ Inadequately trained personnel ▪ CCD issues not being taken up into WASH studies and knowledge production processes – seen as separate issues leading to poor understanding of relationship between WASH and CCD ▪ Limited funding
DISASTER MANAGEMENT	▪ Limited knowledge on the impacts of floods ▪ Lack of disaster preparedness ▪ Community cultural beliefs for example when it comes to relocation	▪ Inter country collaborative disaster management ▪ Environmental and Social Impact Assessments and Risk and Vulnerability Assessments ▪ Evaluation of the impacts of floods ▪ Integration of indigenous knowledge systems in flood management ▪ Inter-ministerial management of climate change related disasters	▪ Expertise on disaster management and preparedness ▪ Monitoring and evaluation (after effects of the floods)	▪ Inter-ministerial collaboration in disaster management limited ▪ International collaboration in disaster risk reduction and management limited, especially for shared river systems that flood
NUTRITION AND FOOD SECURITY	▪ Limited knowledge on small grains – early yielding and drought resistant varieties, for example, rapoko ▪ Limited knowledge on the nutritional benefits of such grains like rapoko	▪ Assessment of the viability of different crop varieties in different regions; with emphasis on nutritional value and food security ▪ Food production and trade system changes ▪ Knowledge on nutritional benefits of small grains	▪ Nutritional scientists ▪ Soil scientists and biological scientists ▪ Nutritional evaluation of different food crops	▪ Limited institutional capacity to develop and implement educational programmes and new research programmes

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
SKIN DISEASE PREVENTION AND MANAGEMENT	▪ Limited knowledge on the effects of increased heat/sun light (ultraviolet) on the skin ▪ Limited knowledge on the importance of staying indoors or under the shadow ▪ Lack of indigenous trees (trees in general) especially in the rural areas	▪ Surveys on the magnitude of skin cancers due to increasing temperatures ▪ Surveys to establish knowledge gaps, attitudes and behaviour related to heat increases	▪ Skin problem experts – dermatologists	▪ Limited institutional capacity to train dermatologists
MINING AND TECHNOLOGY	▪ Existence of alluvial river gold panning but lack of mining (appropriate) technology ▪ Impacts of mercury in aquatic ecosystems ▪ Lack of knowledge of clean technology for artisanal mining	▪ No research is taking place on sustainable mining in river beds (from experience with EMA)	▪ No interaction between miming experts and water management experts hence lack of holistic approach in the management of river bed mining	▪ Fragmented research units (focus areas) in tertiary institutions ▪ Lack of institutions involved in research of this nature
SUSTAINABLE ENERGY	▪ Sustainable energy generation and use options	▪ Research on efficient generation of energy required and information dissemination approaches ▪ Policy gaps	▪ Few renewable energy experts ▪ Limited interdisciplinary sharing of knowledge	▪ Need for sustainable energy experts and research facilities for sustainable energy research programmes and pilot testing of viable options

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
BIODIVERSITY MANAGEMENT AND CONSERVATION	▪ What still exists in the forests? For example, the disappearing species e.g. *Bulimia decurens* including species mix ▪ Information update of the flora and fauna of Zimbabwe. A starting point is Herbarium and Botanical Institute of Zimbabwe ▪ Limited knowledge of climate sensitive flora and fauna e.g. disappearance of Mopane worms and unsure whether it's due to harvesting or other reasons ▪ Limited knowledge of the impacts of temperature increases on flora and fauna	▪ Surveys of flora and fauna biodiversity need updating ▪ Database creation ▪ Appropriate research methodology for data collection and models for use ▪ Socio-economic aspects that relate to CC influences on flora and fauna	▪ Lack of expertise with biodiversity management systems (BMS) ▪ Lack of Zoology and Botany specialists; statistical modellers; biodiversity management specialists ▪ Training of new generation of scientists and biodiversity practitioners as many have been lost to the 'brain drain' ▪ Interest and motivation	▪ Lack of expertise to train next generation of biodiversity specialists ▪ Lack of coordination ▪ Collaboration among institutions ▪ Systems and structures e.g. missing links, interface and connections to properly house climate change, biodiversity issues being overshadowed in some organisations by other issues, leading to neglect of biodiversity issues ▪ Reward and remuneration systems for the biodiversity sector are weak and it is difficult to attract people into this sector

Prioritised needs for CCD	Knowledge gaps	Research gaps	Individual capacity gaps	Institutional capacity gaps
FOREST MANAGEMENT AND CONSERVATION Re-greening Matching of site to plant species Development of climate resilient plants Natural Woodland Management Integrated Management of Invasive Alien Species	▪ Lack of knowledge on the ecology and management of Indigenous trees ▪ Lack of knowledge on how to improve their adaptability and productivity – and what 'climate resilient plants' would be, and how ecosystems are being affected by CC ▪ Lack of accessibility (cost) and awareness of alternative energy sources ▪ Lack of linkages with other stakeholders such as energy, infrastructural development on alternative sources ▪ Lack of knowledge of matching site to plant species and how CC will affect plant species and their distribution, especially also to changes in ground water and ground water use patterns.	▪ Lack of research methods/ knowledge on Indigenous trees ▪ Lack of knowledge on germinating / propagation and improving growth of indigenous trees ▪ Lack of use of IKS in scientific research ▪ Integrated pest and invasive management systems ▪ Research on integrated management of invasive alien species in CC conditions	▪ Lack of foresters (silviculturists, breeders and forest entomologists) ▪ Lack of energy specialists ▪ Lack of forestry scientists with CCD expertise	▪ University curriculum to mainstream CC issues to do with forestry in all courses and the development of forest science ▪ Training of new practitioners as the sector has been affected by the brain drain ▪ Reward and remuneration systems to retain expertise ▪ Integrated responses to energy resources and alternatives to reduce deforestation

The workshop participants provided extensive detail of the specific knowledge and capacity gaps for Zimbabwe, within clearly defined thematic contexts. Overall there was a lack of climate change knowledge in various sectors highlighted, with particular concern with the effect of climate change on **water reserves, forestry, agriculture, health**. Issues with limited data to shape **monitoring mechanisms**, and establishing **modelling scenarios** was also a constantly cited concern. A lack of knowledge to inform **disaster preparedness** for flooding and drought specifically was also prioritised by participants. An interesting cross-cutting knowledge limitation is the inadequate incorporation of **indigenous knowledge systems** across sectors and how IK can be related to scientific knowledge, and **education, training and curriculum development** were also emphasised.

With regard to **research gaps**, participants called for **holistic approach towards consolidating interdisciplinary research** outcomes across different disciplines and developing appropriate **research methodology for data collection** and to develop modelling scenarios for the country. Documentation and publication of research was consistently referred to by participants as a vital research need that can nourish the climate change and CCD related research culture in Zimbabwe, but also improve how research feeds into policy and implementation.

Specific **knowledge gaps** emerging from policy point to the need for comprehensive climate change information and science to adequately support decision making. Knowledge on how the private sector can participate in greening the economy was also included in policy. Climate change vulnerability at household level, local climate risks and sensitivities, local coping strategies and innovations to hydrological stress and cross-sectoral and community adaptation were highlighted in Zimbabwe National Climate Change Response Strategy (2013) as key knowledge gaps to be considered. Congruent with the workshop participants, climate change effects in the health, water and natural resources management sectors were stressed, as was the need to improve meteorological data sets and other baseline data on the national level impact climate change.

Prioritised **research gaps** raised by the Zimbabwe National Climate Change Response Strategy (2013) align closely with those emergent in the workshop. The strategy also calls for a holistic approach to climate change research, and improving research tools and techniques on all aspects of climate change. Policy research, formulation and analysis that can be used to support decision making systems as well as curricula development were highlighted in the strategy. Other interesting cross-cutting research gaps mentioned in the strategy were the need for gender differentiated data and the role of indigenous knowledge in adaptation and mitigation.

Questionnaire data by-and-large confirmed the above, and added the following nuances to the identified knowledge gaps and research needs.

- Monitoring agriculture season, droughts, yields assessments, fire: developing drought tolerant crop varieties (e.g. SIRDA maize 113)
- Use of models to predict/project the effects of climate change on various aspects of agriculture and food production
- Mitigation actions towards climate change related shocks and hazards
- Community-based monitoring of climate change

- Climate change adaptation and mitigation in transfrontier conservation management contexts
- Agro-climatology research

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

The Zimbabwe National Climate Change Response Strategy (2013) notes that key capacity gaps exist in forecasting and developing and using climate models, understanding and using numerical weather prediction models, conducting comprehensive vulnerability assessments and effectively sharing information, participating in cross-sectoral communication and operating/maintaining new technology. Technical capacity to implement/manage climate change projects as well as participatory planning and community involvement were also seen as specific individual capacity gaps. Other specific skills needed are in using and developing Geographic Information Systems (GIS) and remote sensing, effective participation in international negotiations, environmental entrepreneurship and scientific training of technical and managerial personnel to respond to climate change issues. The policy also highlights the need to build the capacity of foresters and government agencies for measurement, reporting and verification of carbon stocks.

There are several initiatives in Zimbabwe aimed at building climate risk management capacities: some at national level with government, private sector and civil society participation and others at community level. Three examples are: the multi-stakeholder promotion of conservation agriculture practice in about 50 percent of the rural districts of the country, the strengthening of National Capacity for Disaster Management in Zimbabwe, and exploring measures to enhance the adaptive capacity of local communities to respond to pressures of climate change. Further detail on these is provided in the institutional analysis.

3.5.3 Needs analysis: Institutional capacity gaps

The policy review revealed the following specific institutional capacity gaps, which were mainly sourced from the draft Zimbabwe National Climate Change Response Strategy (2013):

- Coordinated policy or legislative framework governing climate change matters;
- Strengthened policy framework for conserving biodiversity and protecting ecosystems;
- Existence of multiple and diverse organisations working on climate change;
- Climate change policy and response strategy;
- Access to processed climate change data due to costs associated with the commercialisation of the Meteorological Department;
- Database that includes occurrence of environmental hazards and level and spatial spread of vulnerability;
- Effective early warning systems that issue accurate and timely information;
- Mainstreaming of climate change in development plans across sectors and layers of government;
- Staff with the necessary competencies in the required numbers;

- Technical capacity to conduct policy relevant research and carry out long term planning;
- Capacity for communication, education and public awareness;
- Research, development and technology transfer
- Systemic observation and information sharing;
- Packaging of climate change information in formats that are appropriate to different stakeholder groups such as policy makers, industry and commerce, extension workers, NGOs, donors and farmers;
- Funding, related resources and incentives;
- Climate change focus offices in relevant ministries and with required competencies;
- Capacity building of local financial institutions to support and manage climate finance transactions;
- Enhanced participation of gender organisations in climate change negotiating and decision making processes; and
- Up-to-date research equipment and methodologies across climate sensitive sectors.

As indicated in Table 2 above, other institutional capacity gaps identified in the workshops include: limited co-operation amongst stakeholders, inadequately trained personnel, fragmentation amongst research units, and inadequate curriculum development, and inadequate resources (e.g. technological equipment) for research.

The Zimbabwe questionnaire responses identified the need for institutional capacity building in a range of key areas. Improved funding and funding mechanisms are needed, as is the need for improved human resources capacity building. Participants responding to the questionnaire also felt that collaboration and linking with other researchers in the area of rangeland and climate change was particularly crucial. Also highlighted was need to improve the institutional capacity to coordinate issues on climate in the Ministry departments responsible for climate change issues. Finally a coordinated policy framework governing climate change issues was seen as major institutional capacity gap. Hopefully this will be addressed by the draft National Climate Change Response Strategy (2013).

4 INSTITUTIONAL ANALYSIS

4.1 Introducing the institutional analysis

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

The institutional review begins by mentioning wider institutional arrangements for addressing climate change and moving towards CCD, and any relevant research and development frameworks. It then goes on to discuss some of the current climate change and CCD initiatives and programmes that are taking place in Zimbabwe, and identifies some of key stakeholders that could form part of a Zimbabwe's 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. From there, it also considers other aspects of higher education interaction with climate change and CCD, namely community engagement, student involvement, policy engagement and campus sustainability initiatives.

4.2 Policy and institutional arrangements

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

There are a number of statutory bodies that monitor and regulate the provision of higher education in Zimbabwe. These bodies address various issues including quality assurance, identification of training and research needs, representation of lecturing staff and monitoring occupational standards. The most important statutory bodies responsible for higher education provision in Zimbabwe are:

- The Zimbabwe Council for Higher Education (ZIMCHE), which monitors and regulates the quality of qualifications being offered by private and public institutions of higher learning within the country;

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

- The National Manpower Advisory Council (NAMACO), which acts as an intermediary between industry and higher education and supervises the industrial committees that identify, determine and monitor training needs;
- The Zimbabwe Manpower Development Fund (ZIMDEF), which is responsible for levy collection, and supplements voted funds for the procurement of training materials and consumables;
- The College Lecturers Association of Zimbabwe (COLAZ), which represents lecturers in collective bargaining;
- The National Economic Consultative Forum, which recommends economic priority programmes including human capital development; and
- The Zimbabwe Occupational Standards Service (ZOSS), which carries out job profiling and develops occupational standards upon which technical and vocational education and training (TVET) curricula are based, and which form the basis upon which examinations, test items and trade tests are developed.

The Ministry for Tertiary and Higher Education (TMTHE) is the custodian of post-secondary education in Zimbabwe. According to SARUA's previous profiling study (Kotecha 2008), the Ministry sets out a number of goals for higher education in the context of the country's needs and priorities. These goals were part of a five-year strategic plan implemented between 2006 and 2010. The paragraphs to follow pay particular attention to each of the goals (Kotecha 2008).

Enhancing quality education and relevance of higher and tertiary education and training: Contrary to the goal of the early 1980s of increasing access to education in order to reverse the racial disparities caused by the previous government, at the beginning of the new millennium, the government of Zimbabwe took the bold step of shifting focus from increasing access to higher education to paying more attention to the quality of higher and tertiary education being offered by institutions. The establishment of ZIMCHE in the early 2000s is a clear indication of how issues of quality assurance have become critically important in the provision of tertiary education in the country. Along with increasing the quality of education, the responsible Ministry also saw fit to ensure that institutions of higher learning link the programmes that they offer to the economic and developmental needs of the country (for example, curricula with a specific focus on poverty eradication, improved health standards and contributions to the creation of wealth). Climate change, as shown above is introducing a new developmental priority into Higher Education quality discourse.

Promoting science and technology in higher and tertiary education: In line with the Millennium Development Goals (MDGs), especially goals 1, 2 and 5, the Ministry has embarked on a drive to promote the teaching of science and technology in higher and tertiary education. Such a drive is expected to trigger innovation in various industries (for example in manufacturing and health). The spin-offs from these industries should help to improve the livelihoods of people in Zimbabwe as envisaged by the MDGs. Climate change draws renewed attention to MDG Goal 7, but also to the other MDGs as it requires cross-cutting science and technology innovations as shown above.

Enhancing the resource base and management of higher and tertiary education by intensifying income-generating projects for institutions and involving the private sector: While the

government remains the main funder of higher education, this goal seeks to bring more stakeholders into the funding process. This will enable higher education institutions to generate their own income through consultancy projects and knowledge commercialisation, and encourage the private sector to partner with government or individual institutions in funding the provision of higher and tertiary education. This goal also aims to facilitate the contribution of higher education to poverty reduction, enhancing partnerships for development and promoting gender empowerment.

Strengthening life skills education, including education about HIV and AIDS: by the turn of the 21st century Zimbabwe was one of the sub-Saharan countries ravaged by the high prevalence of HIV infections and related deaths. In a bid to reverse the impact of this epidemic the ministry placed high priority on ensuring that tertiary education plays a critical role in teaching and imparting life skills, especially relating to HIV and AIDS. This is in line with the MDGs and the national policy goal of combating HIV, AIDS, malaria and other diseases, and will be achieved through offering training in prevention, care and support. As noted above, climate change brings new and exacerbated health risks that would need to be covered under this goal.

Promoting regional and international co-operation by intensifying the implementation of the SADC Protocol on Education and Training and seeking the transformation of education in the region: As a signatory to the SADC Protocol on Education and Training, the Ministry fully subscribes to the mandate of this protocol. Hence the Ministry seeks to put all necessary means in place for the promotion of an integrated region, a harmonised system of education, an education management information system (EMIS), a common quality assurance approach, and an effective open distance learning system in the region. At the core of these goals is the issue of promoting sustainable economic development, reducing poverty and meeting the basic socio-economic needs of the people of Zimbabwe as reflected in the MDGs and the National Vision 2020. In order to monitor the progress of these goals, the Ministry has put in place a number of mechanisms, including: departmental and institutional performance agreements and individual work plans; monthly, quarterly, and annual reports by departments and institutions; and audit reports. At the time of writing this report it did not seem that climate change had been mainstreamed into these monitoring systems.

4.2.2 Policy context for climate change

Zimbabwe's 2012–2015 Medium Term Plan (MTP) recognises that climate change poses a significant and complex challenge to social and economic development, calling for climate-smart policies and placing climate change concerns at the centre of development strategies, plans and programmes in all sectors of the economy. The new draft National Climate Change Response Strategy (NCCRS 2013) provides a framework for a comprehensive and strategic approach on aspects of adaptation, mitigation, technology, financing, public education and awareness; and further includes a National Action Plan for adaptation and mitigation. Regarding other relevant policy and legislation, the National Environmental Policy and Strategies (2009) complements the Environmental Management Act (2003) in matters pertaining to environmental protection, monitoring and sustainable development. The sectoral Acts that have climate change dimensions include the National Water Act (1998); the

Meteorological Services Act (1990); and the Civil Protection (against disaster risks) Act (1989). The following policies are relevant to climate change issues in Zimbabwe: Agriculture, Land Reform, Wildlife-based Land Reform, Forestry-based Land Reform, Drought Mitigation, National Disaster Management, Energy, Transport, Gender, and Population.

4.2.3 Institutional arrangements for Climate Change

The Office of the President and Cabinet has overall responsibility for decisions on climate change policy. A National Task Team on Climate Change has been established under the Directorate of the President's Office. The Ministry of Environment and Natural Resources Management (MENRM) advises Cabinet and sectoral ministries on climate change matters. It chairs the National Climate Change Committee, which comprises representatives from government ministries; hosts the Climate Change Office; and is the Secretariat of the Clean Development Mechanism. The Climate Change Office coordinates climate change activities across ministries and organisations, including the private sector; and represents the country on climate change matters. The Disaster Risk Management Department, the Meteorological Department, the Environmental Management Agency (EMA)[13], the Department of Civil Protection, the National Early Warning Unit, and the Zimbabwe Vulnerability Assessment Committee also play important roles in climate change adaptation and mitigation. The EMA conducts much of the research and training on climate change issues in Zimbabwe.

Stakeholder engagement: The Institute of Environmental Studies at the University of Zimbabwe was appointed to lead the development of a National Climate Change Response Policy and Strategy. Nation-wide public consultations are being conducted on the draft National Climate Change Response Strategy, to ensure that it meets the needs and desires of Zimbabweans. This University Institute was identified as a major centre of climate change research in Zimbabwe during the workshops (see below).

4.3 Research and development frameworks

The aims of the Science and Technology Policy, which provides an important relevant research framework, include the promotion of rapid and sustainable development, and environmentally sound development programmes. The Ministry of Science and Technology, the Research Council of Zimbabwe (RCZ), and the Zimbabwe Scientific, Industrial Research and Development Centre (SIRDC) provide leadership on research matters in Zimbabwe.

[13] This was formerly the Department of Natural Resources.

4.4 Some current CCD initiatives and programmes

There are a number of CCD initiatives and programmes active in Zimbabwe. This institutional analysis was only able to identify *some* of these (see Table 4 below). More comprehensive national analysis would be able to expand the insights into existing active programmes.

Table 4: Some CCE initiatives and programmes in Zimbabwe

Programme / Initiative	Driving agency / department	Focus and time frame	Status / additional comments
Mainstreaming climate change adaptation in Zimbabwe's extension system	▪ Department of Agricultural, Technical and Extension Services (AGRITEX) ▪ Practical Action ▪ University of Reading ▪ Nuffield Africa Foundation	▪ Time frame unknown: Mainstream climate change adaptation in agricultural extension systems of Zimbabwe so that agricultural extension staff can facilitate smallholder farmers to adapt to, and cope better with climate variability and change	
Coping with Drought and Climate Change in Zimbabwe	▪ Environmental Management Agency and Natural Resources Management ▪ UNDP ▪ Funded by GEF-SCCF	▪ 2008–2012: Supporting effective adaptation among subsistence farmers in six locations in Chiredze District ▪ How to use climate risk information for agricultural planning	Project encouraged replication of optimised crop production by using Farmer Field Schools (FFS) as learning platforms
Lack of Resilience in African Smallholder Farming	▪ University of Zimbabwe and Soil Fertility Consortium for Southern Africa. Funded by the International Development Research Centre	▪ 2007-2010 ▪ Exploring Measures to Enhance the Adaptive Capacity of Local Communities to Respond to Pressures of Climate Change	
Support for the Strengthening of National Capacity for Disaster Management in Zimbabwe	▪ Department of Civil Protection and Ministry of Local Government, Public Works and National Housing. Funded by UNDP	▪ 2004–2009 (no details provided)	

Programme / Initiative	Driving agency / department	Focus and time frame	Status / additional comments
Capacity development of Trans-frontier Conservation Area (TFCA) managers and community leaders in climate change adaptation and mitigation	▪ SADC Regional Environmental Education Programme (REEP)	▪ Time frame unknown: Mainstreaming climate change adaptation and mitigation in TFCA Management Plans ▪ Climate change adaptation actions at local level ▪ Community-based monitoring of climate change	
Meeting Information and Advocacy Needs for Climate Change Adaptation in Zimbabwe	▪ DfID funded, co-ordinated by the International Institute for Environment and Development (IIED) and implemented by Zimbabwe Environmental Research Organisation (ZERO) and Dialogue on Shelter for the Homeless Trust	▪ 2012 (publication date) production of a set of nine interdisciplinary research papers and case studies on climate change adaptation concerns in Zimbabwe (see Box 2 below). Published as an IIED Working Paper.	

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

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

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

At present, climate change issues are addressed in the draft Zimbabwe National Climate Change Response Strategy (2013). Even with this policy, there is a need to develop a common understanding of the core issues of Climate Compatible Development (CCD) necessary for knowledge co-production in Zimbabwe. Discussion on the meaning of climate compatible development in the workshops in Zimbabwe centred around the core definition provided by the facilitators:

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

necessitates an iterative, learning-by-doing approach, that involves ongoing adaptation.

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

- "Climate compatible development involves activities that are aligned to address the impacts of climate change"
- "Currently as an organisation we focus on research and development, training and consultancy in areas of the environment, energy, water, agriculture, food, mining, engineering. So to us CCD is streamlining climate change in all these areas emphasising on mitigation, adaptation and doing vulnerability assessments"
- "CCD refers to methods used to reduce or mitigate effects of climate change"
- "CCD is a sustainable approach to development that recognises climatic risks while minimizing any further exacerbation of the same risks"
- "CCD is low carbon development that promotes clean energy sources and high efficient technology"
- "Development that promotes 'green' technologies. Adaptation strategies that promote resilience to climate change"
- "It is development which takes into consideration the effects of climate change and put in place counter measures to mitigate, adopt and strategize on climate change negative effects. For example putting in place irrigation to counter drought"
- "With the changes in climate, we have to come up with development strategies for the nation"
- "Climate compatible development would be development that is sensitive to the transformation in climate, particularly centred on the protection and conservation of the climate patterns".
- "Development that is driven and guided by the transformations on the climate"
- "Climate smart initiatives that ensure minimal/no emissions of carbon. Initiatives that build resilience of farmers or nation to effects of climate change"
- "It is development which considers mitigation of climate change and/or also adapts to climate change"
- "These are activities that centre around ensuring that development is based on incorporating the changes in climate or the variations"
- "These are developmental endeavours that put climate change impacts as a pivot for planning. The initiatives or plans produce optimal results under the given climate scenarios"
- "It's when current and future climate risks are mainstreamed into the development agenda"
- "This is low carbon and climate resilience development that is able to adapt and mitigate the risks and threats posed by climate change for example conservation farming in light of erratic rainfall patterns"

Within the Universities across Zimbabwe, there were somewhat different understandings of CCD, as shown by these extracts from the questionnaire data obtained from university respondents:

- "It is more of a green economy approach that is sustainable and minimises harm to the environment"
- "Development which leads to the creation of environmental conditions that give human capability to live in changed climate conditions (adaptability)"
- "Climate compatible development is development that takes into account changes in the climatic change conditions. Since some communities are overwhelmed by climate change in terms of the sources of their livelihoods, the development initiatives that takes place should enable these communities to be able to better cope with hazards, droughts and other associated disasters that come with climate change"
- "Development that mainstreams climate change in that it also considers mitigation and adaptation to climate change"
- "Development in an area, region or country which is compatible with the environmental friendly contents"
- "Adapting to changes and addressing mitigation issues"
- "Changes in Agricultural policy and priorities so that we find ways of growing enough food in the face of less water in some regions, and shorter seasons in some regions and water harvesting – more emphasis on irrigation technology"
- "It is development that is responsive to the demands of climate change. In other words, climate change is put at the centre of all development activities in order to achieve climate compatible development"
- "This involves a pursuit of a development agenda that is accommodative of a changed set of climatic conditions for the benefit of humanity"
- "CCD is development that takes into account in the context of agricultural use of crop varieties that are tolerant to the temperature and increased incidence of droughts and floods. It also encompasses the adoption of methods that provide a carbon sink to minimise desertification"
- "Climate compatible development is low carbon, climate resilient development. It is development that doesn't seek to increase the gravity of climate change. It is development that adapts well to the changing climate while at the same time mitigating the negative impacts of climate change. It is development that seeks to promote greening of the economy, hence, low carbon. It is development which is compatible to the changing climate"
- "This is the identification of problem areas that are related to climate change and the development of strategies to mitigate the problems"
- "It is development that we undertake with our eyes open to devastations in the environment and we have in place strategies for mitigation"
- "Realising that climate change is a fact of life there is need to adapt to the changing climate and adopt systems and technologies that help humans cope with these events"
- "In agricultural meteorology, it would mean climate smart agriculture. This means using climate information in agricultural processes in order to maximise the benefits of good weather and minimise the damaging effects of bad weather"
- "These are the actions people carry out either as individuals or groups to adapt to the significant changes in the climate"
- "How sport performance is coping with the changes in climate e.g. the severe of long heat periods, the windy days as they affect breathing and speed"

- "It is the idea of taking on board climate change issues/impacts in all developmental programmes in Agriculture and other sectors"
- "Climate development initiatives that take into consideration the changing climate in addition to changes in biodiversity"
- "It is development that fits the demands of climate change"
- "CCD involves development activities that do not harm our 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 **adaptation and mitigation**, and climate compatible development and **sustainable development**. It is also apparent that **the concept of CCD is relatively new** to some of the stakeholders. **Context** also has an influence on how CCD is understood, and influences meaning making and understanding of the concept. For example, those with agricultural specialist knowledge tended to relate the concept of CCD to its implications for agriculture, while health related interests influenced how the concept was seen in this context. This has important implications for knowledge co-production processes, and will require careful engagement in development of mutual understanding in such processes.

4.5.2 Current research related to Climate Compatible Development

4.5.2.1 General view

An assessment of what research is needed for CCD in Zimbabwe and a detailed database search of all research published on climate change / sustainable development research in Zimbabwe would provide substantive detail on what research is already being conducted in Zimbabwe. 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 Zimbabwe.

As mentioned earlier, the Institute of Environmental Studies at the University of Zimbabwe was appointed to lead the development of a National Climate Change Response Policy and Strategy. In addition to this the Ministry of Science and Technology, the Research Council of Zimbabwe (RCZ), and the Zimbabwe Scientific, Industrial Research and Development Centre (SIRDC) provide leadership on research matters in Zimbabwe, and are currently responsible for leading the climate change research agenda in the country. NGO organisations such as ZERO (Zimbabwe Environmental Regional Organisation) and a number of development research organisations (that are also linked to and associated with the University) such as the Centre for Applied Social Sciences (CASS-Trust; affiliated to the Social Science and Humanities Faculty) also undertake climate change research.

A rapid review of published research available on Google Scholar (first ten articles listed with 'climate change Zimbabwe' in the search) shows the following research conducted on climate change in Zimbabwe (see Table 5).

Table 5: First ten articles listed with 'Climate Change' and 'Zimbabwe' in the search and the origin of the first author

Article	Origin of first Author
Moyo, M., B.M. Mvumi, M. Kunzekweguta, K. Mazvimavi, P. Craufurd and P. Dorward. 2012. "Farmer perceptions on climate change and variability in semi-arid Zimbabwe in relation to climatology evidence," *African Crop Science Journal* 20(2): 317-335.	Zimbabwe
Thierfelder, C. and P. C. Wall. 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
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
Nkomozepi, T. and S.O. Chung. 2012. "Assessing the trends and uncertainty of maize net irrigation water requirement estimated from climate change projections for Zimbabwe," *Agricultural Water Management* 111: 60-67.	Zimbabwe/Korea
Nkomozepi, T.D. and S.O. Chung. 2012. "General Circulation Model Derived Climate Change Impact and Uncertainty Analysis of Maize Yield in Zimbabwe," *Journal of The Korean Society of Agricultural Engineers,* 54.	Zimbabwe/Korea
Marshall, B.E. 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
Nkomozepi, T. and S.O. Chung. 2011. "Simulation of the Effects of Climate Change on Yield of Maize in Zimbabwe," *Journal of The Korean Society of Agricultural Engineers*, 53.	Zimbabwe/Korea
Mugandani, R., M. Wuta, A. Makarau B. Chipindu. 2012. "Re-classification of agro-ecological regions of Zimbabwe in conformity with climate variability and change," *African Crop Science Journal* 20(2): 361-369.	Zimbabwe
Chikozho, C. 2010. "Applied social research and action priorities for adaptation to climate change and rainfall variability in the rainfed agricultural sector of Zimbabwe," *Physics and Chemistry of the Earth*, Parts A/B/C, 35(13): 780-790.	South Africa

From this it is possible to see that there are a variety of different research publications available regarding Climate Change in Zimbabwe. It is also possible to see that eight out of the first ten publications with the title including "climate change" and "Zimbabwe" (shown up on the Google Scholar search) are published within the last two years. All but one of the articles was primarily authored by researchers from Zimbabwe, showing that there a strong research presence regarding climate change in Zimbabwe that feeds into the international arena. The majority of the articles/chapters noted above in Table 4 focus on Agriculture and fisheries, and these sectors' adaptation to climate change.

However, there is a substantive body of research on climate change taking place in Zimbabwe, not all of which is published. Some examples are indicated below (found on the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) Open Access Repository. Here papers from the ICRISAT researchers in Bulawayo and University of Zimbabwe scholars were found:

- Mutsvangwa-Sammie, E.P, K. Mazvimavi, C. Murendo and G. Kundhlande. 2013. *A Micro-Level Analysis of Vulnerability to Climate Change by Smallholder Farmers in Semi-Arid Areas of Zimbabwe.* In Invited paper presented at the 4th International Conference of the African Association of Agricultural Economists, 22-25 September 2013, Hammamet, Tunisia.
- Mazvimavi, K.[14], P. Nyathi and C. Murendo. 2011. *Conservation Agriculture practices and challenges in Zimbabwe.* In Resilient Food Systems for a Changing World: Proceedings of the 5th World Congress of Conservation Agriculture incorporating 3rd Farming Systems Design Conference, 26-29 September 2011, Brisbane, Australia.
- Mazvimavi, K. 2011. *Coordinating and Advocating for Conservation Agriculture Policies in Southern Africa.* Technical Report. Unknown.
- Mazvimavi, K. 2010. *Socio-Economic Analysis of Conservation Agriculture in Southern Africa.* Technical Report. FAO Regional Emergency Office for Southern Africa (REOSA).
- Mazvimavi, K., S.J. Twomlow, P. Belder and L. Hove. 2008. *An Assessment of the Sustainable Uptake of Conservation Farming in Zimbabwe: Global Theme on Agroecosystems Report no. 39.* Research Report. International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh, India.
- Mapanda, F., S. Munotengwa, M. Wuta, P. Nyamugafata and J. Nyamangara. 2013. "Short-term responses of selected soil properties to clearing and cropping of miombo woodlands in central Zimbabwe," *Soil & Tillage Research* 129: 75-82.
- Mujuru, L., T. Gotora, E.J. Velthorst, J. Nyamangara and A. Hoosbeek. 2014. "Soil carbon and nitrogen sequestration over an age sequence of Pinus patula plantations in Zimbabwean Eastern Highlands," *Forest Ecology and Management* 313: 254-265.
- Masikati, P., A. Manschadi, A. Van Rooyen and J. Hargreaves. 2013. "*Maize–mucuna rotation: An alternative technology to improve water productivity in smallholder farming systems*," *Agricultural Systems*: 1-9.
- Nyamadzawo, G., M. Wuta, J. Nyamangara and D. Gumbo. 2013. "Opportunities for optimization of in-field water harvesting to cope with changing climate in semi-arid smallholder farming areas of Zimbabwe," *SpringerPlus* 2 (100): 1-17.

Other examples of research that is being conducted but that is not published international journals includes:

- Brown, D., R. Chanakira, K. Chatiza, M., Dhliwayo, D. Dodman, M. Masiiwa, D. Muchadenyika, P. Mugabe and S. Zvigadza. 2012. *Climate change impacts, vulnerability and adaptation in Zimbabwe*. IIED Climate Change Working Paper No. 3. December 2012.
- Chagutah, T. 2012. *Climate Change Vulnerability and Preparedness in Southern Africa. Zimbabwe Country Report.* Cape Town: Heinrich Boell Stiftung.

[14] Note that Professor Mazvimani has recently moved to the University of the Western Cape in South Africa.

- Chatiza, K., M. Dhliwayo and D. Muchandenyika. Forthcoming. *Cities, Infrastructure and Climate Change in Zimbabwe.* Climate and Development Knowledge Network (CDKN-ODI).
- Chigwada, J. 2009. "Case Study 6. Zimbabwe Climate Proofing Infrastructure and Diversifying Livelihoods in Zimbabwe," *IDS Bulletin* 36 (4): 103-116.
- Mtisi, S. 2010. *LEAPS and Climate Change: Opportunities for Industry*. ZELA. Presentation.
- McDevitt, A. 2009. *Climate Change and Zimbawbe*. Heldesk research report. Governance and Social Development Resource Centre.
- Murwira, A., M. Mosocha, I. Gwitira, M.D. Shekede, D. Manatsa and R. Mugandhani. Unpublished. *Zimbabwe Vulnerability and Adaptation Assessment*. Draft report.
- Murwira, A. Unpublished. *Climate Change in Zimbabwe: Opportunities for Adaptation and Mitigation through Africa.* Biocarbon Initiative Draft Report submitted to Centre for International Forestry Research.
- Mutasa, C. 2008. *Evidence of climate change in Zimbabwe.* Paper presented at the Climate Change Awareness and Dialogue Workshop for Mashonaland Central and Mashonaland West Provinces held at the Caribbea Bay Hotel, Kariba, Zimbabwe, 29-30 September 2008.
- Unganai, L. 2009. "Adaptation to climate change among agropastoral systems: case for Zimbabwe IOP," *Con. Series: Earth and Environmental Science* 6. 412045 doi: 10.1088/1755-1307/6/412045.

This shows that while there is some strength in agriculture and climate change research in Zimbabwe, there are also other areas of research related to cities, infrastructure, climate proofing and so on.

4.5.2.2 University-based research

The Zimbabwe questionnaire and workshop data shows a diversity of university faculty and department involvement in climate change related research, amongst others (Table 6 below):

Table 6: Diversity of university faculty and department involvement in CC research

Faculty / School / Centre	Department	Programmes / Institutes
Harare Institute of Technology (HIT) Zimbabwe Chemical Process System & Engineering (CPSE)	Department Chemical Engineering	Vermiculture technology; Coal methane gas extraction and use in power generation; Waste management and disposal site technologies; Sewage water degradation; Waste to energy

Faculty / School / Centre	Department	Programmes / Institutes
Chinhoyi University of Technology Zimbabwe Agricultural Sciences and Technology	Crop Science and Post Harvest Technology	Impact of conservation agriculture on greenhouse gas emissions and carbon sequestration in various soil types and agri-ecologies of Zimbabwe – PhD student registered; Effect of plant manipulation on water use efficiency in maize; Population dynamics of fruit in the Risutu valley and predicting the impact of climate change on the valley
Chinhoyi University of Technology Zimbabwe Directorate of Research	Directorate of Research	Building climate change and adaptive capacity of smallholder farmer
Zimbabwe Open University Science and Technology	Nursing Science	Health Threats of Climate Change
Zimbabwe Open University	Centre for ODL Research & Scholarship	Climate compatible Waste Management
Lupane State University Zimbabwe Agricultural Sciences	Animal Science & Rangeland Management	Improving quality of drought tolerant sorghum varieties
Zimbabwe Open University Zimbabwe Applied Social Science	Department of Development Studies	Disaster Management
University of Zimbabwe (CASS-Trust)	Centre for Applied Social Sciences	Community-based Natural Resources Management; Climate Change and Human Settlements; Rural Institutions and Indigenous Technical Knowledge and Rural Development
University of Zimbabwe	Institute of Environmental Studies	Climate change policy; interdisciplinary research on climate change
University of Zimbabwe	Institute of Development Studies	Economics of Climate Change Adaptation in Zimbabwe
University of Zimbabwe	Faculty of Agriculture	Climate change and livestock management research (Department of Animal Sciences) Climate change and crop diversification research (Department of Crop Sciences)
University of Zimbabwe	Faculty of Education	Education for Sustainable Development and Climate Change Education research
University of Zimbabwe	Faculty of Medicine (Biomedical Research Training Institute)	Biomedical research with some focus on malaria research

Note: The table above may not be complete, and is therefore indicative rather than definitive.

Table 6 above shows both faculty-based diversity and departmental level diversity of participation in climate change related research. The table also shows that most of the universities have some form of climate change related research programme. It should be noted too that Table 6 is incomplete. Few climate change researchers from the University of Zimbabwe responded to the questionnaire and/or participated in the workshop so there is likely to be more research activity in all of the universities, beyond what is shown here. Workshop and questionnaire data showed that there is some research taking place on topics that are related to CCD and that there are a number of active researchers engaged in climate change research in Zimbabwe.

Gender and PhD profile: Of those lecturers responding to the questionnaire five were male, and two were female, showing some participation of women scientists in climate related questions in Zimbabwe, the research environment seems to be somewhat male dominated. Those responding to the questionnaire ranged from having between two and ten years climate change experience in their disciplines. Three of the respondents had a PhD.

Workshop data showed that there was strong support for developing more PhD scholars, and there may possibly be the need to encourage further PhD research in climate change and CCD related fields in Zimbabwe, especially since workshop participants reflected that many experienced academics from Zimbabwe had left the country due to the economic downturn. A number of academic researchers have also joined consultancy companies as the remuneration is potentially higher there than in universities, and there is a fluid relationship between university academics and consultancy organisations. Zimbabwean researchers also tend to be active regionally and contribute to a number of regional programmes, which in turn benefits national knowledge production.

4.5.2.3 Centres of Excellence, Centres of Expertise and Research Networks

TERMINOLOGY USED IN THIS SECTION:

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

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

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

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

Centres of Excellence:

ICRISAT, **The International Crops Research Institute for Semi-Arid Tropics** is a research station in Bulawayo, Zimbabwe. Whilst the Zimbabwe station may not be classified as one of the two African 'hubs' for ICRISAT, it is still a strong link to this international research organisation which can be classified as a 'Centre of Excellence' in Dryland and Semi-Arid Tropics research into agriculture with a strong focus on climate change adaptation research. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organisation that conducts agricultural research for development in the drylands of Asia and sub-Saharan Africa. ICRISAT is headquartered in Hyderabad, Andhra Pradesh, in India, with two regional hubs (Nairobi, Kenya and Bamako, Mali) and country offices in Niger, Zimbabwe, Malawi, and Mozambique; creating a strong southern African network. ICRISAT conducts research on five highly nutritious drought-tolerant crops: chickpea, pigeonpea, pearl millet, sorghum and groundnut. The ICRISAT website describes ICRISAT's research-for-development agenda as being linked to and "achieved through the CGIAR Research Program on Dryland Systems, the CGIAR (CGIAR is a Global Agricultural Research Consortium linking a number of major agricultural research programmes) Research Programme on Policies, Institutions and Markets, the CGIAR Research Programme on Grain Legumes and the CGIAR Research Program on Dryland Cereals. These are implemented in ways that benefit smallholder farmers, enabling them and their families to go beyond subsistence farming to produce surpluses that can be stored and sold to markets, paving the way for prosperity in the drylands. Surplus produce, which is stored as food, serves as a buffer in times of hunger. Income from marketed produce enables farm families to purchase more food when needed, including inputs such as seeds, fertiliser, labour, tools, livestock, insurance and education. These will further raise farm productivity, kicking off a series of investments that bring about economic growth. As this is sustained, it creates a self-reinforcing pathway to prosperity. The foregoing describes a socio-economic process called inclusive market-oriented development (IMOD) on which ICRISAT's strategy is anchored. It states further that "ICRISAT has defined six developmental outcomes that it believes will help the poor to move along the IMOD path: food sufficiency, intensification, diversification, resilience and health and nutrition, and women empowerment. Significant reductions in poverty and increases in food security in the dryland tropics are possible through this route." The organisation has been in existence for 40 years. ICRISAT has made a strong contribution to the development of agriculture and human resources in Zimbabwe. Several students have been trained up to PhD level via the organisation as well as farmers in the Matebeleland region. In Zimbabwe, ICRISAT has been in existence for 28 years since its invitation into the country by the Southern African Development Community (SADC) Heads of State and government in 1984 after which the ICRISAT Matopos Research Station was set up in Bulawayo. ICRISAT is part of the global CGIAR (formerly the Consultative Group on International Agricultural Research) network of organisations whose ambit straddles agricultural research for sustainable development, reducing rural poverty, improving food security, improving nutrition and health, and sustainably managing natural resources via donor funding. ICRISAT collaborates with multilateral organisations, including national and regional agricultural research institutes, civil society organisations, academia and the private sector. The relevance of institutions such as ICRISAT cannot be overstated in a climate change context. Director: Andre van Rooyen. Email: icrisatzw@cigar.org

The Biomedical Research Training Institute is a Centre of Excellence in Biomedical Research at the University of Zimbabwe (www.brti.co.zw) – linked to the African Institute of Biomedical Science and Technology (www.aibst.com). From its inception in 1995, the BRTI has sought to become a centre for excellence in health research and training in Africa. They are conducting research on malaria which may be highly relevant to the reports of increased risk of malaria resulting from climate change. The website describes the research as follows:

> *"Despite the intensified use of Insecticide Residual Spraying (IRS) and Insecticide Treated Nets, parts of Zimbabwe have been experiencing a dramatic rise in numbers of malaria cases, with Manicaland experiencing one of the worst outbreaks. The BRTI, in collaboration with Johns Hopkins Bloomberg School of Public Health, the National Institute for Health Research and the University of the Witwatersrand have established a field site in Mutasa to study different aspects of malaria and the mosquitoes responsible for its transmission. The team, led by Dr. Sungano Mharakurwa, has shown there have been changes in the species of mosquito, with the emergence of Anopheles funestus. These data indicate that An. funestus can be regularly found in households that have had recent had IRS, and this confirms previous findings that An. funestus shows high levels of resistance to pyrethroids and carbamates. This mosquito is a very efficient transmitter of malaria, much more so than An. gambiae which was thought to be the common malaria-mosquito in Zimbabwe. The emergence of An. funestus in South Africa in 2000, for example, was associated with a dramatic increase in the cases of malaria in that country*".

They undertake research into malaria epidemiology and control (chief scientist: Dr Sungaro Mharakurwa) and cholera (epidemiological spatial analyses) (main researcher: M. Fernandez), and other health risks and vulnerabilities that have been identified as climate related health risks. Contact email: admin@brti.co.zw.

The BTRI is linked to the African University, Stanford University, and many other partners through the **African Institute of Biomedical Science and Technology** which is a pan-African Centre of Excellence in Biomedical Science and Technology Research located in Harare, Zimbabwe. The CoE in Biomedical Research at the UniZim and the AiBST are also affiliated to the John Hopkins University Centre of Excellence in Malaria research in the USA, and a wider network of International Centres of Excellence in Malaria Research. The AiBST Centre of Excellence, like the BRTI, focuses on a wider range of biomedical health issues such as HIV/AIDS and tuberculosis, but also specialises in malaria research, using nanobiotechnology and has national, regional and internationally linked research activities in this area. This contributes to climate change health research. The African Institute of Biomedical Science and Technology, AiBST, was established in 2002 with the aim to strengthen African's scientific and technical capacity to contribute to health care solutions for its people. It is a private not-for-profit research and education institute which is registered with the Ministry of Higher and Tertiary Education in Zimbabwe and works closely with the Ministry of Health and Child Welfare and the Ministry of Science and Technology Development. It also trains postgraduates. Dr. Colleen Masimirembwa (PhD, DPhil) is Chief Scientific Officer and Founder of AiBST: colleen.masimirembwa@aibst.com.

Centres of Expertise

The Institute of Environmental Studies (IES) was established in 1994 as an independent, non-faculty unit within the University of Zimbabwe, in response to national consensus about the ecological, social and economic consequences of environmental change. IES undertakes research and development, education and training, and consultancy and networking. The chief role of IES is facilitatory in that it is a front door to harnessing the wide range of resources available throughout the University of Zimbabwe. It operates by means of a series of highly decentralised partnerships with other university departments, universities in the developed and developing countries, government institutions and non-governmental organisations. The nature and duration of the partnerships are determined by the specific projects. Most recently the IES has undertaken development of the National Climate Change Response Strategy for Zimbabwe (2013). (Prof. S.B. Feresu is Director of the IES).

The Institute of Development Studies (IDS) at the University of Zimbabwe was established in 1982 as ZIDS (Zimbabwe Institute of Development Studies). It was set up as a statutory body mandated to undertake policy-oriented research and spearheading policy discussions and debates in line with Government objectives. In 1990 ZIDS was incorporated into the University of Zimbabwe (as IDS), a development that led to the new institution taking additional academic roles such as teaching and students' supervision. IDS has restructured its work recently in line with new global and national developments. The new focus is on intense research programmes, postgraduate supervision and mentorship as well as organising a development dialogue Public Lectures and Seminar series that seek to address the emerging socio-economic challenges (including climate change). The IDS undertakes research on gender, governance and most recently has started to do climate change research focusing on the economics of climate change adaptation. (Dr Medicine Masiiwa is undertaking economics of CCA research in the IDC.)

Centre for Applied Social Sciences (CASS) is located in the Faulty of Social Studies in the University of Zimbabwe. CASS is a multi-disciplinary social science research and teaching department which operates in relation to an independent trust (the CASS Trust). The mission of CASS is to provide multidisciplinarity graduate and policy-relevant training and applied research to various constituencies so as to enhance the process of societal transformation. Within the broad area of environmental teaching, CASS focuses on the social, political, micro-economic and institutional aspects of natural resources management, longitudinal and participatory methodologies being dominant. It also focuses on themes such as environment and sustainable development; community development; land reform and agrarian studies; political economy of development; rural livelihood strategies; food security (sovereignty); gender studies. It is involved in various climate change and climate variability related research projects associated with climate change adaptation including projects on housing, urban settlements and climate change, community-based natural resources management and indigenous knowledge, water sector reforms. It collaborates with regional and international partners and works with research associates that are linked to the CASS Trust. (The chairperson is Dr Billy Billards Mukamuri, email: bmukamuri@soiol.uz.ac.zw.)

Makoholi Research Institute: Makoholi is a government public research institute (not a university-based centre, but it was mentioned in the workshops as an important research centre for climate change related research in Zimbabwe). The core functions of the Institute are to develop technologies for sustainable intensive livestock production systems within the low rainfall region/ agro-ecological regions in Masvingo and Midlands provinces. The goals are: To develop and disseminate viable, practical, and sustainable livestock and pasture production technologies that meet the needs of the livestock industry in Zimbabwe with reference to a changing climate. http://www.drss.gov.zw

Note: These may be incomplete and do not cover all universities in Zimbabwe, although a websearch of all universities' websites was used to identify Centres and Institutes with climate change research capability. This was the best available information at the time of reporting. No specific information was given on Centres of Expertise, except a reference to the Institute of Environmental Studies during the workshop.

4.5.2.4 Zimbabwean Research Networks

Zimbabwe Research and Knowledge Networks cited in the workshop and in questionnaire data include:

- Environmental Management Agency (EMA) – involved in environmental awareness campaigns, conservation
- Department of Meteorological Services
- Early Warning Units – Climate forecast unit level rests in Zimbabwe
- United Nations Development Programme (UNDP)
- Scientific and Industrial Research Centre – Zimbabwe
- Civil Protection Unit – Ministry of Transport in Zimbabwe
- Zimbabwe Vulnerability Assessment Committee (ZIMVAC)
- Climate Change Taskforce (Office of the President)
- Research Council of Zimbabwe
- Zimbabwe Open University International Research Conference on Sustainable Development
- WATERNET (multi-funded university network) /CAP-NET (UNDP) – capacity building programmes and networks for Integrated Water Resources Management
- Civil Protection Unit
- Zimbabwe Environmental Research Organisation (ZERO)
- ZINWA Collaboration of Government Departments e.g. AGRITEX, EMA, Police
- World Food Programme
- International Crops Research Institute for Semi-Arid Tropics (ICRISAT)

Regional Environmental Research Centres and knowledge networks include:

- SARUA
- SADC Vulnerability Assessment Committee
- SADC Early Warning Unit
- SADC Drought Monitoring
- Distance Education Association of Southern Africa (DEASA)
- African Union (AU)
- Zambezi Early Warning Systems
- SARCOF (Southern African Regional Climate Forecasting)

- SADC-REEP (Regional Environmental Education for Sustainable Development)
- FEWSNET (Famine Early Warning Systems)
- Zambezi River Authority
- COMESA
- Transfrontier Parks
- ZIMOZA
- Climate and Development
- Square Kilometre Array (South Africa)
- SWEDESD (Swedish Education for Sustainable Development)
- Durban Platform for climate change
- World Food Programme

4.5.3 Curriculum innovations and teaching for CCD

Participants who responded to the questionnaires indicated that there is some existing work taking place with regard to CCD curriculum innovation in their departments. Questionnaire responses indicate that all the participants from the various universities showed a willingness to get involved in new issues such as climate change and/or climate compatible development with regard to their curriculum innovation and teaching, and the questionnaire data showed that staff ability to get involved was good. Chinhoyi University of Technology was the only institution that confidently claimed that CCD issues and opportunities were incorporated into their current curriculum; the other universities felt they did not feel confident that they were teaching CCD as of yet. All respondents showed little experience with regard to inter- and/or transdisciplinary teaching approaches to CCD. An exception here could be the CASS Centre in the Faculty of Humanities and Social Studies which explicitly specialises in multidisciplinary teaching and research focusing on environment-society concerns.

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. A web search of courses in various faculties in the universities did not provide any further information other than what is provided below. Thus it is not simply a matter of reviewing all the courses in an institution. Identification of climate change content in courses thus requires engaging with those that teach the courses. Data presented is therefore limited by this factor.

Table 7: Courses which are oriented towards climate compatible development – Questionnaire and Workshop data

Course/s being developed and run	Who is involved	Type and level of course
Environmental Management (Pollution and Protection of the environment) – a subject in Chemical Engineering course at HIT	Anthony Phiri Harare Institute of Technology (HIT) Zimbabwe Chemical Process System & Engineering CPSE Department Chemical Engineering	Undergraduate
Crop Science and Technology undergraduate course: ▪ Global Environmental Issues and climate change and Stress Physiology and Plant Adaptation to Stress ▪ In addition there are many other courses with components that address climate change such as Molecular Biology (1st year), Recombinent DNA Technology (2nd year), Plant Breeding Methods (4th year), Simulation and Modelling (3rd year) etc. ▪ ["We are currently developing MSc Programmes in Plant Breeding and Biotechnology for Stress environments and Crop Production for Stress Environment to increase competence of graduates to undertake research and advise farmers on drought adaptation strategies"]	Arnold Bray Mashingaidze Chinhoyi University of Technology Zimbabwe Agricultural Sciences and Technology: Crop Science and Post Harvest Technology	Undergraduate
Environmental Hazards and Human Response (2nd year course)	Cornelius Gibson Tichagwa Zimbabwe Open University: Geography and Environmental Studies	Undergraduate
BEd and Masters Level courses in Education Faculty courses (Geography Education): ▪ Climatology taught as a main course for Masters level students. For undergraduate it is a year 2 course	Dirwai Crispen University of Zimbabwe: Department of Science and Maths Education	Undergraduate and postgraduate
Environmental and Natural Resource Economics Courses: ▪ Generic environmental and natural resource management courses (cover climate change issues such as natural resources to some extent)	Emmanuel Mwakiwa University of Zimbabwe, Faculty of Agriculture, Department of Agricultural Economics and Extension	Undergraduate

Course/s being developed and run	Who is involved	Type and level of course
Ecology and Wildlife Management – 3rd year (Agriculture)	Ishmael Pompi Zimbabwe Open University Science and Technology Agriculture Department, Mashonaland East Region	Undergraduate
Course on Disaster Preparedness (floods) in BSc Nursing Science	Junior Mzengi Zimbabwe Open University Department of Science and Technology, Nursing Science	Undergraduate
Agro-climatology	Margaret Taona Moyo Lupane State University Department of Agricultural Sciences, Animal Science and Rangeland Management	Undergraduate and postgraduate
Department of Development Studies: BSc Honours Degree in Development Studies	Thomas Musankuleni Kapuya Zimbabwe Open University Department of Applied Social Science, Disability Studies and Special Needs Education	Undergraduate and postgraduate
Agricultural Meteorology	Veronica Makuvaro Midlands State University Department of Natural Sciences Management and Agriculture Agronomy	Undergraduate and postgraduate (MSc)
Dissertations on the impact of global warming – Post graduate level	Wisdom Kurangwa Midlands State University Faculty of Commerce, Economics Department	Postgraduate

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

There appears to be a link between those lecturers involved in climate change related research and curriculum innovations in this area. This shows that the relationship between CCD research and curriculum innovation should be more clearly understood, which implies that there is a need to examine *how research drives curriculum innovation* in new knowledge areas such as CCD in universities.

As can be seen from Table 7, Chinhoyi University of Technology has dedicated CC / CCD courses at undergraduate level. For all the universities the dominant pattern of practice appears to be to 'integrate' aspects of CCD into existing courses; although some discipline-specific climate change courses such as Agro-meteorology are good 'carrier subjects' for CCD

related content, but the nature of CCD is such that it needs to be mainstreamed into a range of courses, in addition to specialised courses such as climatology, or agro-meteorology. It is difficult to examine the scope and focus of such integration without a detailed curriculum analysis. The table above also shows that it may be productive to examine CCD integration within *all faculties and all departments* within the university. The university-based questionnaire (esp. Section C) in Appendix C can be used for this purpose. The questionnaire will, however, have to be introduced to all staff in the university, preferably at Departmental level to obtain a clearer view of how CCD is / is not being integrated into teaching, and where the 'gaps' are for new development of CCD content into either a) existing programmes or b) design of new programmes. Such a process would need to be led by the Academic Registrar of the university to ensure consistent and comprehensive data.

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

- Use of case studies and practical site visits;
- Formal lectures;
- Using examples of sea-level change, icebergs/glaciers melting out of season;
- Problem solving methods: this is done across the different subject areas
- Participatory – students actively take part in tours and scientific expeditions to collect data in areas showing climate change/symptoms of it e.g. drought stricken areas, desertification etc. (students learn by doing);
- Use of studies done by university alumni who specialised in climate change adaption;
- Visits to communities for direct observation and interviews;
- Field visits to identify elements that are indicative of the evidence of climate change;
- Field work to collect data on climate change in an identified area, report back tutorials; and
- Modelling the impact of climate on various sectors of the economy in our Econometrics courses.

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

4.5.4 Community and policy outreach University of Zimbabwe

The Institute of Environmental Studies (IES) of University of Zimbabwe has been involved in Climate Change policy development and outreach according to Anthony Phiri from the Harare Institute of Technology (HIT); and as also shown on the IES website. Professor Feresu of the IES led a multi-disciplinary research team to produce the research necessary for the draft National Climate Change Response Strategy. Some participants mentioned they have attended some government organised climate change policy workshops. Emmanuel Mwakiwa from the University of Zimbabwe's Department of Agricultural Economics has undertaken a study on Climate change in Chiredzi district of Zimbabwe Development of which policy briefs and book chapters were produced for climate change adaptation policy in Zimbabwe. The Second National Communication, and the research reports outlined above show that a number of

university researchers are contributing to national climate change assessments and policy making.

4.5.5 Student involvement

According to the questionnaire data, the Harare Institute of Technology (HIT) has a student organisation called HIT ENVIRO, which participates in a variety of different climate change related outreach activities. The University of Zimbabwe's geography students in the Faculty of Education are involved in a series of change projects in schools on CCD; they are not collected through a student organisation but are participating as individuals through their project work. The Zimbabwe Open University contains ZIMTA: the Zimbabwe Teachers Association whose students are involved in climate change activities in the communities in which they teach and work. And finally the Lupane State University' Geographical Society is involved in various outreach activities coordinated by students. Again this information is not complete, but is limited by the data provided in questionnaires and the workshops.

4.5.6 University collaboration and networking

The institutional analysis shows that there is a high level of *potential* for knowledge co-production partnerships (Table 7), and some knowledge partners exist for CCD knowledge co-production in Zimbabwe. There are some knowledge co-production partners that are strongly engaged in CCD research, such as the government-based agricultural adaptation research stations (Matopos Research Station linked to ICRISAT and focusing on crop related adaptation issues mentioned above), the Makholdi Research Station focusing on livestock related adaptation issues, and active NGOs and Institutes that *specifically* focus on climate change adaptation such as:

- **The Development Reality Institute.** Established in 2009, Development Reality Institute (DRI) is a donor funded Zimbabwean youth oriented organisation that is focused on education, networking and interventions that address sustainable use of natural resources and adaptation to climate change. DRI's mission is to mitigate against and build society's adaptive capacity to address the effects of climate change and this is achieved through capacity strengthening, policy analysis, knowledge management and programme interventions using cutting edge ICT solutions. The programmes are implemented through a network of young professionals, international volunteers and collaborations with other development partners. DRI has a 'virtual school' offering online courses on climate change and CCD. They also contribute to research. (www.driafrica.org. The climate change programme co-ordinator is Sika Ahawo: saahawo@driafrica.org)
- **Zimbabwe Regional Environmental Organisation.** ZERO recently co-ordinated the multidisciplinary research programme funded by DfID in partnership with the IIED into Climate change impacts, vulnerability and adaptation in Zimbabwe (reviewed in Box 2 below). They are particularly also engaged with applied research and community-based adaptation (CBA) in partnership with IDRC, and have produced research and documentation on this approach. Projects developed and administered by ZERO include agricultural productivity and land resources issues. For example, wind pattern studies have been carried out leading to the development and erection of

wind turbine electrical generation plants. These have been used to power irrigation farming in, and bring electricity to, rural Zimbabwe. ZERO also develops other renewable energy sources, appropriate technology and stimulates income generation models in rural areas. It has also co-authored a publication on climate change and trade, and in 2007 it worked with IIED to undertake research on cities and climate change, a joint project undertaken under CLACC (www.clacc.net). Agricultural and climate change research is an area of focus. ZERO is the lead agency in Zimbabwe for the implementation of the United Nations sponsored Millennium Development Goals (MDGs) and functions as the Regional Secretariat for the Community Organisations Regional Network (CORN), a SADC country member network (www.zeroregional.com; Director –Shepard Zvigadza: szvigadza@gmail.com).

Note: The above may be incomplete; these were the two NGO organisations that were mentioned in the workshop as being particularly active in CCD related *research*, and are therefore mentioned here. In the workshop, different roles were ascribed to different partners involved in the knowledge co-production process as outlined briefly below.

The roles for **universities** included:

Curriculum development and mainstreaming of CCD:

- Identification of training needs;
- Mainstreaming climate change issues in all university programmes;
- Promotion of climate change in the university through review of the current curriculum;
- Participatory and adaptive curriculum development to meet emerging needs of CCD; and
- Introduction and streamlining of CCD across faculties.

Resource mobilisation for CCD research:

- Creation of a common pool of resources, human, material etc.;
- Funding of research at universities should be directed at multidisciplinary teams;
- At least one percent of university funds should be set aside for research and the development of a CCD framework; and
- Prioritising CCD for resource mobilisation and allocation.

Research and knowledge co-production

- Collaboration of universities and other research organisations;
- More community driven research;
- Creating multidisciplinary teams and social scientists for each research assignment;
- Collaboration with government departments, NGOs and the private sector with different skills and expertise;
- Introduction of courses on multidisciplinary research;
- Creating innovations that promote CCD through research; and
- Information dissemination through journals and collaboration with other stakeholders such as EMA and Forestry Commission.

The **private sector** was ascribed the following roles:

- Coordination of funding and research;

- Strengthening collaboration with universities;
- Sharing of knowledge to avoid duplication;
- Research, training and development; and
- Extensive use of Environmental Impact Assessments.

Donors were ascribed these roles:

- Funding for CCD including coordination with central government;
- Availing of funds for research and training that are transdisciplinary and multidisciplinary; and
- Supporting local initiatives rather than bringing their own agendas.

And **government** was ascribed these roles in CCD knowledge co-production:

- Effective monitoring and evaluation strategies, law enforcement;
- Promotion of research and development including training/retraining;
- Compliance with green issues and their integration into policy;
- Ensure effectiveness of institutions such as Environmental Management Agency, through taxes etc.;
- Establishment of a Centre of Excellence for CCD;
- Integration of ministries and their the need for flexibility;
- Clear strategic energy policy that is environmentally friendly;
- Inclusion of climate change in school and university curricula; and
- Coordinating body on CCD and the levying of private sector to support CCD.

4.5.7 University policy and campus management

Chinhoyi University of Technology is involved in tree planting programmes as part of a carbon sequestration and outreach initiative, which they undertake with the local council and communities to discourage deforestation. The University of Zimbabwe's Faculty of Education is involved with campus based sustainability policy and community outreach activities within the university who in turn works closely with the Department of Works. Zimbabwe's Open University is involved in some environmental related issues within campus, pertaining mostly to waste removal, hosting workshops on climate change and trying to reduce the amount of paper they use. The Midlands State University mentioned that they make use of energy saving technology, but did not provide details of what systems they have in place.

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

4.6.1 A multi-faceted process, needing an integrated approach

Discussions in the workshop on 'who is doing what and how' led to some reflections on the status quo, and what could be done differently. These show that Zimbabwe stakeholders, researchers and lecturers have a very clear understanding of what needs to be strengthened and what could be done differently when it comes to CCD in research, teaching, outreach and networking in their contexts. What can be seen from the outcomes of the workshop and

questionnaires is that there are several different key areas that require attention. These areas are not loyal to a particular research discipline, or institution, but rather affect various different fields and disciplines. This shows that responding to the current situation in Zimbabwe with a view to 'doing things better', requires an integrated approach, and will require especially the participation of university and government leadership, but also leadership of other stakeholders (e.g. business).

4.6.2 Co-ordination, collaboration and improved partnership building:

There is generally a need to improve internal co-operation, collaboration and improved partnership building in Zimbabwe. Overall improvements are needed in communication, knowledge transfer and coordination of a sound integrated climate change and CCD related research framework. Contributions from government departments, and willingness to collaborate with research institutions could be improved, however recent activity in the development of the Zimbabwe National Climate Change Response Strategy (2013) has made many researchers confident and inspired regarding future climate change and CCD related research going into the future. The data shows that universities in Zimbabwe are already providing climate change and CCD related curricula, or are in the process of establishing these but further work is needed for mainstreaming these. What is also needed is for the private sector and government to participate more actively in the CCD research community to reduce reliance on donor funding, and to strengthen internal systems and strategies for CCD research. As shown above, there is some work going on related to CCD, but it is not well co-ordinated at national level, and the request for a Centre of Excellence in CCD may help to address this. The proposed policy intention to "Build a climate change knowledge repository, based on reliable data, international best practice and scientific evidence, with the support of development partners" in the draft National Climate Change Response Strategy of 2013 is clearly needed, and it would seem that this needs to be more than a 'knowledge repository'. What is required is a Centre of Excellence in CCD research (or a network of such Centres) that links up all national partners, universities and participating faculties and which can host such a 'knowledge repository', potentially creating a more dynamic platform for CCD research in Zimbabwe.

4.6.3 Strengthen and expand understandings of CCD

As shown in section 4 above, CCD is a relatively new concept to some stakeholders and university researchers, yet it is being integrated as part of their research and teaching. From the workshop and questionnaire data it can be seen that the concept of CCD also has different meanings, and lends itself to a diversity of contextual interpretations. It is also multidisciplinary, and multifaceted and has diverse research and capacity building implications. This was further explored in the workshop which brought in regional perspectives, stressing that **there is need for alternative development options that are continually responsive to changing climate change and emerging global and regional development paradigms related to climate which take into account what is happening in the region in and around Zimbabwe.** Further discussion revealed the need to see CCD as not a static concept, but rather as an emergent and evolving research area that needs to include indigenous forms of mitigation and adaptation.

Linked to the need to strengthen and expand understandings of CCD, workshop participants stressed the importance of integrating this into Zimbabwe's education system, including public education and grass roots community programmes. Curriculum development and community awareness and training were continuously cited in the workshop and questionnaires, and this is a key area of concern for further educational development into the future.

4.6.4 Capacity building for CCD and staffing

There was a strong call for capacity building, particularly for undertaking multidisciplinary research but as mentioned above, also for integrating CCD into curriculum and teaching as well as in specific disciplines and technical positions. 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. There currently seems to be little engagement with multi-, inter- and transdisciplinary research in the university context. While this is the case, researchers are working in such teams in the context of other organisations e.g. the IIED research project, and capacity development and enabling these capacities in Zimbabwe should be considered a key priority moving forward. The CASS Trust has considerable experience in such multidisciplinary research as mentioned above, as do organisations such as ZERO, so there is 'leading capacity' that can be mobilised to expand capacity for this kind of research in Zimbabwe and regionally.

4.6.5 Curriculum development and curriculum innovation

As shown in the institutional analysis above, CCD is currently mainly being 'integrated' into existing courses although some specific courses on CCD related issues are also on offer. There seems to be considerable expertise in CCD adaptation research and subsequent curriculum development in a variety of areas. Zimbabwe's most prolific research on CCD appears to be in the agricultural sector, although there are also other areas of research expertise that could be tapped to inform curriculum innovation, such as the human settlements, infrastructure and health related CCD research mentioned above. Zimbabwe has potential to offer contributions therefore in approaching agricultural adaptation to climate change, and curriculum development support within the region. The work of the Development Reality Institute (an NGO) may also potentially be innovative as they are offering virtual courses on climate change using ICTs, and have had a good uptake amongst young people. Linking some of this innovative work on CCD (the DRI has already won four international awards for this work) to formal accredited learning pathways may be a potentially powerful option for curriculum innovations for CCD in Zimbabwean universities.

4.6.6 Research

Many recommendations were made on how research for CCD could be improved in Zimbabwe's university and between other stakeholders. Key amongst these was to improve the CCD research culture in the universities, and commitment to CCD research amongst research partners, especially local and national government, who are responsible for creating an overarching CCD policy and action plan. This would require integrated coordination and collaboration of universities with government, and other partners. The dissemination of

knowledge for all spheres of the society (government, communities, academia and civil society organizations) was highlighted, and climate change research was seen to not only include geographical and environmental sciences but a range of different disciplines.

The creation of a common pool of resources; human and material was called for to improve research efforts, and suggestions such as allocating one percent of university funds to CCD research and the development of a CCD research framework were made by workshop participants. Improved identification of training needs, more community driven research, the introduction of CCD across faculties, developing multidisciplinary teams to collaborate with government departments were some of the innovative suggestions offered. A call was also made for NGOs and the private sector with different skills and expertise to participate in such research networks. Little was said about inter-university networking and research co-operation, but this is clearly also a potentially powerful arena for CCD research innovation, especially if such research partnerships were to be multidisciplinary, mobilising the country's best researchers into research teams. Zimbabwe has a strong culture of using semi-autonomous university 'institutes' as mobilisers of multi-disciplinary partnership building, and it is recommended that those institutes with existing capacity (e.g. the IES, CASS etc) be strengthened in this regard, for undertaking CCD related research.

Research priorities also included the development of simple but effective methods for information dissemination, that improve not only how knowledge is generated (for example forms of participatory research) but also how knowledge is expanded and shared in its essential production. It was also noted that knowledge production should be used inherently to support communities affected by climate change; in this way part of the research agenda requires an inherent emancipatory sensibility.

It was noted too that it was important for the research community in Zimbabwe to keep a primary focus on identifying new climate change-related research lines of enquiry, that were contextual and specific to the conditions in Zimbabwe, to ensure ongoing social innovation and responsiveness to what was recognised as being a highly critical issue for Zimbabwean society.

4.6.7 The role of university leaders

The role that university leaders play in supporting CCD research and development mostly focused on their responsibility to incorporate climate change in their institutions' research, teaching (curriculum development) and outreach agenda. Fundraising and the allocation of funds for research and outreach to climate change issues was another consistently suggested role of university managers in the questionnaire data. Other participants felt that leader's role was to enable the sharing of knowledge on climate change and to participate in think tanks and policy forums on climate change; building partnerships for CCD related research at national and international levels. The incorporation of CCD across the university curriculum was a key priority raised in the workshops and the questionnaire data. Other suggestions included: Encouraging publication of relevant climate change research results, training and supervising of students undertaking research on climate change and offering exchange programme to expose those universities that have no components of CCD to those that have. University leaders were also seen to be responsible for developing dedicated institutions/units that participate in research specialisation on climate change and adaptation for Zimbabwe and

surrounding regions. Leadership should also encourage research into key policy issues as well as encourage policy briefs and knowledge transfer between researchers and policy makers, through conferences, workshops and other platforms. Staff development through the creation and support of various training programmes in climate change and CCD was also suggested.

5 KNOWLEDGE CO-PRODUCTION POSSIBILITIES

5.1 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.[15] 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.[16]

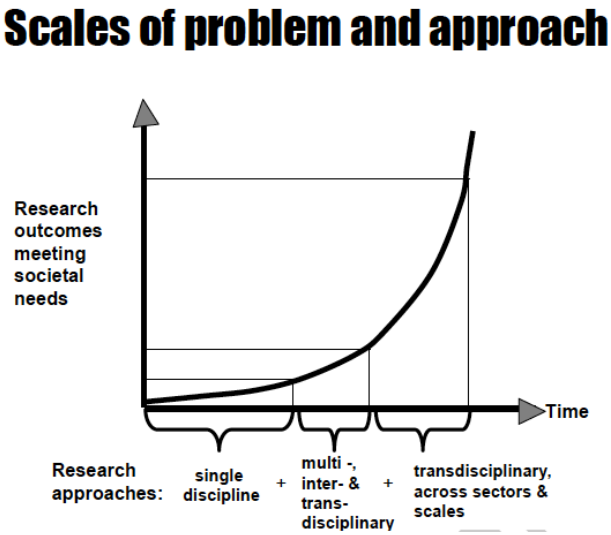

Figure 5: Research approaches

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

[16] 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.[17]

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[18]; 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[19] across sectors and at different scales.

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[17] 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.

[18] 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.

[19] 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.[20] 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.[21] 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 current status of multi-, inter- and transdisciplinary approaches are not readily observable considering the findings of the workshop and questionnaires. However, the University of Zimbabwe, Agricultural Meterology department is offering training in climate related courses for multi-disciplinary personnel who will apply climate compatible development in their different areas of specialties. No further detail was provided regarding this, and so it seems to be a valuable programme to further investigate.

A major multidisciplinary research programme that has recently been facilitated by the Institute of Environmental Studies (IES) at the University of Zimbabwe, is the construction of the draft National Climate Change Response Strategy. This has clearly been a carefully constructed, thorough research based initiative that has drawn together the best researchers, and the best available knowledge of climate change in Zimbabwe; which also draws on the Zimbabwean Second National Communication to the UNFCC (which also reflects a multidisciplinary research endeavour). While not much information was available on the

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

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

research team, and how the multidisciplinary policy research team was mobilised and/or worked together for the policy and the SNCC, these are clearly good starting points and examples of how multidisciplinary research teams are mobilised for policy and reporting on CCD related concerns.

Two other exemplary cases of interdisciplinary CCD research were brought to the attention of the SARUA research team during the workshop, summarised in Boxes 2 and 3 below. Box 2 summarises the research project captured in more detail in an IIED Working Paper No 3, produced in December 2012. The example in Box 2 demonstrates many of the intentions of inter- and transdisciplinarity discussed above, and is good example of multi-stakeholder knowledge co-production. The example in Box 3 summarises interdisciplinary research taking place in transboundary conservation contexts in Zimbabwe.

Box 2: Multi; inter- and transdisciplinary research to establish 'Climate Change Impacts, Vulnerability and Adaptation' in Zimbabwe

(Brown, D., R. Chanakira, K. Chatiza, M. Dhliwayo, D. Dodman, M. Masiiwa, D. Muchadenyika, P. Mugabe and S. Zvigada. 2012. Climate Change impacts, vulnerability and adaptation in Zimbabwe. IIED Climate Change Working Paper No. 3: December 2012.)

This research project sought to provide a broad overview of the key issues related to climate change facing Zimbabwe. It drew on a set of background papers that were produced by the Policy and Advocacy for Climate Change in Zimbabwe project funded by the UK Department for International Development (DfID) and implemented by the International Institute for Environment and Development (IIED), the Zimbabwe Environment Research Organisation (ZERO) and Dialogue on Shelter. These papers were set to examine climate trends, scenarios and projections for Zimbabwe and also to draw on a variety of case studies on adaptation projects. The report states that "applied research has an important role to play in informing the development of adaptation strategies that respond directly to the needs and vulnerabilities of women and men, in raising climate change as a policy priority at all levels, and in informing an integrated approach to future climate policy-making".

The following multidisciplinary background papers were produced to inform the synthesis research project:

Climate change and housing in Zimbabwe: An exploratory study (Chatiza, K. and D. Muchandenyika, CASS Trust). This paper used literature and interviews to explore the relationship between housing and climate change in Zimbabwe; focussing on urban growth, development and disaster trends, especially in rapidly growing peri-urban areas surrounding major cities.

Meeting information and advocacy needs for adaptation to climate change in Zimbabwe: Research on local climate change impacts (P. Mugabe, University of Zimbabwe). This paper analyses two case studies to understand how communities are coping with climatic variability under different environmental conditions. Six case studies of community-based adaption projects were also presented in the paper, which highlight the importance of local context.

Meeting the health needs of people living with HIV and AIDS (PLHIV) in the framework of climate change in Zimbabwe: Case of support groups of PLHIV in Mashonaland (V. Makiba, Development Reality Institute). The paper examines how climate change my compound existing humanitarian crises related to public health, related to PLHIV. The paper reports on a partnership programme that sought to develop the community systems strengthening (CSS) approach which builds capacity

of all local level partners to design, deliver, develop, monitor and evaluate the efficacy of health services and activities. This was done via practice-based research, where practice-centred solutions and alternatives were tried out.

Climate Change and Gender (R.R. Chanakira). This paper used literature and policy review, as well as case study reviews to highlight gaps and policy recommendations on gender and climate change in Zimbabwe.

Climate change impact on water resources in Zimbabwe (ZIMNET): This paper presents the findings of the Meeting Information and Advocacy Needs for Adaptation to Climate Change Project carried out by ZIMNET in Nyanga District. The project's focus was on responding to the impacts of water scarcity on livelihoods supported by rain-fed agriculture. It examines workshops hosted by ZIMNET on sustainable environmental management practices addressing the concerns, to reveal adaptation strategies employed by communities in practice.

Economics of climate change adaptation in Zimbabwe (M. Masiiwa, University of Zimbabwe): This research uses literature review and key informant interviews to analyse the potential social and economic costs of climate change adaptation in Zimbabwe. Its focus is on key economic sectors, notably agriculture. Autonomous and planned adaptations are examined for each sector in relation to their ability to curb future costs.

Legal framework on climate change (M. Dhilwayo, ZELA): This paper makes the case for the development of a dedicated national legislative and policy framework on climate change in Zimbabwe, noting that CC is generally treated as a secondary issue in policy. It advocates for a human rights approach to CC, and outlines barriers to CCD.

Impacts of climate change on agriculture in Zimbabwe (L. Unganai, UNDP): This case study provides analysis of the impacts of CC on agriculture and examines possible adaptation strategies based on the experiences of the GoZ-UNDP/GEF: Coping with Drought and Climate Change Project in Chiredzi district, considering best and worst case CC scenarios associated with sensitivity to rain fed maize, sorghum and cotton production. For livestock, cattle and goats are considered. The main drivers of vulnerability and possible adaptation strategies are identified through participatory techniques involving the vulnerable men and women of the District. It also reviews action-oriented adaptation strategies used in the district to reduce small-holder farmers' vulnerability to impacts of drought and CC, and these are evaluated in the context of vulnerability reduction. It also includes estimated costs associated with adaptation strategies; challenges encountered and lessons drawn from the implementation of pilot projects in the Chiredzi District.

Climate change and gender impacts in Zimbabwe (Swedish Cooperative Centre) This paper features a case study on the impacts of climate change on water and gender roles undertaken by the Swedish Cooperative Centre in Shurugwi, Lupane and Chikomba Districts. The case study focusses on the impacts of Cyclone Japhet on the Chirume community. The effects of the cyclone, which destroyed a nearby dam, forced households to travel longer distances to collect water, which resulted in changes in gender roles as men became involved in addition to women. It also focusses on the adaptation measures introduced, and impacts of these on people's lives; challenges and lessons learned.

As can be seen from the above, the research was constituted as a multi-partner; multidisciplinary and at times transdisciplinary research programme (as in the UNDP research project in the Chiredzi district). It involved researchers from the University of Zimbabwe institutes (CASS Trust, Institute of Development Studies and Institute of Environmental Studies), but also researchers from leading NGOs involved in CCD (DRI, ZERO), and researchers working in international partner organisations (UNDP and Swedish Cooperative Centre), and international partners (DfID and IIED).

REFLECTION ON THE ABOVE: The macro-analysis of these papers reviews key aspects of vulnerability in Zimbabwe focussing on sectoral issues and cross-cutting themes of agriculture, water, health, infrastructure and energy, human settlements, gender and costs and impacts of adaptation. It also focusses on responses to climate change and lessons from practice, highlighting Community-based Adaptation (CBA) as an approach to adaptation. It further reviews the legislative framework and climate governance context, and points to challenges, lessons learned and makes recommendations for policy and practice. It makes the important point that autonomous adaptation strategies that were effective in the past are increasingly ineffective for coping with climate change, a situation which is aggravated by varying local perceptions and interpretations of climate variability, which can be broad and diverse within different social groupings and between communities. It notes that specialist skills and knowledge in climate change across sectors including health, water and natural resources management are lacking, which is compounded by the limited capacity of Zimbabwe's tertiary education system and poor media coverage, both of which reinforce limited awareness and knowledge across society. Government institutions also lack capacity to engage in policy implementation related to adaptation. Skills migration combined with limited financial resources in government departments and research organisations further constrains research and development on climate change. Capacity development therefore remains a significant institutional challenge. Additionally, relations between civil society and government are strained, hampering the potential for collaborative engagement with CCD matters.

Key lessons learned include the importance of local context in developing adaptation strategies that build on local knowledge and cultural norms, practices and value systems. Participatory methods were also found to be successful in engaging traditionally marginalised groups (particularly women), identifying the diverse needs of farmers and engaging them in adaptation options, and instilling a sense of ownership in adaptation solutions amongst participating communities. Communities also identified the potential for greater knowledge and information sharing between stakeholders, especially to strengthen early warning systems. Future projects were recommended that focus on co-ordination and facilitation roles amongst farmers, and improved use of media.

Various recommendations were made for adaptation projects and programmes which include a reconceptualisation of participation in CBA projects; considering climate information in CBA projects, and participatory vulnerability assessments; for adaptation policy-making and climate governance which include funding recommendations, inclusivity recommendations, policy framework recommendations and exploration of the potential of multi-level risk governance to support 'linked up' action between communities, civil society, the private sector and government at all levels.

The study concludes that applied research is of fundamental importance in informing the development of adaptation strategies that respond directly to the vulnerabilities of the poor women and men in both urban and rural areas. It also notes that there is a gap in knowledge related to urban vulnerability in Zimbabwe, which the report notes, is characteristic of research in southern Africa where the emphasis has been on ad hoc appraisals of poverty and vulnerability to climate-related hazards.

Note: The above text has been extracted and partly summarised from the Brown et al. report. Overall the research shows the power of interdisciplinary synthesis of multidisciplinary research that also draws on transdisciplinary and community engaged approaches to research for knowledge production on CCD. ZERO co-ordinated this project.

Box 3: Interdisciplinary research on CCD related research in Protected Areas and Transfrontier Conservation Areas in Zimbabwe (Patience Zisada-Gandiwa patience.gandiwa@gmail.com)

The Greater Mapungubwe Transfrontier Conservation Area undertakes a number of research activities to establish vulnerability and resilience of ecosystems within protected areas in Zimbabwe. The research covers broad areas of aquatic and terrestrial ecosystems inside protected areas, but also involves collaborative research to establish climate change vulnerabilities of communities surrounding and associated with the parks. The purpose of the research is to ensure that ecosystem health issues are integrated into climate change and livelihood strategies in Transfrontier conservation areas and protected areas. Challenges identified include lack of downscaled information on climate change impacts, hence the need for localised ecological monitoring, which has, for example, identified that the major rivers in Gonarezhou (Save, Runde and Mwenezi) are losing pools (drying up) both inside and outside protected areas. The impacts are more acute outside park estates, impacting on women. Efforts are underway to link community knowledge to scientific knowledge in adaptation responses. Large herbivores (hippos and crocodiles) have also been identified as being vulnerable. Some publications on this research are emerging, with a few listed below.

- Zisadza, P., E. Gandiwa, H. van der Westhuizen, E. van der Westhuizen and V. Bodzo. 2010. "Abundance, distribution, and population trends of hippopotamus in Gonarezhou National Park, Zimbabwe," *South African Journal of Wildlife Research* 40(2): 149-157.
- Gandiwa, E. and P. Zisadza. 2010. "Wildlife management in Gonarezhou National Park, southeast Zimbabwe: Climate change and implications for management," *Nature & Fauna* 25(1): 101-110.
- Zisadza-Gandiwa, P., E. Gandiwa, J. Jakarasi, H. van der Westhuizen and J. Muvengwi. 2013. "Abundance, distribution and population trends of the Nile crocodile (*Crocodylusniloticus*) in three major rivers in Gonarezhou National Park, southeast Zimbabwe," *Water SA* 39(1): 165-169.

Workshop discussions revealed that there is optimism that with growing government interest in establishing strategies and action plans for CCD, there will be further opportunities for multi-, inter- and transdisciplinary approaches to research and knowledge production. Universities too need to take the lead in supporting their academics to work together and to adopt knowledge co-production approaches, and to explore the multi- and inter- and transdisciplinary potential of CCD-related research. The Zimbabwe Open University, for example, has held a two-day workshop for staff in the Faculty of Science to discuss the implications of climate change for their research and practice. A recommendation from the workshop was to encourage research on climate change in Zimbabwe. Plans were also in place for an October 2013 Climate Change Research Symposium, with multidisciplinary research contributions on agriculture, water, energy, health, biodiversity and tourism, as reported by Dr T. Mpofu (Acting Dean, Faculty of Science and Technology ZOU).

As shown across this mapping study Country Report, there is a clear need for such research and for the development of multiple research partnerships. These, as also shown in this report are possible, within the stakeholder networks that are interested in CCD research, and there is an understanding of the societal benefit of such approaches to research. There are also some examples of such research taking place in Zimbabwe, which can be more widely shared, discussed and expanded upon as shown in Box 2 and 3 above. More such examples can be presented at the kinds of symposia and conferences proposed by the ZOU (see above). However, it was also noted that research systems and cultures of practice in universities are currently not optimally 'set up' to support such research innovation.

6 SUMMARY AND CONCLUSION

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

6.1.1 Context that frames the needs

Zimbabwe is experiencing increases in temperature, recurrent droughts and unpredictable rainfall patterns, according to the Southern African Risk and Vulnerability Assessment report (2012). The warming trend is already established, with an increase of at 0.4°C since 1900, with the last decade of that century as the warmest. Rainfall declined by 5 percent during the twentieth century, with the driest years experiencing in the 1990s. The country is experiencing more hot and fewer cold days than before as a result of climate change and variability. The projected rates of warming range from 0.15–0.55°C per decade, with higher temperature changes in the dry seasons compared to the wet seasons. Increasing temperatures of around 2.5°C by 2050 have been projected. Rainfall is predicted to decrease in all seasons; this is more conclusive for the early and late rains than for the main rainy season months of December to February.

Within this context, the mapping study needs analysis for Zimbabwe 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 the further development and implementation of Zimbabwe's National Climate Change Policy which is currently in draft form. Consistent with the socio-economic context, overarching barriers to adaptation indicated in all three data sources include informational barriers: brain drain, inadequate research and development facilities, low levels of awareness about climate change. There are also political and institutional barriers which include inadequate planning capacity and weak institutions; socio-cultural barriers which include resistance to adoption of biogas cooking technologies; and financial barriers which emerge from the recent economic crisis in Zimbabwe.

6.1.2 Broad adaptation and mitigation needs

There is broad agreement amongst the three data sources (policy, workshop, questionnaires) on the *broad priority focus areas for adaptation* – namely, agriculture and food security, biodiversity and forestry, rangelands, water resources, human settlements and tourism, and economic planning (infrastructure).[22] This is not surprising given that Zimbabwe's key climate vulnerabilities lie in these areas. The data sources also agree on *broad mitigation priorities and needs*, which encompass industry and energy, waste, and land use and forestry (reforestation

[22] It is assumed that this refers to climate-proofing infrastructure against climate risks such as more intense rainfall and increased flooding.

and afforestation). Concerning the latter, policy notes the need for mitigation measures such as conservation farming, reforestation, regeneration, and bio-electricity, while a few questionnaire responses noted the need for clean technology and improved industrial policy and development to reduce greenhouse gas emissions. Both policy documents and workshop data emphasise the need to strengthen and promote renewable energy sources. A number of cross-cutting policy issues are also identified for adaptation and mitigation – especially capacity building, research and technology transfer, education and awareness raising, and governance.

6.1.3 Specific knowledge and research gaps

In the Second National Communication, research capacity gaps were mainly focused on climate sciences, observation and modelling, water, land use and forestry and agriculture, biodiversity and forestry, mining and health. Knowledge needs associated with these issues include, for example, risk analyses and modelling to predict the various climate change scenarios on water availability and on the various use sectors; yield assessments for surface and groundwater systems; exploration and analysis of ground water resources; development of information systems to capture and manage land use changes, development of instruments for accounting for carbon stock changes; modelling and prediction for time scales between weather forecasts and seasonal forecasts; establishment of a strong national monitoring system and network; and improved early warning systems. From an Agriculture perspective the following knowledge and research gaps were identified: research gaps on varietal and breed adaptation to drought and heat resistance; poor information on stress physiology; limited knowledge of choice of water harvesting technologies and relationships between these choices and soil types.

Overall there was a strong view that Zimbabwe had limited knowledge of indigenous knowledge systems and what they could potentially offer to improved NRM and Climate Change Adaptation. Workshop participants also noted a lack of adequate knowledge on disaster management, and health related concerns. There was also a strong feeling that more research was needed on the efficacy of the education and training system, and how it is dealing with CCD issues.

6.1.4 Cross-cutting needs

Key cross-cutting needs are the need for better coordination, knowledge management, flow of and access to information, and packaging information appropriately. Cross-cutting educational priorities included addressing the lack of research programmes and curricula specifically targeted to climate change, leading to superficial treatment in courses; and concerns over the few climate change-related Masters or PhDs available. Inhibiting factors affecting climate change and CCD-related research included a lack of collaboration within and between sectors and disciplines. Overall there was a clear need for improving education and training processes, curriculum development and curriculum innovation, and working more effectively with indigenous knowledge.

6.1.5 Individual capacity gaps

The Needs Analysis has shown that there is concern about the insufficient number of suitably trained and skilled people. More detailed individual capacity gaps included the need to develop skills for systematic observation and modelling of climate change; the technical competence of key officials involved in assembling and interpreting climate data; the capacity to translate and transmit expert knowledge to local communities; and project preparation skills and the ability to mobilise financial support. There were also a number of gaps clustered around the area of community outreach and education, which included targeted training of teacher education, training of extension officers and building capacity at the community level, especially of community leaders. Improved collaborative capacities are required at different levels, as is improved leadership and management skills across institutions, and enhanced political will to address the scale of the challenges. Other specific individual capacity gaps identified include: Community health workers with CCD expertise, experts in Disaster Management and Preparedness, Nutritional scientists, Soil Scientists and Biological Scientists, Skin problem dermatologists, Renewable Energy experts, Zoology and Botany specialists, Siviculturalists, Foresters, experts with breeding biotechnology expertise (amongst others).

6.1.6 Institutional capacity gaps

Specific institutional capacity gaps emerging from documentation, the workshops and questionnaire responses show an overall lack of institutional capacity on climate change issues, which is not surprising given the recent economic issues facing Zimbabwe. There is consensus across the data sources on the need to *consolidate and reinforce adaptation and mitigation research* in general, and to develop active *information sharing mechanisms* for accessing existing information technologies, and for making meteorological data more available to researchers. Lack of adequate research facilities and funding was a key institutional issue identified, as well as a loss of capacity due to movement of skilled academics during the economic crisis. In addition to this, *policy and legislative frameworks*, operationalised under a single framework, are needed to coordinate and consolidate climate change activities in the country, and it was felt that there was a need for stronger impetus for policy implementation. Overall participants felt that a *mainstreaming and consolidated co-ordinated approach of allied CCD elements across all government systems and departments* is needed, which should include *CCD integration in curricula* across all educational levels, as well as other training and outreach programmes, especially into the extension services.

6.2 Synthesis perspective on the Institutional Analysis

This mapping study has identified existing initiatives amongst the HEIs in Zimbabwe and their partners where activities such as research, teaching, policy engagement and community outreach are addressing climate change-related needs. The institutional assessment has shown that higher education institutions (HEIs) in Zimbabwe do have expertise and capacity for responding to climate change and moving towards CCD, as do other stakeholders. University-based expertise is summarised in the table in Appendix E. The institutional assessment also showed that Zimbabwean researchers are publishing their CCD research in the international literature which shows a ‘strong research presence’ from Zimbabwe on climate change which

is feeding into regional and international knowledge on climate change responses, especially in the agriculture and fisheries sectors.

However, while this is the case, there was still a strong agreement in the workshop that the existing areas of capacity for work on CCD will need to be substantially expanded and supported though strategic and sustained programmes to enhance, deepen and expand this capacity and expertise, especially in the light of the severity of the climate related issues facing Zimbabwe, as reported in the Needs Assessment. The institutional assessment has identified the need for collaborative research, increased networking, innovative approaches to climate change, and relevant capacity development of academic staff and other stakeholders to unlock these approaches, as well as greater access to meteorological data. A critical point highlighted in the study is that there is a need to consider how CCD research can contribute to economic development and employment opportunities, especially for youth, and that knowledge does not necessarily translate into action – we need to understand what unlocks this at different levels – for example, political commitment at the policy level, and empowerment at the community level. There was a strong sense that greater use should be made of indigenous knowledge as a means to bridge university and community knowledge, policy and practice.

Key areas are policy response, behavioural and social changes, and better interactions such as between communities and researchers, and between policy and praxis. Workshop participants felt that, even with growing engagement of government, government could further enhance improvement of CCD, especially in enabling cross-sectoral collaboration and knowledge exchange. More dedicated funding and resourcing of CCD research was also highlighted as an important enabling factor, as was the need to develop a 'new generation' of academics as many experienced academics had left the country during the economic downturn.

Student outreach, campus management and community outreach activities that are seeking to contribute to CCD objectives were found at the Chinhoyi University of Technology, where students were involved in a tree planting and carbon sequestration community outreach project where they worked with local councils and communities to address deforestation problems. The University of Zimbabwe is providing in-service training for teachers in partnership with the SADC REEP, and Zimbabwe Open University are engaged in campus management activities mainly related to waste management. The Harare Institute of Technology has a student organisation called HIT ENVIRO that is involved in various student outreach activities.

Stakeholders in Zimbabwe firmly located climate compatible development (CCD) within the umbrella of sustainable development. They identified a critical role for indigenous knowledge research and more inter- and transdisciplinary approaches to research as ways of bridging the gap between universities and communities, a point that was also strongly emphasised by the Minister who opened the workshop. Universities and training colleges classified CCD-related activities according to areas of teaching, research and service. A number of courses on climate change were being offered in the universities, and it was noted that these were generally integrated into other courses such as a climate change component in Molecular Biology (1st year course), plant breeding methods (4th year course), simulation and modelling (3rd year course at the Chinhoyi University of Technology in Zimbabwe's Agricultural Sciences and Technology Department. At the Zimbabwean Open University, a second year course on

environmental hazards and human responses was taught in the Geography and Environmental Studies programme, and the University of Zimbabwe were teaching climate change at BEd and Masters level via a Climatology course. Agroclimatology was a specialist area at Lupane State University at both undergraduate and postgraduate levels, and at Midlands State University Agricultural Meteorology was being taught at both undergraduate and postgraduate levels. There was, however, no mainstreaming of CC taking place, and courses were inserted by those who had developed an interest in CCD research. It was felt that much more could be done to improve the scope of CCD courses, and that this should be done in a clearly structured way to ensure progression of learning.

The institutional assessment has revealed that capacity development of the wider CCD-related research community in Zimbabwe is needed, and Zimbabwean researchers emphasised the need for expanding their capacity as they felt that whilst they were doing good research, the institutional support was not adequate. Although useful starts have been made in integrating climate change into a number of university courses, a wider more transdisciplinary and collaborative capacity development programme is needed, that addresses the social process capacity needs in response to climate change among other needs specifically in curriculum development, food security, water and energy infrastructure, and cross-cutting issues between biodiversity, agriculture, water resources, forestry and health. Key areas identified for universities in Zimbabwe included curriculum development and innovation, strengthening of research infrastructure, and community engagement.

The institutional assessment highlighted that it was extremely important for universities to go beyond standard teaching, so that they could be located within key climate change dialogues. Modalities identified included short courses for climate change professionals, as well as capacity development interventions that target youth and communities. This could include technical skills and translation of CCD knowledge into tangible and meaningful information for communities.

6.2.1 A broad map of Zimbabwe's CCD knowledge co-production pathways

Considering the workshops and questionnaires, as well as other data sets *in relation to each other*; one can begin to map out a CCD capacity development pathway/s for Zimbabwe, based on the analyses presented in this mapping study (see Table 8). Knowledge co-production pathways associated with CCD priorities can be further developed based on the identified CCD needs in this Mapping Study and in national policy.

Additional knowledge, research and capacity development pathways can be developed as also shown in case study of the IIED / ZERO project (Box 2) which involves multiple perspectives on the same issue. In the UNDP study reported on within the IIED/ZERO cluster of studies a situational focus is taken as starting point, and from there knowledge and research gaps are identified on the ground, and then responded to via an integrated mix of research and practice. Such a process also presents a knowledge, research and capacity development pathway and has considerable potential to involve communities and multiple stakeholders in the research and knowledge co-production process.

Table 8: CCD Knowledge, Research, Capacity Building and Institutional Capacity Gap Analysis: Develop agricultural practices more resistant to drought and improve food security

CCD PRIORITY	Knowledge and research gaps (Research agenda)	Individual capacity gaps (Education and Training agenda)	Institutional capacity gaps (Institutional development agenda)
ADAPTATION: AGRICULTURE AND AGRICULTURE MANAGEMENT	▪ Seasonal forecasts: knowledge on seasonal forecast is limited ▪ Communication: Interpretation of seasonal forecasts to lay people i.e. language used in forecasts ▪ General knowledge about the climate change mechanisms and mitigation that need to be taken up in the education system e.g. implications of deforestation burning on the atmosphere ▪ Appropriate drought tolerant varieties and breeds ▪ Little information on relationships between indigenous knowledge systems and scientific knowledge ▪ Need for more knowledge on stress physiology – how plants and animals adapt to changes in temperature and others factors ▪ Knowledge of adaptation mechanisms and modelling, as well as costs of adaptation ▪ No information on extent of public appreciation of climate change issues and their ability to adapt to climate change	▪ Individuals lack capacity to receive and effectively use climate change forecasts ▪ We have little knowledge of what is taught in schools and colleges about climate change ▪ Manpower shortages in breeding, biotechnology ▪ Institutional capacities need to be restored in Zimbabwe ▪ Mentoring of new scientists ▪ Research skills, especially also for multi-, inter- and transdisciplinary approaches	▪ Lack of information from Meteorological Department for modelling (information is costly) ▪ Educational system needs to mainstream CC knowledge ▪ Research skills and appreciation of the importance of the CC issue ▪ More and adequate research funding for comprehensive studies; and longitudinal field testing studies and CCA practice case studies that model new approaches ▪ Lack of approaches that foreground knowledge co-production with farmers

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.

As noted above, there exists capacity in Zimbabwe for CCD related research, but this requires further support at strategic, policy and practice levels. It appears that universities have lost some of their research strengths in the past few years with the economic downturn and with skills migration out of Zimbabwe. However, Zimbabwe also has a system of using research institutes to enable multidisciplinary collaborations and there are traditions of such research in the country that can be strengthened, and supported with renewed vigour. A key finding of this mapping study is that Zimbabwean researchers have a strong tradition of, and strong

capacity for research publishing, which can also be shared more widely in SADC with other countries, where this tradition is less visible.

Various recommendations were made for strengthening capacity for research and knowledge co-production in this mapping study that can be useful for charting a way forward, including aspects such as improving collaboration and systems of working together to produce CCD knowledge that feeds into practice or that is co-engaged with practitioners as the knowledge is produced.

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

- Further consolidate the national knowledge co-production analyses based on the needs and institutional analyses in this country mapping study, and as modelled in the example above (Table 8), to guide further action at country level.
- Support and expand the CCD research that is currently taking place in existing Centres of Excellence or in association with wider networked Centres of Excellence in Zimbabwe, and to strengthen and expand the capacity of those Centres of Expertise where CCD research is beginning to flourish. Develop a 'capacity pathway' for strengthening individual research competence, so that individual interest and research capacity can grow into a 'node of expertise' and then into a 'centre of expertise' and potentially into a future 'Centre of Excellence'. Strategic policy support from the climate compatible development policy community, and the Higher Education community will be needed to facilitate such capacity building pathways in Zimbabwe, especially to strengthen and expand research capacity in this area, and to link up various CCD research initiatives that are occurring under the auspices of government, NGOs and development programmes with university research and research capacity building.
- Improve co-operation, communication and shared access to data at all levels and maximise potential knowledge exchange and co-operative research opportunities with national and regional research organisations that are focusing on CCD.
- Develop motivation and incentives for researchers, especially for engaging in multi-, inter and transdisciplinary research approaches. Support capacity development of researchers in these areas and create mechanisms that allow existing researchers to learn from new approaches to inter- and transdisciplinary research and modelled in national case studies (e.g. UNDP programme in Chiredzi district) and others.
- Strengthen research partnerships and research infrastructure, including research funding and incentives for students.
- Support curriculum development capacity, and curriculum innovation to mainstream CCD into existing courses and programmes.
- Strengthen existing policy and community outreach activities within a knowledge co-production framework and develop monitoring tools to make the impact of such work visible within the university system, and seek ways of incentivizing engagement with policy systems and communities.
- Develop campus management policies and practices that engage students in CCD issues, and also that model solutions and provide demonstrations of CCD learning pathways.

Co-production of knowledge and its reliance on **improved cross-sectoral institutional capacities** is a significant area of concern in Zimbabwe, as this need to co-operate across institutional boundaries was noted more than once. The specific knowledge and research gaps identified in this mapping study pose significant challenges for the successful implementation of the proposed draft National Climate Change Response Strategy. However, stakeholders and university professionals consulted during this study indicated that there was a 'renewed optimism' in the light of the recent initiative to produce such policy in Zimbabwe, and the time was right for new innovations in research and capacity building, hence the timing of this mapping study is opportune, and its outcomes should be maximised at a national level, wherever possible.

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

Climate Change and CCD research and teaching in Zimbabwe seems to be dominated by adaptation expertise, however it may also be due to the strong drought disaster relief incentive placed by the government since 1996, which focused heavily on drought relief that involved a variety of adaptive and some mitigation forms of research. There are also some interesting mitigation and cross-cutting climate change related knowledge production niches in Zimbabwe. Particular areas of strength identified in Zimbabwe include:

- **Climate change adaptation research**: Conservation Agriculture, and various aspects of Agriculture and agricultural adaptation (crops and livestock); Climate change and human settlements (peri-urban); Community-based Adaptation approaches
- **Climate change mitigation research**: Sustainable Engineering, Climate Compatible Waste Management; Climate proofing; Urban settlements and CC research
- **Cross cutting issues research**: Sustainable Rural Livelihoods, Health and climate change; Gender and CC.
- **Systems of social change research**: Agrarian Economics and Rural Development; Disaster Management; Community-based Adaptation; Early warning
- **Teaching and curriculum innovation:** Development studies: Disaster Management; MSc programmes in development on 1) Plant Breeding and Biotechnology for Stress Environments and 2) Crop Production for Stress Environments (Chinhoyi University of Technology); MEd courses in Education for Sustainable Development and Climatology in the Education Faculty to inform Climate Change Education and Social learning; Environment and Natural Resource Economics (University of Zimbabwe, Faculty of Agric); Agro-climatology (ZOU); Agricultural Meteorology (Midlands State University) and others. CASS Trust linked multidisciplinary teaching in the Faculty of Humanities and Social Studies in the University of Zimbabwe provides good examples of multi-disciplinary programmes in, for example, Social Ecology
- While not university-based, the curriculum and course design and delivery innovations on climate change for youth, by youth currently being developed within the **Development Reality Institute** (an independent youth driven institute) should be looked at as an example of innovation in curriculum and course design and delivery, that could (and appears to be already) servicing youth demands for climate change and climate change adaptation knowledge. In the first year they enrolled 300

participants in their courses, and have won four international awards, despite only being in operation for five years.

- **Research writing and publications expertise:** As noted above, Zimbabwe is one of the countries in the SADC Region that stands out for its CCD research writing and publications expertise. There is clearly strong capacity to get research published, and researchers are also publishing in collaborative partnerships with researchers nationally, and internationally. This competence needs to be more widely developed across SADC.

APPENDIX A: WORKSHOP ATTENDANCE LIST

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APPENDIX B: RESEARCH PROJECTS CURRENTLY BEING UNDERTAKEN IN RESPONSE TO CC AND THE NEED FOR CCD (BASED ON UNIVERSITY-BASED QUESTIONNAIRE RESPONSES)

Table 8: Research projects in response to CC and the need for CCD in Zimbabwe

Institution, Faculty, Department	Research project	Researcher/s or Deans / HODs Years experience: years experience in climate change research	Type of research project
Harare Institute of Technology (HIT) Zimbabwe Chemical Process System and Engineering CPSE Department Chemical Engineering	Sustainable Engineering	Anthony Phiri (PhD) phiriam15@yahoo.co.uk 13 years:10 years	Vermiculture technology Coal methane gas extraction and use in power generation Waste management and disposal site technologies Sewage wate degradation Waste to energy
Chinhoyi University of Technology Zimbabwe Agricultural Sciences and Technology, Crop Science and Post Harvest Technology	Conservation Agriculture and Climate Change	Arnold Bray Mashingaidze (PhD) abmash@yahoo.com abmashingaidze@cut.ac.zw 20 years: 10 years	Impact of conservation agriculture on greenhouse gas emissions and carbon sequestration in various soil types and agri ecologies of Zimbabwe - PhD student registered Effect of plant manipulation on water use efficiency in maize Population dynamics of fruit in the Risutu valley and predicting the impact of climate change on the valley
Chinhoyi University of Technology Zimbabwe Directorate of Research	Climate change and Adaptive Capacity	F.T. Mugabe Male (PhD) ftmugabe@yahoo.co.uk 20 years :7 years	Building climate change and adaptive capacity of smallholder farmer
Zimbabwe Open University Science and Technology, Nursing Science	Health and climate change	Junior Mzengi Female (Masters) jmzengi@yahoo.com 2 years: 2 years	Health Threats of Climate Change
Zimbabwe Open University, Centre for ODL Research & Scholarship	Climate Compatible Waste Management	Kudzanayi Ruvharo (Masters) kruvharo@gmail.com 4 years: 4 years	Climate compatible Waste Management

Institution, Faculty, Department	Research project	Researcher/s or Deans / HODs Years experience: years experience in climate change research	Type of research project
Lupane State University Zimbabwe Agricultural Sciences, Animal Science and Rangeland Management	Climate change and agricultural adaptation	Margaret Taona Moyo (Masters) maghirethi@gmail.com 8 years: 4 years	Improving quality of drought tolerant sorghum varieties
Midlands State University Zimbabwe Natural Sciences Management and Agriculture Agronomy	Capacity needed for climate change adaptation	Veronica Makuvaro (Masters) makuvarov@gmail.com makuvarov@msu.com 12 years: 5 years	Project over (2007 - 2010) Capacity building, capacity for adaptation to climate variability and change

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

Note: A more detailed list of active climate change researchers in Zimbabwe needs to be compiled, and was not easily available to the SARUA mapping study team. This could potentially be sourced from Professor Feresu, Director of the IES.

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 IN ZIMBABWE

Table 9: Identified sources of expertise for CCD in Zimbabwe

University	Nodes of expertise	Centres of expertise	Centres of excellence[23]	Active CCD related research networks
Harare Institute of Technology (HIT)	**Department of Chemical and Process Systems Engineering**: Vermiculture technology, coal methane gas extraction and use in power generation; waste management and disposal site technologies; sewage waste degradation; waste to energy		No specific CCD Centres of Excellence were identified, but two Centres of Excellence that are undertaking CC related research in Zimbabwe were identified. ICRISAT (International Crops Research Institute for Semi-Arid Tropics) has a research station in Bulawayo (Matopo Research Station). It is affiliated to ICRAF and other ICRISAT 'hubs' in Africa and in Asia, including those in Mozambique and Malawi. The focus is on drought- resistant crop varieties and community-based adaptation.	▪ Department of Meteorological Services ▪ SADC Drought Monitoring ▪ Early warning units – Climate forecast unit level rests in Zimbabwe ▪ SADC Regional Environmental Education Programme ▪ SARDC – Southern African Research Documentation Centre (linked to Zambia) ▪ SWEDESD (Swedish Centre for Education for Sustainable Development) ▪ WATERNET / CAPNET ▪ SIRDC – Zimbabwe ▪ ZIMVAC – Zimbabwe Vulnerability Assessment
Chinhoyi University of Technology	**School of Agricultural Sciences and Technology:** Crop Science and Post-Harvest technology research, focussing on the impact of conservation agriculture on greenhouse gas emissions and carbon sequestration in various soil types. Also studies underway focussing on effect of plant manipulation on water use efficiency in maize; and predicting climate change impacts on fruit growing			

[23] No relevant formal SADC Centres of Excellence located in Zimbabwe could be identified via web searches.

University	Nodes of expertise	Centres of expertise	Centres of excellence[23]	Active CCD related research networks
Zimbabwe Open University	**Nursing Science:** Health threats of climate change **Centre for ODL Research and Scholarship**: climate compatible waste management research Department of Development Studies		(Director: Andre van Rooyen) The Biomedical Research Training Institute at University of Zimbabwe (www.brti.co.zw), together with the African Institute of Biomedical Science and Technology (www.aibst.com) and other affiliated Centres of Expertise such as the John Hopkins Centre of Expertise in Malaria Research and an international network of centres of expertise in malaria research are focusing on some climate related malaria research.	Committee ■ Research Council of Zimbabwe ■ ZERO ■ Matopo and Mokolodi Research Stations (agricultural research stations of government) ■ ZINWA Collaboration of government departments e.g. AGRITEX, EMA, police ■ World Food Programme ■ ICRISAT ■ SADC Vulnerability Assessment Committee ■ SADC Early Warning Unit ■ Zambezi Early Warning Systems ■ SARCOF (Southern African
Lupane State University	**Agricultural Sciences:** Animal Science and Rangeland Management; crop science research focussing on improving quality of drought tolerant sorghum varieties			
Midlands State University	**Faculty of Natural Resources Management and Agriculture, Department of Agronomy:** Capacity building for adaptation to climate variability and climate change			

University	Nodes of expertise	Centres of expertise	Centres of excellence[23]	Active CCD related research networks
University of Zimbabwe	**University of Zimbabwe and Soil Fertility Consortium for Southern Africa**: Measures to enhance the adaptive capacity of local communities to respond to pressures of climate change **Department of Agricultural Economics:** Studies on climate change adaptation amongst smallholder farmers in districts affected by climate change (e.g. Chiredzi district) **Faculty of Education:** Education for Sustainable Development and Climate Change Education research and outreach. Climate Change courses also taught and interventions are taking place in teacher education and with schools. **Faculty of Humanities and Social Studies:** Sociological and multidisciplinary research and teaching on human-environment / natural resources concerns, including climate change. Affiliated to Centre for Applied Social Science (CASS)	**Institute of Environmental Studies**, established in 1994 as an independent, non-faculty unit. Involved in development of Zimbabwe's National Climate Change Response Strategy and various research projects related to environmental science, sustainable development, rural livelihoods, soil fertility, indigenous soil and water conservation and climate change adaptation. (Director: Prof. S.B. Feresu) Institute of Development Studies, established in 1982; currently undertaking some research on the economics of climate change, and agricultural adaptations to climate change. (Lead CC researcher: Dr Medicine Masiiwa) **Centre for Applied Social Science (CASS)**, located in the Faculty of Social Studies. It is a multidisciplinary research centre undertaking various human-environment related research; including climate change adaptation research focusing on human settlements, infrastructure, community-based natural resource management and indigenous knowledge. (Chairperson: Dr B. Mukamuri)	Malaria research is one focus of these CoEs work, but nevertheless they present a formidable research force with potential to engage with health related CCD concerns. (Dr S Mharakurwa, BRTI; Dr Coleen Masimirembwa, AiBST)	Regional Climate Forecasting) ■ FEWSNET (Famine Early Warning Systems)

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